Co-Designing with Mixed-Ability Groups of Children to Promote Inclusive Education

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In this half-day workshop, we will explore how to co-design technology in inclusive classrooms where children have diverse sensory, motor, cognitive or behavioral abilities. We will discuss barriers and opportunities in co-designing for inclusion, exploring techniques and tools to support learning in a collaborative environment. We encourage researchers, educators, parents, and other stakeholders to participate and provide their expertise and know-how in improving these environments, with an aim to support both inclusion and collaboration; and children's exploration of their own interests and approaches to learning. We seek to better understand research experiences in these environments, co-design techniques that were successfully used, and what they can teach the broader field of interaction design for children.

CCS Concepts: • **Human-centered computing** → *Participatory design*; *Accessibility design and evaluation methods*.

Additional Key Words and Phrases: Inclusive Education, Co-design with Children, Mixed Abilities.

1 INTRODUCTION

We are witnessing a worldwide effort to promote high-quality inclusive education, where children with mixed abilities learn together. Besides the benefits of enabling all children to have access to information and learning, children in inclusive classrooms outperform their peers in regular classrooms at the academic, social and emotional levels [7, 10, 22]. These benefits may be related to the different ways used to represent information, and the multiple ways of engagement that have more probability to fit children's interests and motivations.

Despite the positive outcomes of inclusive education classrooms and their increasing prevalence, there have been few co-design experiences with children with mixed abilities aiming to promote inclusion. PD approaches could embrace the principle of **equity** to guarantee that all children have access to the necessary support to participate; and of **inclusion**, the right of all children to access and participate, fully and effectively, in the same PD activities [20]. Similarly, we have a limited understanding of the challenges of providing equitable learning, as it involves complex processes of structural

changes in teaching and learning strategies, and in content. Co-designing with children with mixed abilities could aim towards such structural changes in content and strategies [15].

In the last decade, children with disabilities started to be more involved in co-designing and other PD approaches have taken an active role in the development of technology. Some of the observed benefits of including children with disabilities included an improvement of teamwork, social skills, technology-related skills, creativity, confidence, sense of empowerment, and self-efficacy (for a review see [3]).

Because children with disabilities attend mainstream or inclusive schools, research has been recently more focused on widening children's participation, including children with disabilities along with their peers by providing a multiplicity and diversity of PD techniques, materials and ways to communicate [2, 9, 12, 13, 16, 17, 19, 21, 23]. Although previous research already included mixed ability children playing as creative agents in designing technologies for inclusive activities [4–6, 9, 11, 14, 16, 18, 19], this inclusive learning is fairly unexplored as a co-design goal.

Inclusive participatory approaches could be a tool to empower children and increase social interactions and collaborations among children with mixed abilities. But how to consider different abilities in the design of participatory approaches and maintain children's engagement while fostering inclusion is still a challenge. We aim throughout the workshop to discuss barriers and limitations when co-designing with children with mixed abilities as well the opportunities that this challenge could bring to make a shift in the community and use PD approaches also as a tool for inclusion.

Throughout the workshop, we will include in our discussion the inclusionary model [8] and four principles [1] to involve children with special needs in the design process. The inclusionary model proposed by Guha et al. [8] has three related considerations: (a) levels of children's involvement, (b) nature or severity of the disability, and (c) the availability and intensity of support, for children with disabilities. For instance, the level of involvement of a child as a design partner would depend on the nature and the severity of the impairment as well on the availability and type of support that the child needs. We will also focus on four principles that may be also useful for the context of a mixed ability classroom [1]: (a) deep engagement with children and stakeholders with regular sessions, (b) interdisciplinarity to understand children's development, needs, and abilities, (c) consider the individuality of children as there is great variability between children, and (d) the practicability to sustain the technology in children's daily contexts to have a great impact on children's lives. We will also use the lens of inclusion and collaboration between children to motivate ideas about strategies and tools. For instance, should we use asymmetric roles in PD sessions where children are assigned different tasks according to their abilities but work collaboratively to the same end? How can we motivate collaborative actions in PD sessions?

This workshop is a call to practitioners, psychologists, educators, parents and CCI researchers to embrace the opportunity to create participatory design approaches to leverage collaboration and inclusion while empowering children with mixed abilities in the process. We will discuss techniques and tools, materials, and strategies to facilitate collaboration and inclusion.

2 GOALS

The workshop has two goals: (1) explore and define the barriers, limitations and opportunities in applying PD approaches for and with children with mixed abilities, (2) explore PD techniques and strategies to promote inclusion and collaboration among children.

3 ORGANIZERS

The workshop organizers have experience in PD approaches with children, mostly with children with disabilities, such as children with visual impairments and with autism.

Ana Cristina Pires (corresponding organizer) is a cognitive psychologist with experience in Human-Computer Interaction (HCI). Currently, a PostDoc Researcher in LASIGE, Faculty of Science, University of Lisboa. The great part of her work has been to create educational technologies to foster the acquisition of core skills, such as executive functions, mathematics and computational thinking in children. In the last five years, she has been applying PD approaches with children with visual impairments and stakeholders to design educational technologies.

Isabel Neto is a PhD candidate at Lisbon University, Technical Institute. Her work focused on social robotics and how can robots be used to foster inclusion in mixed-visual abilities classrooms. In her research, she combines accessibility, HCI and HRI, practising inclusive design, and co-design with mixed-visual abilities children for novel human-robot interactions.

Emeline Brulé is a Lecturer at University of Sussex. Her interdisciplinary research focuses on accessible design and children's experiences of inclusive education setting.

Laura Malinverni is a professor in the Visual Arts and Design Department of the University of Barcelona. Her research focuses on creative methods for designing interactive experiences with and for children.

Oussama Metatla is a Senior Lecturer in Human Computer Interaction at the University of Bristol, UK. He is interested in exploring how insights and principles from multisensory interaction, crossmodal perception and embodied cognition could be used to co-design more inclusive interactions between people with and without disabilities.

Juan Pablo Hourcade is an Associate Professor at The University of Iowa's Department of Computer Science. He has more than 20 years of experience in the child-computer interaction field and has worked in multiple projects involving participatory design techniques and children with disabilities.

4 PRE-WORKSHOP PLANS

We will add our workshop to http://www.inclusiveeducation.tech to disseminate information about the workshop and to attract participants. We will recruit participants by using HCI mailing lists, personal and institutional contacts, and social media. To increase practitioners' participation we will disseminate the workshop information to stakeholders, such as parents associations of children with disabilities, associations of special needs educators, associations of inclusive educations, and inclusive schools. Because the workshop would be conducted in the same country as the corresponding organizer of the workshop, there is more feasibility in including stakeholders in the workshop as we have previously established contact with them.

5 WORKSHOP STRUCTURE

In this workshop, we aim to provoke discussion on how to engage children with mixed abilities in co-design. It is structured to give participating authors ample opportunities for debate and seek solutions to an inclusive design, with the focus on children's engagement, collaboration and inclusion. As a full group, we will reflect on the barriers, challenges and opportunities to support co-design sessions with children with mixed abilities. To do that we will facilitate group dynamics using diverse tools, such as the prior creation of Personas (eg: children with autism, hearing/visual/physical impairments, cognitive or learning difficulties, attention deficit hyperactivity disorder) and scenarios, and excerpts from teachers and children in these contexts to further fuel our reflections and discussions. Because children are very

diverse, we will create a variety of *personas* corresponding to different participants who would be organized in groups of 4-6 people. We will have sheets with sets of techniques and tools visible during each round table. We will deliver different personas, scenarios and professional or children excerpts to each group. Below we describe each workshop activity in detail:

(1) WELCOME INTRODUCTION (30 min): We will introduce ourselves, present the aim of the workshop, how it will be organized, and the tools that we will be using. Also, participants would have 5 minutes to present themselves and their experience in this context as well as the submitted documents to participate in the workshop.

(2) DISCUSSION GROUP (40 min): Participants will be divided into groups of 4-6 people, considering participants' backgrounds to establish working groups with trans-disciplinary views and techniques. We will start by thinking of a regular co-design session with children in inclusive classrooms, and by identifying the barriers and opportunities when running co-design sessions with children with mixed abilities.

(3) GROUPS SHARING (15 min): A participant from each group will share their outcomes. General discussion and wrap up results.

(4) DISCUSSION GROUP (40 min): Participants will discuss and propose solutions to the barriers previously identified, in order to propose new ideas to create a more inclusive environment in co-design sessions where everyone has a voice that is shared and valued. How can we design a PD session to also foster inclusion and collaboration between peers? Which dimensions, tools and techniques should we consider? Should we use asymmetric roles or force collaboration? Which strategies could we apply to achieve this goal?

(5) GROUPS SHARING (15 min): A participant from each small group will share their outcomes. General discussion and wrap up results.

(6) SUMMARY AND WRAP UP (30 min): Summary and reflections. Assessing participants willingness to plan a special issue of a journal.

6 POST-WORKSHOP PLANS

After the workshop, we will sum up the results and create a white paper or a special issue of a journal to stimulate discussion in the community. Participants would be invited to be part of a collaborative working group to further follow the ideas and suggestions gathered during the workshop.

7 CALL FOR PARTICIPATION

This half-day workshop aims to shed light on how to apply PD approaches with children with mixed abilities and how it could contribute to children's collaboration and inclusion. Specifically, we will divide participants depending on their background to achieve trans-disciplinary groups and we will facilitate the discussion. First, we will explore barriers and possibilities that PD might bring when co-designing with children with mixed abilities. Second, groups will also discuss and explore tools, methods, and strategies to promote inclusion and collaboration during PD.

Papers will be peer-reviewed by the workshop organizers. We will select papers describing diverse backgrounds and experiences.

We invite participants to write short papers of 3-4 pages (without references) as positions papers, initial studies, or case studies, covering one of the following topics: (1) PD approaches with children; (2) PD approaches with children with disabilities, (3) PD approaches with children with mixed abilities, (4) Inclusive education, and (5) Design for inclusion.

To broaden our audience to enable a more trans-disciplinary debate and discussion, we invite participants with diverse backgrounds such as educators or parents to participate as well. We will require a brief statement expressing their interest and motivation in participating in the workshop.

Papers should be submitted to acdpires@fc.ul.pt. At least one author of each accepted position paper must attend the workshop. All workshop participants must register for both the workshop and the main conference.

link to the workshop

REFERENCES

[1] ALPER, M., HOURCADE, J. P., AND GILUTZ, S. Interactive technologies for children with special needs. In *Proceedings of the 11th International Conference on Interaction Design and Children* (2012), pp. 363–366.

[2] AXELSSON, M., RACCA, M., WEIR, D., AND KYRKI, V. A participatory design process of a robotic tutor of assistive sign language for children with autism. In *2019 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)* (2019), pp. 1–8.

[3] BENTON, L., AND JOHNSON, H. Widening participation in technology design: A review of the involvement of children with special educational needs and disabilities. *International Journal of Child-Computer Interaction 3* (2015), 23–40.

[4] BRULÉ, E., AND BAILLY, G. Taking into account sensory knowledge: The case of geo-techologies for children with visual impairments. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2018), CHI '18, Association for Computing Machinery.

[5] CULLEN, C., AND METATLA, O. Co-designing inclusive multisensory story mapping with children with mixed visual abilities. In *Proceedings of the 18th ACM International Conference on Interaction Design and Children* (New York, NY, USA, 2019), IDC '19, Association for Computing Machinery, p. 361–373.

[6] GARZOTTO, F., AND GONELLA, R. Children's co-design and inclusive education. In *Proceedings of the 10th International Conference on Interaction Design and Children* (New York, NY, USA, 2011), IDC '11, Association for Computing Machinery, p. 260–263.

[7] GRAY, C. Inclusion, impact and need: Young children with a visual impairment. *Child care in practice 11*, 2 (2005), 179–190.

[8] GUHA, M. L., DRUIN, A., AND FAILS, J. A. Designing with and for children with special needs: An inclusionary model. In *Proceedings of the 7th international conference on Interaction design and children* (2008), pp. 61–64.

[9] GUPTA, A., FULFAGAR, L., AND UPADHYAY, P. Co-designing with visually impaired children. In *Design for Tomorrow—Volume 2*. Springer, 2021, pp. 429–439.

[10] HEHIR, T., GRINDAL, T., FREEMAN, B., LAMOREAU, R., BORQUAYE, Y., AND BURKE, S. A summary of the evidence on inclusive education, 2016. https://alana.org.br/wp-content/uploads/2016/12/A_Summary_of_the_evidence_on_inclusive_education.pdf.

[11] MAGNUSSON, C., CALTENCO, H., FINOCCHIETTI, S., CAPPAGLI, G., WILSON, G., AND GORI, M. What do you like? early design explorations of sound and haptic preferences. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct* (New York, NY, USA, 2015), MobileHCI '15, Association for Computing Machinery, p. 766–773.

[12] MALINVERNI, L., MORA-GUIARD, J., PADILLO, V., MAIRENA, M., HERVÁS, A., AND PARES, N. Participatory design strategies to enhance the creative contribution of children with special needs. In *Proceedings of the 2014 Conference on Interaction Design and Children* (New York, NY, USA, 2014), IDC '14, Association for Computing Machinery, p. 85–94.

[13] MALINVERNI, L., MORA-GUIARD, J., PADILLO, V., VALERO, L., HERVÁS, A., AND PARES, N. An inclusive design approach for developing video games for children with autism spectrum disorder. *Computers in Human Behavior 71* (2017), 535–549.

[14] MCELLIGOTT, J., AND VAN LEEUWEN, L. Designing sound tools and toys for blind and visually impaired children. In *Proceedings of the 2004 Conference on Interaction Design and Children: Building a Community* (New York, NY, USA, 2004), IDC '04, Association for Computing Machinery, p. 65–72.

[15] MEDINA-GARCÍA, M., DOÑA-TOLEDO, L., AND HIGUERAS-RODRÍGUEZ, L. Equal opportunities in an inclusive and sustainable education system: An explanatory model. *Sustainability 12*, 11 (2020), 4626.

[16] METATLA, O., BARDOT, S., CULLEN, C., SERRANO, M., AND JOUFFRAIS, C. Robots for inclusive play: Co-designing an educational game with visually impaired and sighted children. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (2020), pp. 1–13.

[17] METATLA, O., READ, J. C., AND HORTON, M. Enabling children to design for others with expanded proxy design. In *Proceedings of the Interaction Design and Children Conference* (New York, NY, USA, 2020), IDC '20, Association for Computing Machinery, p. 184–197.

[18] METATLA, O., THIEME, A., BRULÉ, E., BENNETT, C., SERRANO, M., AND JOUFFRAIS, C. Toward classroom experiences inclusive of students with disabilities. *interactions 26*, 1 (2018), 40–45.

[19] NETO, I., NICOLAU, H., AND PAIVA, A. *Community Based Robot Design for Classrooms with Mixed Visual Abilities Children.* Association for Computing Machinery, New York, NY, USA, 2021.

[20] ORGANIZATION, W. H., AND BANK, W. World report on disability 2011, 2011.

[21] PYLVÄNEN, S., RAIKE, A., RAINÒ, P., ET AL. Co-design for accessibility in academia for deaf students. *Co-Create 2013* (2013).

[22] RUIJS, N. M., AND PEETSMA, T. T. D. Effects of inclusion on students with and without special educational needs reviewed. *Educational Research Review 4* (2009), 67–79.

[23] WILSON, C., BRERETON, M., PLODERER, B., AND SITBON, L. *Co-Design Beyond Words: 'Moments of Interaction' with Minimally-Verbal Children on the*

261 *Autism Spectrum.* Association for Computing Machinery, New York, NY, USA, 2019, p. 1–15.

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