Piloting Diversity and Inclusion Workshops in Artificial Intelligence and Robotics for Children

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***Abstract*—This document is a model and instructions for LaTeX. This and the IEEEtran.cls file define the components of your paper [title, text, heads, etc.]. *CRITICAL: Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.**

***Index Terms*—Open Educational Resources, Educational robots**

I. Introduction

Accessible and affordable technology with open educational resources can promote equal opportunities for childhood education [1]. However, teaching state-of-the-art technologies to children such as Artificial Intelligence and Robotics for children, air4chidren, is a current challenge for low-income and often politically or culturally marginalized countries. Additionally, creating the right environments and promoting inclusivity and diversity to teach air4children to construct a fair society has been little investigated. Astobiza *et al.* 2019. for instance, reported the need of collaborations between industry and a multidisciplinary group of researchers to address concerns on the paradigm of inclusivity in robotics [2]. In that sense, Astobiza *et al.* suggested that inclusive robotics should be based on two points: "1) they should be easy to use, and 2) they must contribute to making accessibility easier in distinct environments" [2]. Peixoto *et al.* reported the use of robots as tool to promote diversity leading to improve competences in communication, teamwork, leadership, problem solving, resilience and entrepreneurship [3], [4]. Recently, Pannier *et al.* pointed out the challenges of increasing the participation of women and underrepresented minorities in the areas of Mechatronics and Robotics Engineering as well as the creation of community of educators to promote diversity and inclusion [5]. Similarly, Pannier *et al.* mentioned that the prevalence of free and open-source software and hardware made mechatronics more accessible to a diverse group of population [5]. Pannier *et al.* also touched on the evidence and importance of offering workshops to different range of under-represented students leading to inspire other programs and to create outreach activities for students, trainers and workshops. Recently, Montenegro *et al.* introduced air4children, Artificial Intelligence for Children, as a way (a) to address aspects for inclusion accessibility, equity and fairness and (b) to create affordable child-centred materials in AI and Robotics (AIR) in low-income countries [6]. That said, we hypothesed that piloting workshops of air4chidren in a communities where little is known about state-of-the-art technologiesmight led us to have better understanding of the needs and challenges of promoting diversity and inclusion with open education resources.

This short paper presents our findings on the first pilot workshop (a) to promote diversity and inclusion; and (b) to encourage children to discover and increase their interest in AI and Robotics. This paper is organised with the introduction of diversity and inclusivity in AI and Robotics for children from 6 to 8 years old. We present how four lessons of the pilot workshop were designed with 14 children, three instructors and three supervisors. We present results of the workshops and finalise it with conclusions and future work.

II. air4children with alternative education programs to promote Diversity and Inclusion in low-income countries

A. *New technologies in alternative education programs*

Alternative education programs such as Montessori, Waldorf and Regio Emilia considers children as active authors of their own development [7]. These programs have been well adopted internationally; however Edwards *et al.* pointed out the schools deriving from the same philosophy might also need to observe teacher-child interactions, its environments and interview to the past and present parents and children [7]. Similarly, in the last 5 years such programs are starting to include topics on AI, robotics and computational thinking into their curriculum [8], [9]. For instance, Aljabreen pointed out the adoptions of new technologies and how early child education is re-conceptualised [9]. Elkin et al. in 2014 explored the how robots can be used in the Montessori curriculum [8]. Similarly Elkin et al. posed the question on the revision of new curriculums that include technology should not deviate from the main purpose of the Montessori classroom [8]. Drigas and Gkeka in 2016 reviewed the application of information and communication technologies in the Montessori Method, mentioning the Manipulatives, as objects to develop motor skills or understand mathematical abstractions, are based on cultural areas, language, mathematics and sensoria but little to none on technological areas [10]. Drigas and Gkeka reviewed Montessori materials of the 21st century where interactive systems with sounds and lights, touch application to enhance visual literacy or the development of computational thinking and constructions of the physical world [10]. These indicate that the incorporation of such manipulatives with the use of robotics might led to reach scenarios to explore motor skill development, visualisation and computational thinking. Recently, Scippo and Ardolino reported a longitudinal study of the use of computational thinking in five years participants of primary school in a Montessori school [11] Scippo and Ardolino pointed out the importance of alignment of the Montessori material with the computational thinking activities.

That said, previous authors stated various challenges on the incoporation of new technologies into their curriculum posing more questions on creating curriculims that should be more accessible to a diverse group of population as it is done in the case of open educational resources.

B. Open educational resources to teach AI and Robotics in low-income countries

MX: we might like to add an introduction here of AIR in low-income countries to connect with next bits of Xicothzinco

Xicohtzinco, Tlaxcala México, is a town of a total population of 14,197 (6762 males and 7435 females) based on the INEGI's census 2020. Although the census do not provide number of schools, we know from the current habitants, that there are three public schools including kinder-garden, primary, secondary and high-school; and three private schools including primary and secondary schools.

III. Designing Diversity and Inclusion Workshops

To design diversity and inclusive workshops we were considered the six ideas discussed in "Ensuring education and Inclusive Learning for Educational Recovery 2021" [12] and 'Concrete to abstract' concept within the Montessori philosophy [13]. In one hand, we considered the six ideas to ensuring and inclusive learning summarised as: (1) personalisation of education including the recognition of specific learning expectations and needs, (2) designing inclusive, emphatic and participatory curriculum for an plural and open participation of a diversity of actors and institutions, (3) appropriation of technology as a community resource to strength ties between students, educators, families and communities, (4) empowering knowledge, learning, collaboration, trust and listening among peers, and (5) the visualisation of schools as lifelong learning spaces. On other hand, the workshop were planned to develop concepts and skills using 'concrete' concept with hands-on learning materials to make abstract concepts clearer as it is taught in Montessori education [13].

That said, with the combination of Open Educational Resources, alternative education programs and the six ideas, we designed a four lesson workshop with two-fold aims: (a) to promote diversity of and inclusion to children to teach AI and Robotics and (b) to encourage children to discover and increase their interest in AI and Robotics. Figure 1 presents four lessons of the workshops.

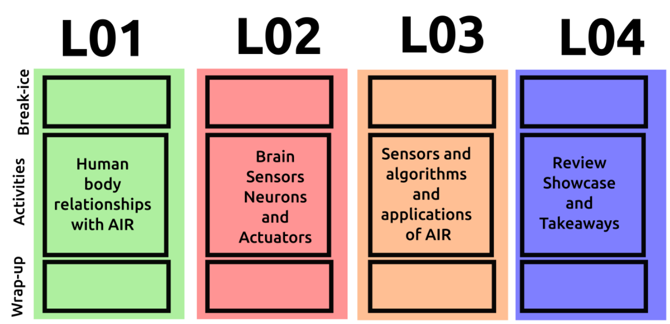

Fig. 1. Curriculum for four lessons (L01 to L04). Lesson 01 introduce the course, lesson 02 provides the basics of anatomy, lesson 03 covers algorithms, and lesson 04 wrap-up and showcase the project of children.

a) Lesson 01: Breaking the ice and motivations: The educational goal for this lesson was to develop the children's curiosity about AI and Robotics while emphasizing the importance of interpersonal connections that will evolve into a collaboration work for the following lessons. That said, this lesson started with a recreational activity where each student and teacher introduced themselves with name, favorite food and a superpower or ability that we would like to have and that was related to robots. This lesson also covers basic concepts and examples of AI and Robotics in different fields and daily life, how the brain works and how the human senses and body parts relates to the way a robot is built and how it works and perform activities.

b) Lesson 02: Human senses and coding my first robot: The main purpose of this lesson was to understand fundamentals of Robotics. Children began to work with more abstract concepts, developing problem-solving skills as well as cooperatively working relationships. The first activity, outside of the classroom, was a true or false game, were the teacher told a sentence about AI and Robotics, and the children jumped in front of a rope if the sentence was true, or if the sentence was false, the kids jumped behind of the rope. In the second activity, the instructor explain about the human senses and their relationship with inputs and outputs. After that, instructors explain examples of sequences and codes. In the last activity, participants were asked to sort out tangram in a group in which a leader of the group provide instructions to the team-mates as an analogy of coding a robot with algorithms.

c) Lesson 03: Playing with reaction-action activities: The educational goal of this lesson is to cover the concept of the effect of causes and consequences with daily life examples and the computational thinking of robots. Hence, this lesson start with a match game consisting of figures and shadow's figures where participants develop their comparing skills to match similar or different robots. This lesson covered points on how robot works with sensors, processors, actuators and programming. The "find the effect" activity was also introduced where participants have to relate pictures of cause and consequences, for example "the cause is the rain and the consequently is a rainbow". Afterwards, we worked with the Otto humanoids in which we programmed the sensor presence for that robot moves, dances and that emit texts with the 8x8 matrix.

d) Lesson 04: Develop your own AIR: The four lesson aimed to summaries what was covered in the previous lessons emphasising the relationship of the human body anatomy (brain, neurons and body parts) with humanoid robots (computer, sensors and actuators). This lesson covered real-word application of AI and Robotics including medicine, spacial robotics and smart cities. Three projects were prepared to be introduced to each team in which every participant have a role. Each team prepare a short speech of their application using AI and Robotics.

IV. Piloting Diversity and Inclusion Workshops

To pilot the workshop, we invited 14 (6 female and 8 male) participants with range of age from 6 to 11 years old (average age of 7.64). Similarly, three instructors with 3 years of experience in teaching and two coordinators with 10 years of teaching experience volunteered to deliver four lessons. Originally, each lessons was planned to be 90 minutes but we did not consider breaks or perhaps the children's energy levels of some of the participants to which in the second to four lesson a 15 minutes break was incorporated. We surveyed children with questions about their understanding and feelings towards different type of robots to find out that some of the children were not in the age to read, to which we support them. Although the survey contained only 10 questions, we decided to made use of 10 minutes at the start of each lesson to complement all the questions.

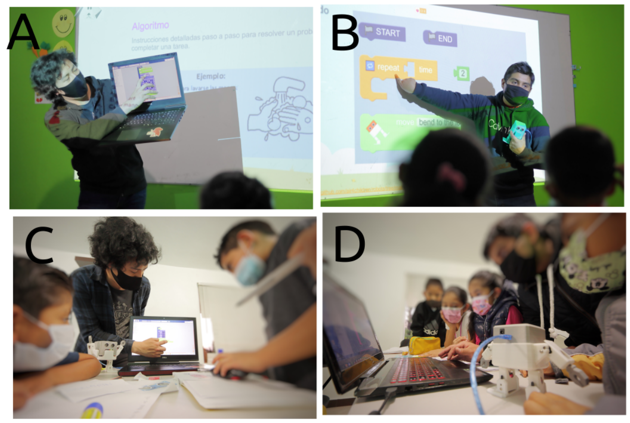

Fig. 2. Instructors demonstrating basics of AI and Robotics (A, and B). Children engaging with robots, classmates and instructors (B, and C).

Figure 2 illustrates instructors and children during interactive activities.

As the lessons progress the children incorporate the knowledge they gained and are able to put concepts together. A show case of their final work promoted a sense of achievement in the children working not only with their mind but also with their social emotional well-being.

V. Conclusions and future work

In this paper, we investigate the challenges of Diversity and Inclusion to teach "Artificial Intelligence and Robotics for Children" with open educational resources and principles of Montessori education. For the design and the pilot of the workshop, we invited 14 children of an average age of 7.64 years old participated of the community of Xicohtzinco Tlaxcala Mexico. The workshops were free of cost as a way encourage participation of anyone. During the pilot workshop, children were enthusiastic about learning the fundamentals for AIR by building, coding, designing and playing with open-sourced robots. The instructors embraced the different set of skills each child had by working in small groups and supporting the students during the process. These lessons intended to remain beyond the learning of a single concept and contribute to develop a skill the children can take and apply to other areas in their life. However, we noted that grouping children of four participants with one instructor was not creating an engaging experience as each group has only one robot and one computer and the space and number of participants was leaving sometimes one participant outside of the reachable robot-computer setup. As a future work, we are planing to organise another workshop in the four quart of the 2022 where we will consider 10 lessons distributed in four weeks with we will invite more participants. For curriculum of the workshops, we will improve the interactivity of the participants and create more engaging and inclusive activities. We will incorporate a similar approach of the synthesis program which aim is to cultivate student voice, strategic thinking and collaborative problem solving [14].

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Contributions

Antonio Perez-Badillo: Contributing to design and write up of lesson 02. Dago Cruz: Diego Coyotzi-Molina: Contributing to design and write up of lesson 03. Donato Perez-Badillo: Contributing to design and write up of lesson 01. Leticia Vazquez: Write up and refinement of the conclusions. Miguel Xochicale: Contributing to create the template, drafting, write-up, edition, and submission of the paper. Rocio Montenegro: Contributing to the write up of designing and piloting workshops.

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