École Polytechnique Fédérale de Lausanne

Participatory design of a social robot and robot-mediated storytelling activity to raise awareness of gender inequality among children

Master's Thesis in Robotics

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January 20, 2023

Abstract

Gender inequality is a widespread problem in our society. It can manifest itself in many ways and contexts, and starting as early as primary school. While an increasing number of initiatives aim at tackling gender biases and inequalities, few of them are aimed at raising awareness of gender inequalities among young children, i.e., at the age in which such inequalities appear in their lives. At the same time, the potential shown by social robots in teaching non-curricular topics is a promising motivation for exploring their use in this context. Indeed, a social robot could offer children the possibility to discuss gender (in)equality with an intelligent entity that is neither male, nor female, but rather a credible outsider with respect to mankind. In this thesis, we present the design process of a social robot, named PixelBot, and an associated robot-mediated learning activity, aimed at raising awareness of gender inequality among children. We used a participatory design approach involving 20 children aged 10-13 to acquire (i) their opinion on how a robot should look like and (ii) stories featuring robots and gender (in)equality. The PixelBot robot was designed to meet most of the requirements identified by the children. Similarly, the robot-based learning activity used a storytelling approach, whose scenario was inspired by the children's prompts. Finally, we conducted a study, involving 8 children aged 9-10, to test the co-designed robot and robot-based learning activity. Results suggest that social robots are a promising avenue to promote gender equality and respect in children.

Contents

1 Introduction

"*Gender inequality* refers to the unequal treatment or perceptions of individuals based on gender"[1]. It can affect anyone, but it primarily affects women and gender minorities. Gender inequality can manifest in many different ways. In the professional field, it can take the form of unequal pay for the same or comparable work or unequal career opportunities. In the private sphere, it can manifest with imbalances in the amount of housework. On the educational front, gender inequality can exhibit itself as unequal access to education. Sexual exploitation, violence and discrimination against specific gender minorities are also part of gender inequalities [1].

Efforts to promote gender equality and address gender inequality can be traced back to the '70s and are still ongoing. Olivares et al. demonstrated in their review that gender inequality is not only learned in the socialization process that starts at home but is also present in the school environment from the very early years [2]. As a result, many tried to solve the problem of gender inequality through education [3, 4, 5]. Hilke and Conway-Gerhardt proposed to introduce in the curriculum a cyclical model for eliminating gender inequality, incorporating the stages of awareness, analysis, action and assessment [3]. Koblinsky et al. explored how the exposure to non-sexist curriculum could significantly reduce sex stereotyping among children [4]. Similarly, Flerx et al. showed how egalitarian sex role models in illustrated stories and films could help reducing stereotypic thinking in children [5].

When it comes to gender inequality, *Robotics* stands in a rather unique position. On the one hand, as a field within the STEM (Science, Technology, Engineering, and Mathematics) domain, robotics suffers from significant gender imbalances [6]. On the other hand, however, as an activity to engage in, it was found to be an effective mean to tackle those same imbalances [7, 8, 9]. For example, Jackson et al. investigated whether participation in a soft robotics design experience would improve students' -especially girls'- perceptions of engineering in contrast to a traditional, rigid robotics experience [7]. Gomoll et al. explored how an after-school robotic club can provide informal STEM experiences that inspire students, with a particular focus on girls, to engage with STEM in the future [8]. Similarly, EPFL created a few years ago a robot programming course named "Les robots, c'est l'affaire des filles" ("Robots are a girl's business") intended exclusively for girls aged 11 to 13 and with the objective to introduce them to computing and communication technologies [9].

A common pattern among the works mentioned above is that robots are used to address gender inequalities *implicitly*, by teaching STEM concepts. Indeed, to the best of our knowledge, no work has investigated the use of robots to address gender inequalities *explicitly*, i.e. by making respect and gender equality the focus of the robot-based educational activity. Investigating this possibility is the main motivation of the work undertaken in this thesis.

In section 2, we present findings from a systematic review on the field of social robots

[1] `https://www.langston.edu/title-ix/gender-discrimination-defined`

for education. In section 3, we describe the participatory design approach we adopted to acquire children's opinions on how a robot should look like and stories that feature the robot and relate to gender (in)equality. In section 4, we detail the robot and robot-based activity developed on the basis of the suggestions provided by the children in the participatory design. In section 5, we report the results of a final study aiming to test and evaluate the effects of the robot-based activity on children. In section 6, we close with a discussion and conclusions.

2 Background

2.1 Scope of the literature review

This review explores the currently open research challenges for the use of social robots as learning companions. We are particularly interested in knowing if gender respect and equality promotion using robots has already been tackled and, if so, what methods have been used to do so. As one of the aims of this thesis is to employ a participatory design methodology, we are also interested in gaining insights into the approaches commonly adopted, particularly with children, as well as the stakeholders generally involved in this kind of design.

2.2 Research methods

2.2.1 Search method

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. The PRISMA approach ensures transparent and complete research reporting while offering the replicability of a systematic literature review [10]. Records have been identified using *Scopus*, a transdisciplinary database of abstracts and citations of scientific publications. Most of the identified records were part of the following databases: ACM digital library, Springer, and IEEE Xplore. The search was done within the articles' title, abstract and keywords, and the following search pattern was used:

> ("social robot" **or** "educational robot" **or** "learning companion") **and**
> (("co-design*" **or** "participatory design") **and** ("children" **or** "learner*" **or** "teacher*")) **or**
> (("interaction-centered" **or** "user-centered") **and** "design")

Below, we define the two search sets of this review:

- **Social robot:** Social robots are designed to interact with people in a natural, interpersonal manner – often to achieve positive outcomes in diverse applications such as education, health, quality of life, entertainment, communication, and tasks requiring collaborative teamwork [11]. Like other robots, social robots are physically embodied [12] and usually take the form of humanoid robots, zoomorphic robots or other more abstract forms [11]. Generally, social robots are equipped with sensors that allow them to perceive their environment in various ways, typically hearing, sight, and touch [13].

- **Participatory Design:** Participatory design is an approach attempting to actively involve all stakeholders in the design process of a product to ensure it meets most of their needs [14]. Usually, it involves an iterative approach in which the product is gradually developed and refined[2].

[2] `https://en.ryte.com/wiki/Participatory_design`

2.2.2 Selection strategy

The search returned 102 records. Of these 102 records, 4 were deleted prior to filtering because they duplicated other records. Among the 98 remaining records, 15 reports could not be retrieved, either because our institution did not have access to them or because they were not correctly referenced anymore, leaving 83 articles to be evaluated for eligibility. Based on the exclusion criteria shown in Table 2.1, 67 articles were excluded: 51 were considered not relevant to the current study (as detailed in the following paragraph), 9 were excluded due to their nature, e.g. editor's notes or project plans, 3 were excluded for being products from second or third sources, 2 were excluded because they did not meet the sample properties requirements and 2 were excluded for being a repetition of other articles. In the end, 16 studies were included in the review (see Appendix A for the complete list of the reviewed studies). Figure 2.1 describes the flow of information through the stages of identification, screening, and inclusion.

It is important to note that the criterion of relevance is subjective. More explanations about this criterion are given below:

- The main criterion for relevance was: *social robots for education*. This means that articles that did not necessarily present a co-design study of a robot or did not involve children but adults could pass the relevance criterion as long as their primary subject was about social robots for education.
- The design of the robot for an educational purpose should be the primary subject studied in the article. This means that articles that involved social robots and education but used these as a "backbone" to study another topic, such as co-design frameworks/guidelines, or instruments to evaluate human-robot interactions, would be excluded.
- We also consider the articles for which a theoretical solution is proposed (i.e., a robot is not necessarily built afterwards). For example, articles that present a participatory design to build a robot and describe how it should behave could be included even if no actual implementation of the robot was done by the authors as long as the theoretical solution is meant for a social robot with a specific education challenge.

2.2.3 Coding and synthesis

The selected 16 articles were first analyzed based on the following features:

- **Type of robot and challenge considered in the article:**
  - Is the robot specifically designed for education, or is it a general-purpose social robot?
  - Is the robot designed for a specific education challenge, or is it a general educational robot?
  - What is the educational challenge considered in the article?
- **Participatory design presented in the article:**

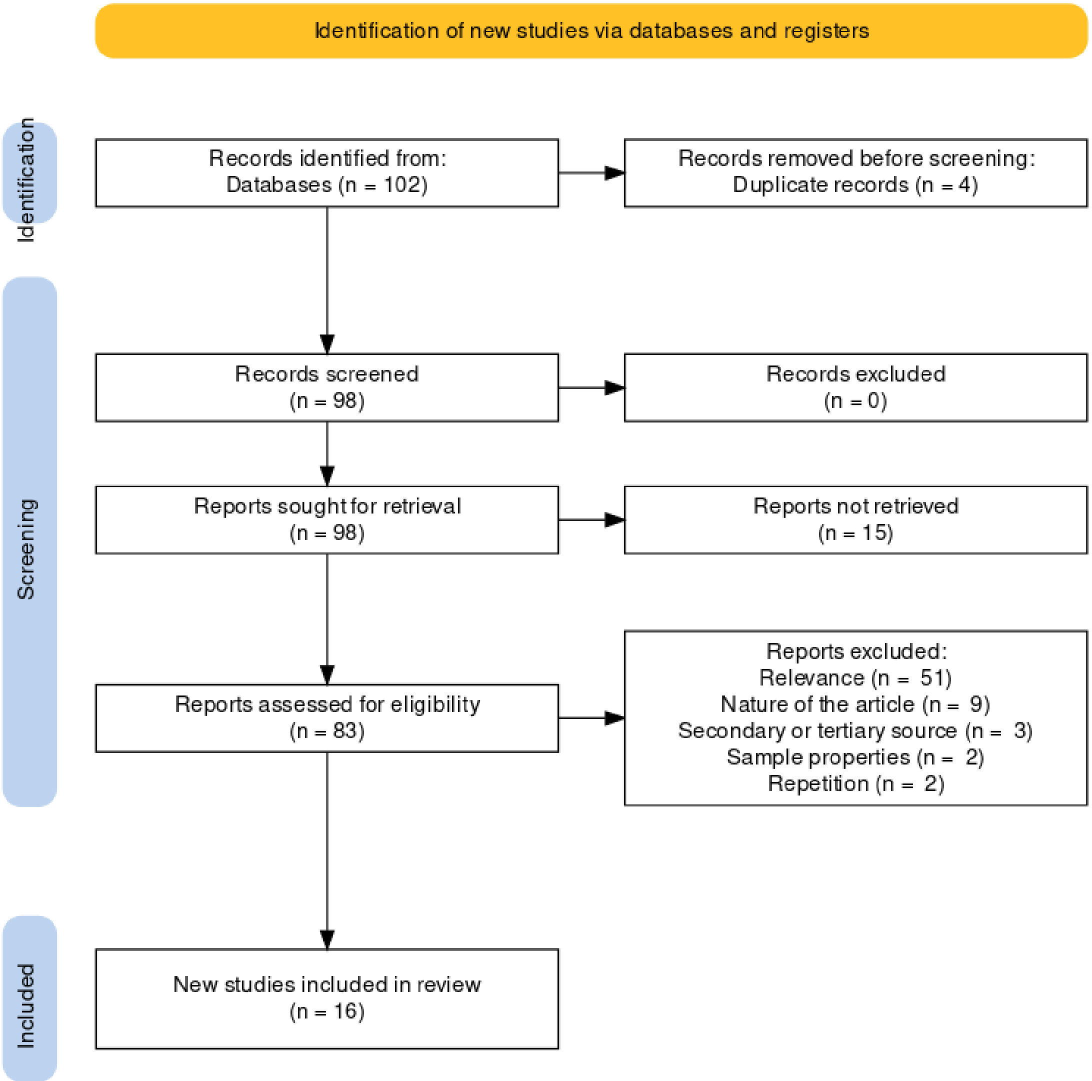


Figure 2.1: PRISMA flow diagram summarizing the flow of information through the stages of identification, screening, and inclusion.

Exclusion criterion	Description
Relevance	Articles which showed no direct connection to our research topic.
Nature of the article	Articles which did not show the desired format: were either expert interviews, editor's notes, summaries of a person's work, or a project plan.
Secondary or tertiary source	Articles which did not present a primary study. Most are syntheses that compared and contrasted the work of various researches or attempted to extrapolate findings from other studies.
Sample properties	Articles which failed to disclose essential information regarding the participants.
Repetition	Articles which are a repetition of other articles seen previously.

Table 2.1: Criteria used for the exclusion of studies.

  - Does the article present a participatory design?
  - How many learners were involved in the participatory design? What are their average age and gender proportion?
  - How many teachers were involved in the participatory design? What are their average age and gender proportion? What is the teachers' discipline?
  - How many stakeholders were involved in the participatory design? What are their average age and gender proportion?
  - What are the methods used during the participatory design?

- **Experimental evaluation study presented in the article:**
  - Is an additional study presented in the article? For example, to test the co-designed robot or robot-based interaction?
  - How many learners were involved in this additional study? What are their average age and gender proportion?
  - What are the different types of measurement and assessment methods used in this additional study?

- **Characteristics of the co-designed robot:**
  - What is the robot's type? Is it a humanoid robot, a zoomorphic robot, or another type of robot?
  - What are the features allowing the robot to perceive its surrounding environment?

Theme	Number of article
Curricular education	2
Non-curricular education	5
Remediation	9

Table 2.2: Classification of the articles by theme.

- What are the features allowing the robot to act on its surrounding environment?
- How does the robot interact with its surrounding environment during the interaction?
- How many degrees of freedom does the robot have?
- In which material is the robot made?

Three themes emerged from this analysis[3], into which the articles could be classified (Table 2.2). We define these themes below:

- **Curricular education:** All the learning which is planned and guided by a school, whether it is carried on in groups or individually, inside or outside of school [15].
- **Non-curricular education:** All the learning which is not planned and guided by a school. It is often learning that incorporates practical activities, student choice, and interdisciplinarity that is not linked to assessment [16].
- **Remediation:** Process of resolving learning difficulties [17] or re-educating cognitive functions which have been altered [18].

2.3 Findings

2.3.1 Curricular education

The theme of curricular education includes studies that used robotics to promote the acquisition of knowledge usually tackled in schools. Two studies, both focusing on language learning, were classified into this category.
Björling et al. [19] designed a culturally responsive child-robot interaction, using the NAO robot and aiming to support English Language Learners (ELLs) in the United States. The researchers first designed a conversational script for the robot based on culturally responsive conversation-based guidelines to aid ELLs in connecting with a text. As cultural informants, twenty-four Spanish-speaking ELLs aged 8-10 then participated in a 15-minute, robot-led, small-group story discussion followed by a post-interaction feedback session. The researchers also conducted reflexive critiques with six ELL teachers, who reviewed the group interactions beforehand. The results presented by the authors show that the students found the social robot engaging, yet, many of them were hesitant to converse with

[3]The analysis can be found at: https://docs.google.com/spreadsheets/d/11a_ZUCvsFkPn_giDszvuJ2mzJ1gj5p2qqbhpTX9CL1o/edit?usp=sharing

the robot. The authors identified challenges and guidelines for future interaction design for ELLs. The participatory design also allowed the authors to gain valuable insights into the importance of adding culturally responsive appearance and behaviour to the robot's dialogue to improve the quality of learning activities supporting ELLs.
Kouri et al. [20] explored the potential of customized language robots for immigrants to support their professional development and adaptation to the local work contexts. The robot used was NAO, and the study involved ten immigrants and multidisciplinary teams composed of the immigrant's workplace representatives, vocational teachers and a language trainer. The multidisciplinary teams first co-designed the learning programs for the robot. These programs were adapted to each worker: the vocabulary to be learnt was specific to the immigrant's workplace and adapted to their proficiency level. The Robot-Assisted Language Learning (RALL) activities were then tested with the participants at their workplaces. On average, three sessions which lasted from 30 minutes to 3 hours were conducted. The researchers took notes during the sessions, and interviews were conducted with the workers afterwards. The results allowed the authors to identify challenges and enabling factors to be considered in the design of future RALL activities.
In summary, studies for this theme suggest that social robots show great promise as learning companions, mainly due to their ability to provide customized learning experiences through their adaptability to the user level, learning objectives, etc. Social robots can also be made engaging and enjoyable by adapting to the background and culture of users.

2.3.2 Non-curricular education

The second theme addresses the general benefits of robots in supporting non-curricular education, i.e. all the learning typically not planned and guided by a school. Five studies were classified into this category.
As an exemplary study of this theme, Sanoubari et al. [21] explored the use of social robots and role-playing to foster anti-bullying peer-support. Twenty-two children aged 8-12 were involved in a co-design study to explore how they envision a "student robot". The first half of the study focused on designing the robot through brainstorming, sketching designs, collecting crafting material, and making a low-fidelity prototype based on the sketches. The second half focused on designing robot-based stories using storyboarding and animation-making. Interviews were also conducted with children and their parents to gain more in-depth information. The qualitative analysis conducted in this study revealed that children envision the robot to be a highly customizable character with predominantly positive traits, but also imperfections. The authors also found that children can articulate various scenarios involving robots taking the roles of bullies, victims, and bystanders. These findings gave the authors valuable insights for designing pedagogical robots and anti-bullying interventions for children.
In another study, Alves-Oliveira et al. [22] co-designed a robot named YOLO aimed at stimulating creativity in children. The authors used a participatory design approach involving 142 children aged 6-10 as active contributors at all design stages. In the first stage, children were included as informants. Through observations during storytelling activities, the researchers investigated how creativity can emerge and be stimulated in children. In the second stage, children were included as design partners. The researchers specified details of the design requirements by observing and analysing children doing body-storming,

puppeteering, and sketching. The third stage was focused on the development of the robot. In this stage, children acted as testers of the robot. They played freely with a low-fidelity prototype, and the researchers relied on Co-Discovery and Active Intervention methods to elicit feedback from children. In the final stage, the researchers evaluated the final prototype of the robot by conducting an experimental study. The study aimed to test the robot's efficacy in stimulating children's creativity. The stories created by the children with the robot were compared against the condition of creating a story with the same robot but without displaying any behaviours and a robot turned off. This final study showed that YOLO could successfully increase children's creativity during play. Through the design of YOLO, the authors were also able to identify design guidelines that promote the successful inclusion of children in the design of robots.

In another study, Prabha et al. [23] presented a participatory design of a robot promoting hand hygiene among children. Forty children (ages not mentioned in the article) were involved in their study and acted as design informants. They were first provided with various pre-cut geometrical shapes made from paper and asked to create their own models of the robot. This would allow the researchers to explore the children's mental representation of a robot which promotes handwashing behaviour. The children were then asked to give feedback on eight a priori conceptual designs of minimalistic caricatured social robots. Based on the children's descriptions, the authors developed their robot named Haksh-E. However, no additional studies to test the co-designed product were performed.

To summarize, studies on this theme suggest that participatory designs of robots are a well-fitted solution to non-curricular education, specifically wherever it is not straightforward to define the characteristics and abilities that a robot would need to have in order to be effective. Indeed, participatory designs increase the chances that the final product will meet most of the users' needs and preferences and be aligned with the content to be taught. It is interesting to notice how the reported studies relied on participatory design to design a robot alongside the robot-based educational activity. This suggests that for non-curricular topics, such as stimulating creativity, promoting hand-hygiene, or also raising awareness about gender (in)equalities, the ad-hoc design of the robot to be involved in the activity might be key for its effectiveness.

2.3.3 Remediation

The third theme includes studies that used robotics as a remediation tool. As defined previously, remediation refers to resolving learning difficulties or re-educating cognitive functions that have been altered. Robots in this category fall under the sub-set of Socially Assistive Robots (SARs) that specifically focuses on medical assistance. Such robots are usually intended to assist in a therapeutic way, and one of their main motivation is to address manpower shortages and to facilitate and augment processes for the delivery of efficient and safe care [24]. Nine studies were classified into this category.

As an exemplary study of this theme, Neto et al. [25] explored the potential of social robots to foster the inclusion of Visually Impaired children (VI) in mixed visual abilities classrooms. The first part of their study consisted in exploring the challenges and barriers to inclusive classrooms for VI children. This has been done mainly through interviews and contextual inquiry sessions with stakeholders such as braille teachers, speech therapists, psychologists, school coordinators and parents. The second part of their study explored

how robots could help overcome the identified barriers and what characteristics children with mixed visual abilities expect from social robots. The researchers worked with 54 children (5 visually impaired) divided into three groups, which corresponded to their school year: Primary school (N=18, 3 children with low vision, Age=8.55, SD=1.29), fifth grade (N=19, 1 child with low vision, Age=10.78, SD=0.41), eigth grade (N=17, 1 blind child, Age=13.23, SD=0.43). They participated in a series of workshops divided into five phases. The first phase aimed to familiarize children with robotic technologies and demonstrate their physical capabilities. In the second phase, the researchers used a participatory design toolkit to engage children in idealizing a robotic device. Using this kit, the children could describe several aspects of the robot, such as its personality, its ways of communicating and sensing, its locomotion means, its shape, the material it is made of, etc. The third phase consisted in sharing and presenting their ideas and design decisions to the rest of the class while other children were encouraged to comment, ask questions or provide new ideas to their classmates. In the fourth phase, the children were asked to build their idealized robots using recycled materials. Finally, in the fifth phase, children were asked to create a script demonstrating how their creation would behave. Outcomes from this study include recommendations for future designs of social robots in the context of mixed-visual abilities classrooms. These recommendations take the form of challenges to tackle, as well as children's preferences and expectations about such robots.
In another study, O'Brien et al. [26] co-designed a robot named TACO, whose aim is to address symptoms of loneliness, anxiety and social isolation in children. Similarly to the study described above, a detailed need-finding process was first undertaken. This process aimed to investigate the challenges faced by children with illnesses, with a particular focus on hospitalised children. A site visit to a national children's hospital was conducted during which potential primary and secondary users (respectively hospitalised children and staff in pediatric hospitals) were observed in a live-setting fashion. This allowed the researchers to familiarize themselves with the real-world environment in which a pediatric therapeutic robot would be used. The authors then conducted semi-structured interviews with a pediatric doctor and a senior child life specialist to deepen their understanding of the needs/requirements of the target user. Based on this first exploratory study, the TACO robot was developed and then tested by sixteen children aged 6-9. The goal of this initial evaluation was not to validate the effectiveness of the robot as a therapeutic aid but to explore the children's first impressions of the robot and to better understand the suitability of the robot's ergonomics. To evaluate each child's activity with the robot, a modified version of the SOFIT (System for Observing Fitness Instruction Time, a validated scale for measuring child activity) method [27] was used during the experiment. Some open questions were also asked post-experiment. The results indicated high levels of engagement with TACO. The experiment also revealed that TACO created pleasant, engaging interactions with children, however, the tests were insufficient to show a therapeutic effect.
As in the previous theme, studies focusing on remediation highlight the importance of designing the robot alongside the robot-based educational activity. The case of TACO is a great example of how the characteristics of a robot (non-anthropomorphism, cuddly shape) can trigger behaviours in children (cuddling and stroking) that are essential for the success of the robot's intervention (to reassure and calm the hospitalized children).

2.4 Synthesis

Educational robots can support learning in a variety of ways. In curricular education, social robots can offer personalized and adaptive learning experiences, which can help meet the individual needs and abilities of students. Social robots can also be made engaging and enjoyable by adapting to users of diverse backgrounds and cultures. In non-curricular education, social robots can provide children with innovative learning experiences helping them to develop a wide range of skills and abilities. The articles described in section 2.3.2 have demonstrated the use of social robots to develop and stimulate children's creativity, promote healthy habits such as hand hygiene and help build intelligent social behaviours such as anti-bullying peer-support. Concerning remediation, social robots have the potential to help people with mental health conditions by providing them with a non-judgmental and supportive presence and engaging them in activities that promote well-being and self-care. Social robots also showed great promise in supporting individuals with physical or cognitive disabilities. Overall, the review highlights the variety of topics for which social robots have been successfully used and supports our idea of using them for raising awareness on gender (in)equality.

Regarding the populations targeted in the reviewed studies, twelve focused on children, two on middle-aged adults, and two on the elderly. Besides the learners, the stakeholders generally involved in the studies were teachers, school administrators, field specialists, psychologists and the learner's parents. The methods used in the participatory designs vary according to the target population. When considering children as the target population, several methods were often combined: storytelling, sketches and drawings, kits to describe the robot features, 3d prototyping, interviews and questionnaires. When considering middle-aged adults and the elderly as the target population, only interviews and questionnaires were used (Figure 2.2). Similarly, the stakeholders other than learners always represented a middle-aged population and intervened in the participatory designs only through focus groups and interviews. As well as giving us an insight into the approaches commonly used in participatory design, the review also informs us of the importance of adapting the methods used when including children as product design informants.

Finally, among the article reviewed, only [21] can be considered as a study using robots to promote respect, namely respect for others. However, this is only an exploratory study and no actual implementation of a robot and a robot-based activity tackling the problem of bullying has been developed afterwards. This motivates us to: (i) explore the use of robots to raise awareness of gender inequality among children, which, to the best of our knowledge, has not been studied yet; (ii) develop, test and evaluate a concrete implementation of a robot and robot-based activity to tackle the challenge aforementioned.

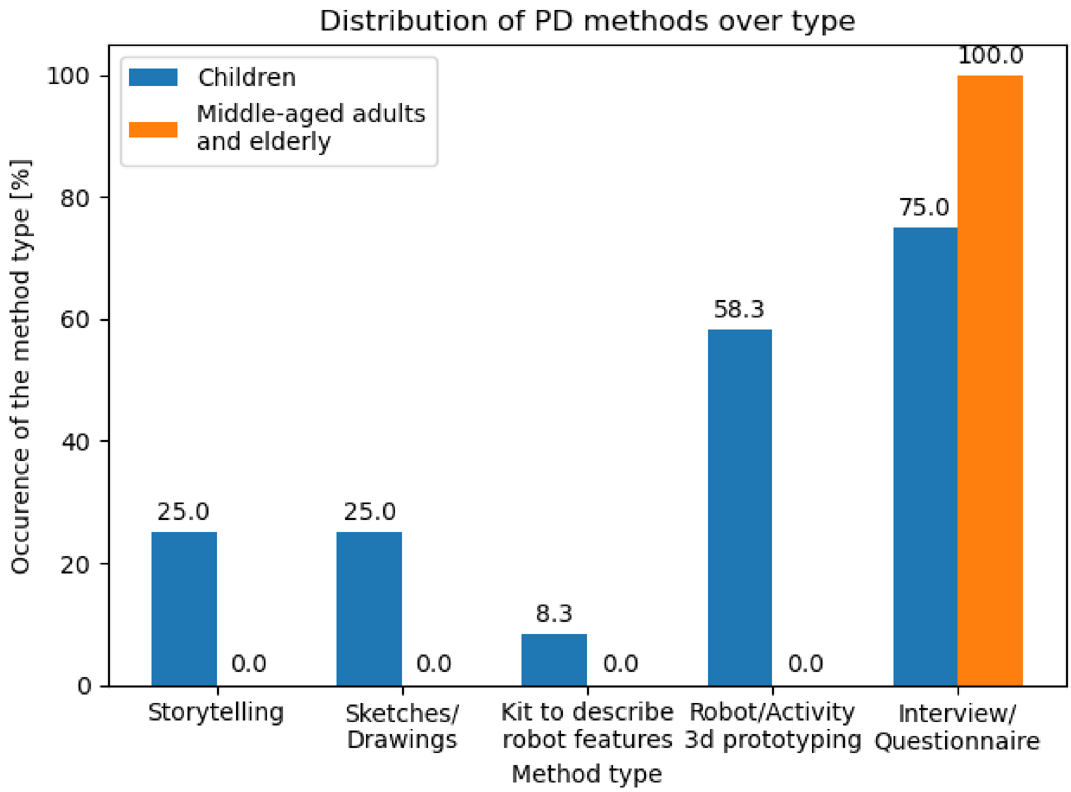


Figure 2.2: Distribution of the methods used in the participatory designs. Only the methods used with the intended user base (the learners) are considered. The methods used are not mutually exclusive.

3 Participatory Design

3.1 Initial prototype and first iteration

We initially envisioned the robot-based learning activity to follow a role-playing approach. As Sanoubari et al. [21] explain, drama and role-play have already been used successfully in anti-bullying interventions and allow children to be immersed in real-world examples, which can enhance learning outcomes, without necessarily involving them in the roles of bullies or victims, thereby reducing the risk of harm. Additionally, as the literature review reported in Section 2 highlights, the design of robot-based interventions for teaching non-curricular topics, as in awareness of gender (in)equalities, requires the robot to be co-designed together with the activity in which it is involved.
The motivations for carrying out a participatory design were, therefore, twofold. The first objective was to gather children's thoughts on the physical appearance and main characteristics of social robots. These opinions would assist us in the robot design process. The second goal was to collect stories that feature the robot and relate to gender (in)equality to gain insights into how a robot could respond to such situations and inform the design of the robot-based learning activity.

To design the first part of our participatory design toolkit, focusing on the robot's physical appearance and characteristics, we took inspiration from the toolkit developed by Neto et al. [25], which we introduced in Section 2.3.3. In their toolkit, children can describe the main features of their idealised robot. Some "feature cards" are given for each feature, and the children have to choose one among them. For example, under the "communication" feature, there might be cards for "Writes", "Body movement", "Speaks", "Sound", and "Facial expressions". Blank cards are also provided for children to specify their own ideas. On the basis of the feedback provided by Melissa Skweres, project officer in the Centre for Learning Science at EPFL with a teaching background, we decided to substitute the card concept with a multiple-choice-like format, in which children could simply select the preferred option describing the robot's feature. While this format may initially seem less engaging for children, we believe it to be easier and faster for them to use. To keep the activity enjoyable for children, we included a section in the toolkit where they could draw their ideal robot. This would also give us a more visual representation of what the children envision for their robot.
Concerning the second part of the participatory design toolkit, which focuses on stories featuring the created robot and gender (in)equality, we took inspiration from Sanoubari et al. [21] (introduced in Section 2.3.2), who used storyboards. Children would create their stories by drawing in each frame of the storyboard. Additionally, they would describe each of them using empty lines underneath. Following a discussion with Melissa Skweres, we also decided to include a story map alongside the storyboard, which would be filled out beforehand and would aid children in establishing the setting for their story.

The first iteration of the participatory design kit (see Appendix B.1) was tested informally during the public day of the Swiss Robotics Days, an event organized by NCCR Robotics[4]. A stand in an open space was allocated to us, and interested children were free

[4] https://swissroboticsday.ch/

to come and participate in the activity (Figure 3.1). In total, fifteen children, usually accompanied by their parents, participated in the activity (9 males and 6 females, age=10.43, SD=2.96). The experiment took place during the afternoon and lasted approximately four hours (from 1 pm to 5 pm). There were no time constraints for children to finish the participatory design activity, but typically, each section of the toolkit (the robot design and the story creation) were completed within twenty to thirty minutes. Children were also free to stop the activity whenever they wanted to and had the possibility to finish it at home (Figure 3.2). The completed toolkits were collected or photographed in case children wanted to bring their work home, to finish it or simply keep it. A mail address was also indicated on the toolkit for children who chose to finish it at home, allowing the parents to send us afterwards photos or scans of their work.

Figure 3.1: Setup of the first iteration of the Participatory Design at the Swiss Robotics Days.

3.2 Second and third iteration

Several observations during the first iteration motivated us to refine the participatory design toolkit. The first change made to the kit involved the process for children to select the features for their robot. In the first version of the toolkit, this process was divided into two parts. In the first part, children were presented with a list of non-exclusive options for each feature and were asked to rank them according to their preferences. In the second part, children were asked to choose only one option for each feature. We noticed that children struggled with the ranking exercise, possibly because the two tables looked similar but required different methods of input - one required ranking the options using numbers,

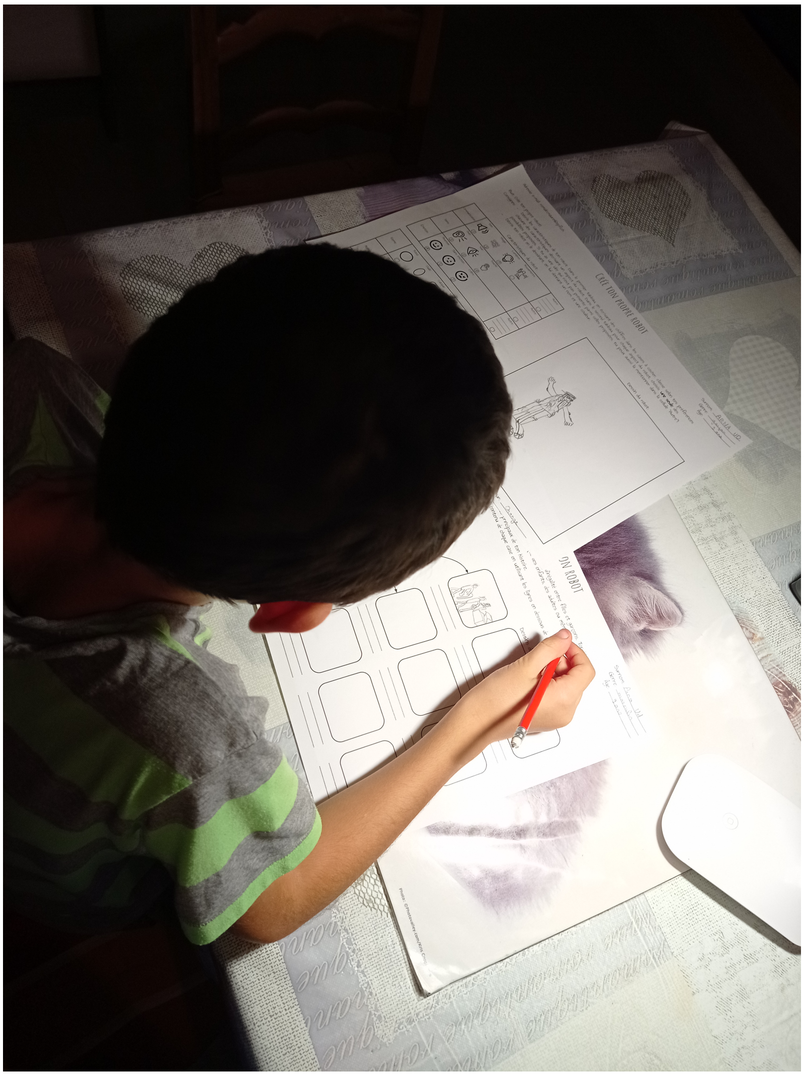


Figure 3.2: A child completing the participatory design toolkit at home.

while the other required selecting a single option. To address this issue, we redesigned the first table to be more intuitive, allowing children to simply draw arrows connecting the options to their desired rank.
During the first iteration, we also noticed that most children focused solely on creating their robots and did not engage with the creation of the story. There could be several reasons for this. The story creation aspect may have been perceived as less interesting or more challenging, particularly due to the requirement to address themes of gender (in)equality. It is also possible that children became tired after spending a significant amount of time on the robot creation part. To address the difficulty that could have been perceived regarding the subject of gender (in)equality, we added a sheet of questions on the topic to the participatory design toolkit. While the story map would assist the children in setting the scene of their stories, the questions sheet would give them avenues for reflection and inspiration.

The refined version of the participatory design toolkit (see Appendix B.2) was then used formally in two different iterations. The second iteration of the participatory de-

sign occurred in our laboratory during an open-day EPFL event (referred as ODE from now on) (Figure 3.3). Eight children participated in the activity (4 males and 4 females, Age=11.37, SD=0.99) and were separated into two groups. Each group performed the iteration for thirty minutes. Similarly to the first iteration, this iteration occurred under the direct supervision of the main researcher and the completed toolkits were then either collected or photographed in case children wanted to return their work home.
The third iteration was performed with a class of twelve children (4 males and 8 females, Age=10.91, SD=0.64) from a private school in canton Vaud and under the supervision of their teacher. This iteration lasted 90 minutes, and scans of the completed participatory design toolkits were sent to us by the teacher.
In the second iteration, the question sheet was completed after the participants had designed the robot but before they created a story. In the third iteration, the question sheet was completed before the children designed the robot. This change was made intentionally based on observations from the second iteration, where it was noted that some children became blocked or stuck when answering the questions (more discussed in Section 3.4).

Figure 3.3: Setup of the second iteration of the participatory design during the ODE.

3.3 Results

3.3.1 Robot design

In this section, we present the findings regarding the robot's features. It is worth noting that this analysis was performed only on the data collected in the second and third iterations.

With regards to the robot's communication (Figure 3.4), the children from the second and third iterations yielded similar results. The ability to move was deemed the most vital method for a robot to communicate with its surroundings. After movements, sounds were considered as another significant means of communication by many children. Lastly, on average, facial expressions and lights received a score near the third and fourth positions. Concerning the way a robot could sense its surrounding (Figure 3.5), the children from both iterations agreed on the fact that vision is a key element for a robot to have. However, the results showed an opposite trend regarding the ability of a robot to sense using touch. While the children who participated in the second iteration (ODE) considered touch sensing as the least needed sense, the children who participated in the third iteration (in school) considered it to be as important as vision. Finally, on average, hearing obtained a score close to the second position, revealing it as an important, but not essential ability for a robot to have.
With respect to the emotions the robot should exhibit (Figure 3.6), children from both iterations converged towards similar results. Most children wanted their ideal robot to behave happily or emotionlessly, while anger was the least desired emotion. Several children mentioned other possibilities: sadness and the ability to exhibit variable emotions were the most represented among them.
Regarding the robot's shape (Figure 3.7), children who participated in the school iteration showed a clear preference for human-like forms which were represented by 66.6% of the votes. In contrast, most children who participated in the iteration during the ODE preferred zoomorphic robots (62.5% of the votes). For the material the robot should be made of, 84.2% of the children ask for their robot to be made from metal. Very few mentioned wood or plastic. Concerning the way the robot should move, legs and wheels were approximately equally mentioned with 57.9% and 36.8% of the votes, respectively. Children who participated in the school iteration showed a slight preference for legs (63.6% of the votes against 50% of the votes for the children who participated in the iteration during the ODE), which is coherent with their preference for humanoid robots. Only one child asked for an immobile robot. Finally, a lot of colours were mentioned by the children for their robot but the colours white and blue were the ones that stood out the most, with 26.9% of the votes each. Some of the robots designed by the children in the second and third iterations are presented in Figure 3.8.

3.3.2 Story design

In this section, we present the results regarding the created stories featuring robots and gender (in)equality. Examples of created stories are shown in Figures 3.11, 3.12, 3.13 and 3.14. This analysis does not consider the stories created by the children from the ODE iteration, as most of them were either unfinished or unrelated to the subject of gender inequality (more discussed in Section 3.4). One story has also been discarded because it did not include the robot.

The topics discussed in the stories about gender (in)equality were various. Among them, the most discussed was inequalities in sports, namely differences in visibility and viewers between men's and women's sports. This subject represented three of the eleven stories. Following inequalities in sports, two children focused their stories on the topic

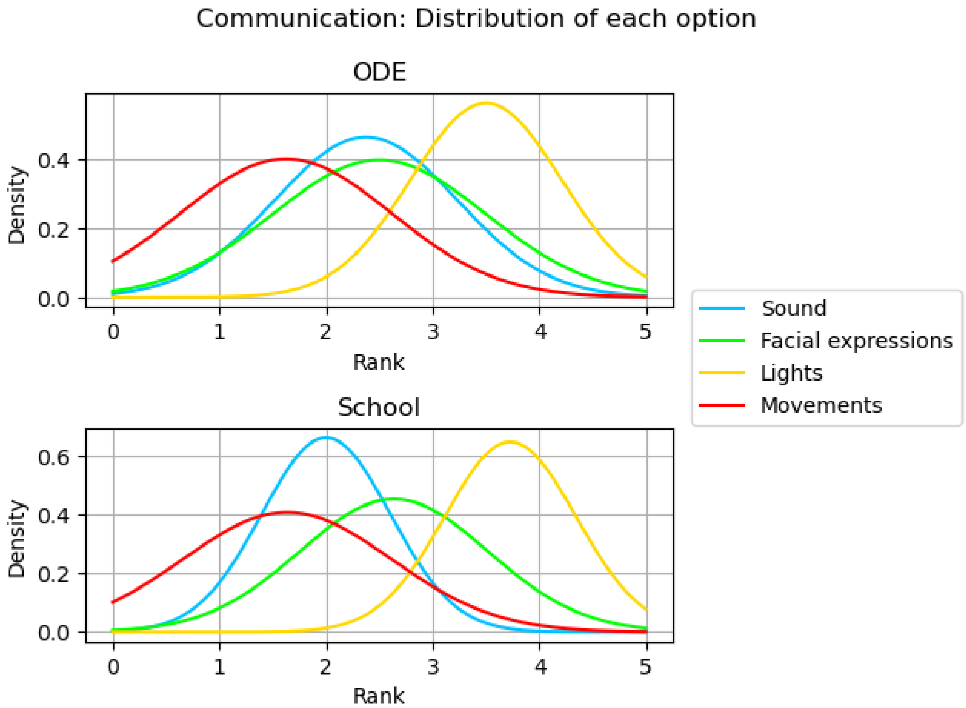


Figure 3.4: Communication: Distribution of each option.

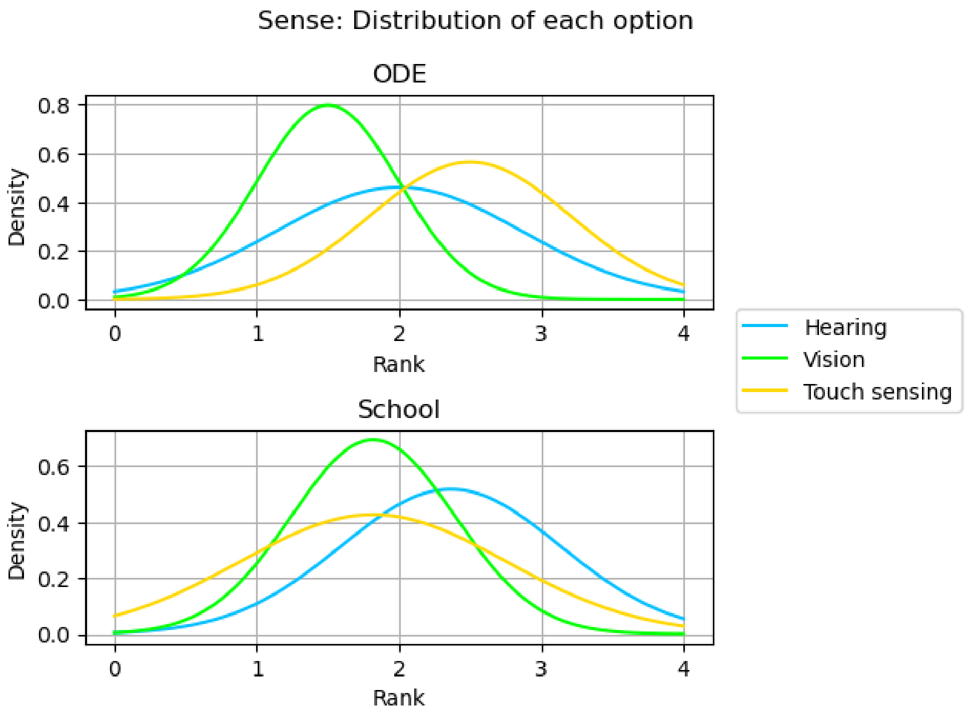


Figure 3.5: Sense: Distribution of each option.

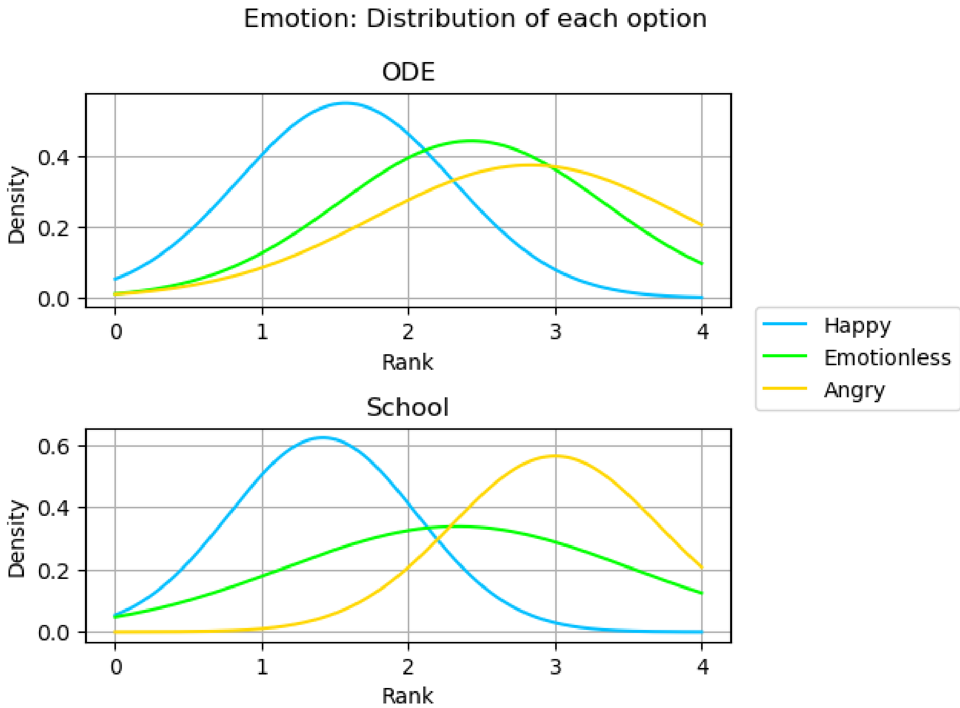


Figure 3.6: Emotion: Distribution of each option.

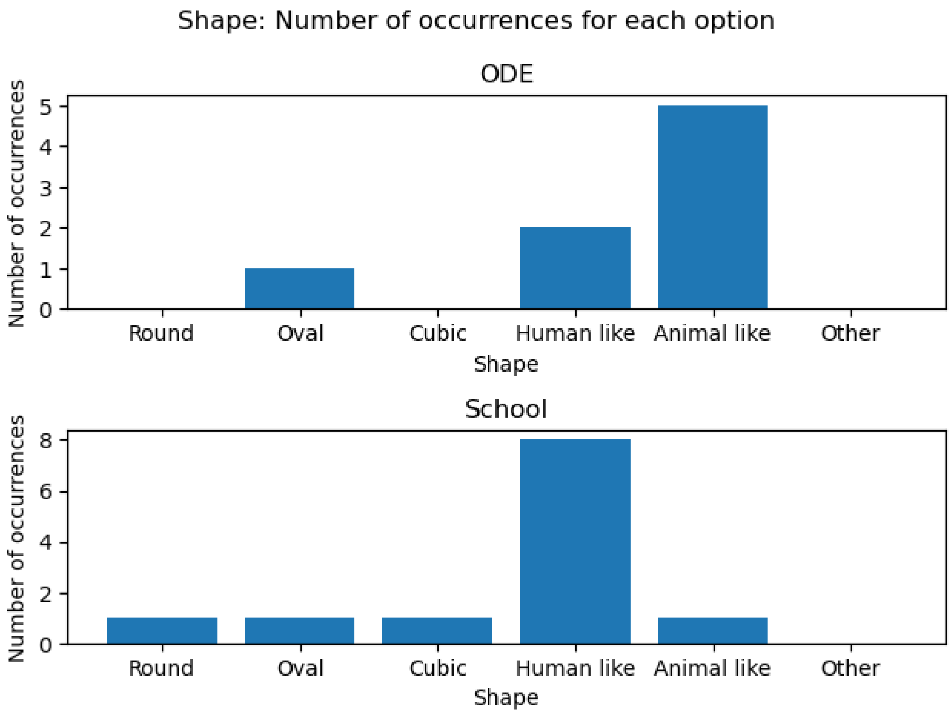
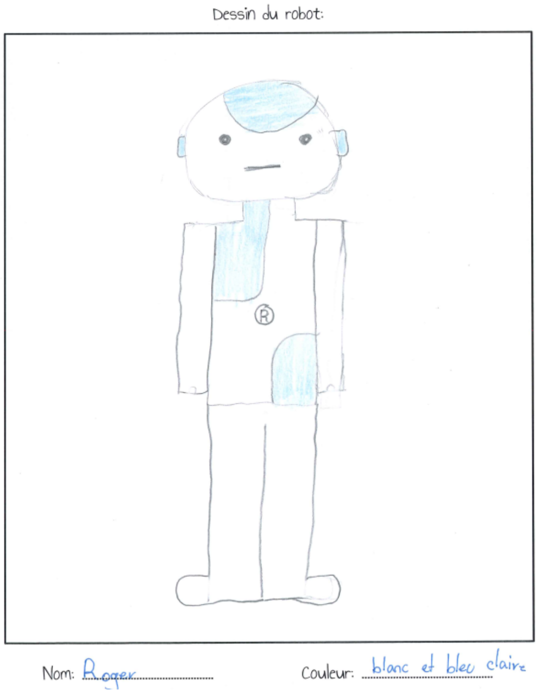
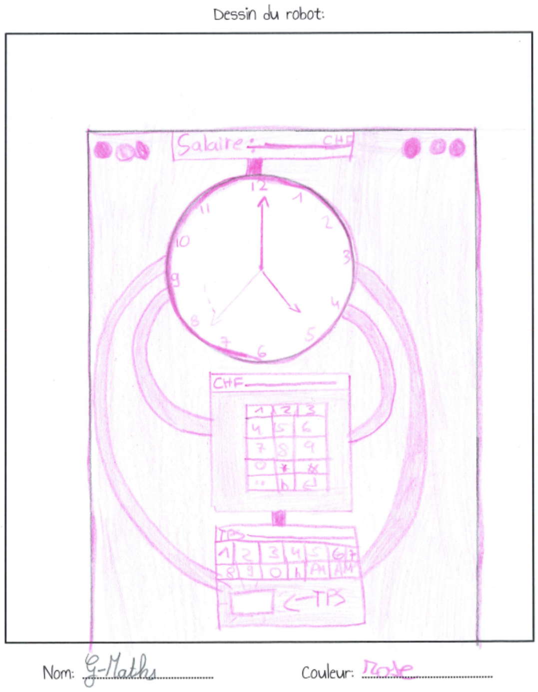


Figure 3.7: Shape: number of occurrences for each option.

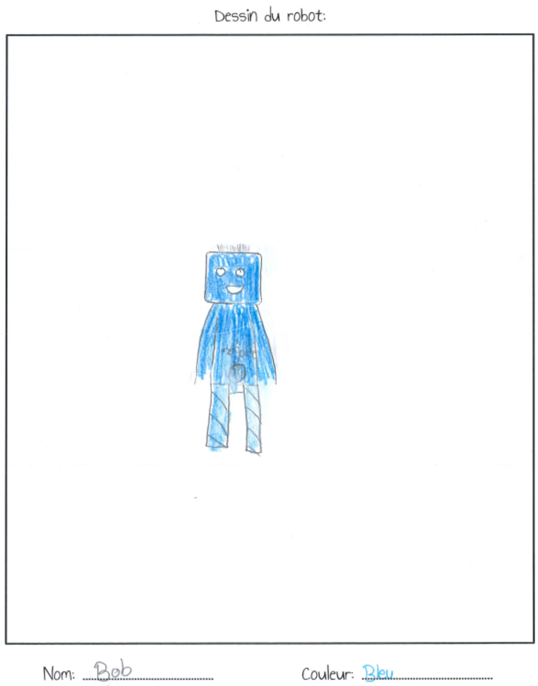


(a) Roger: humanoid-like robot.



(b) G-maths: machine-like immobile robot.

(c) Tika: zoomorphic robot.



(d) Bob: humanoid-like robot.

Figure 3.8: Examples of robot drawings from the participatory design iterations.

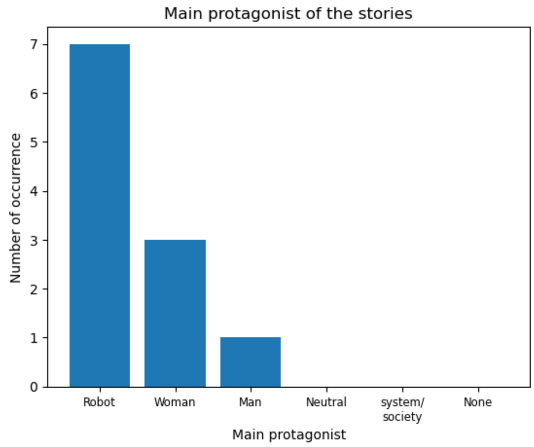
of salary inequalities. Other subjects tackled include inequalities in the sharing of house chores, unequal employees' distribution to specific jobs or unequal career opportunities. Concerning the location of the stories, workplaces were the most represented by being involved in five of the eleven stories. Three stories took place on a sport field, and two at home. Note that several children involved different locations in their stories. With respect to the time of the story, a majority of them happened in the present (six out of eleven), four took place in the future, and one in the past. Finally, out of the eleven stories, nine of them had the issue resolved, while the remaining two did not.

To further analyse the produced stories, we followed the approach proposed by Rubegni et al. [28], which is based on five lenses: *Role, Agency, Embodiment, Personality*, and *Emotion*. Below, we report the author's definitions of the first four lenses (the Emotion lens has been discarded because it requires the use of a software (LIWC[5]) whose free version does not support the french language, in which the stories have been written).

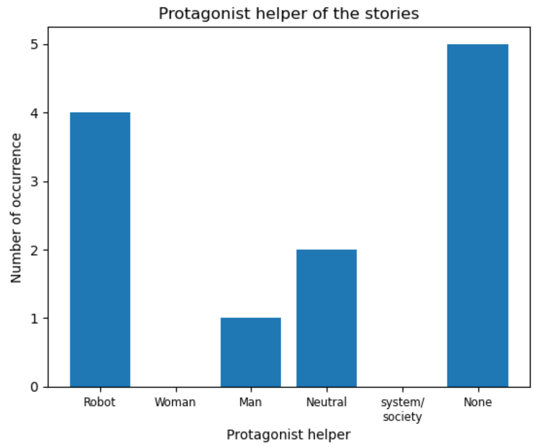
- **Role:** The Role lens aims at identifying the relationship between a character's gender and function according to the fairy tale functions proposed by Propp [29]: Protagonist, Antagonist, Antagonist Helper, Protagonist Helper, and Magic Object.
- **Agency:** The Agency lens focuses on understanding the level of characters' agency in the stories. This lens builds on considering agency as "the human capability to influence one's functioning and the course of events by one's actions" [30].
- **Embodiment:** The embodiment lens aims at analysing how characters are described and represented through multiple formats in the story. Specifically, it focuses on analysing the physical aspect of the characters represented in both pictorial and textual ways.
- **Personality:** The personality lens is about descriptions of attitude and morality [31]: data are collected on the basis of the adjectives used to describe characters' actions and beliefs.

Concerning the Role lens, some of the roles defined by Rubegni et al [28] did not apply in our case which led us to use a different classification. The magic object role has been removed because this role did not intervene in the created stories. Similarly, we removed the antagonist helper role for not intervening in the stories. Indeed, in all of the stories, the antagonist role was represented by one or several persons but was never helped in promoting the problem discussed. Finally, the role *Protagonist being helped* has been added to the roles considered. We thus make a clear distinction between the protagonist, which we consider to be the main protagonist of the story, the protagonist helpers who help the main protagonist in achieving their goal and the protagonists being helped, which are usually the ones being defended by the main protagonist.
The results of the Role lens analysis are shown in Figure 3.9. The first observation that can be made is that the robots were always envisioned by the children as the main protagonist or as a protagonist helper but never as a protagonist being helped or as an antagonist. This finding suggests that children see the robot as a strong and positive figure whose role is to

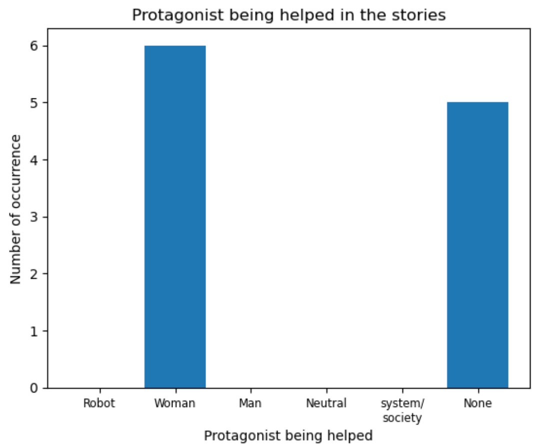
[5] `https://www.liwc.app/`



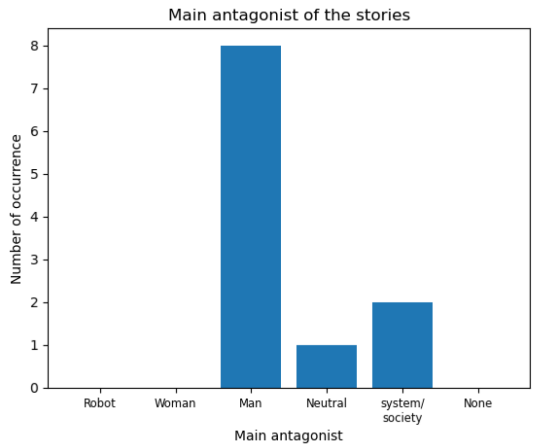
(a) Main protagonists of the stories.



(b) Protagonist helpers of the stories.



(c) Protagonists being helped in the stories.



(d) Main antagonists of the stories.

Figure 3.9: Role lens: the relationship between a character's gender and its function in the stories devised by the children. Note: Neutral refers to a character whose gender could not be identified.

help humans in solving problems and not the other way around. Women were mostly represented as protagonists being helped, while men mostly played the role of antagonists. This finding informs us that children envision gender inequality as a problem mainly caused by men and mostly affecting women. It is worth mentioning that 100% of the protagonists being helped were women, and none of them were men, showing that children are probably unaware that men can also be affected by gender inequality. Finally, some children did not represent the antagonist of their story as a single individual but rather as a societal problem which required societal changes to be solved.

Concerning the Agency lens, we followed the same coding as the one used by Rubegni et al. [28] i.e. by attributing to each character a level of agency described by a number between 1 (low) and 3 (high). For instance, the character resolving the main problem of the story would receive a score of 3, while a character exhibiting a passive behaviour during the whole story would receive a score of 1 [28].

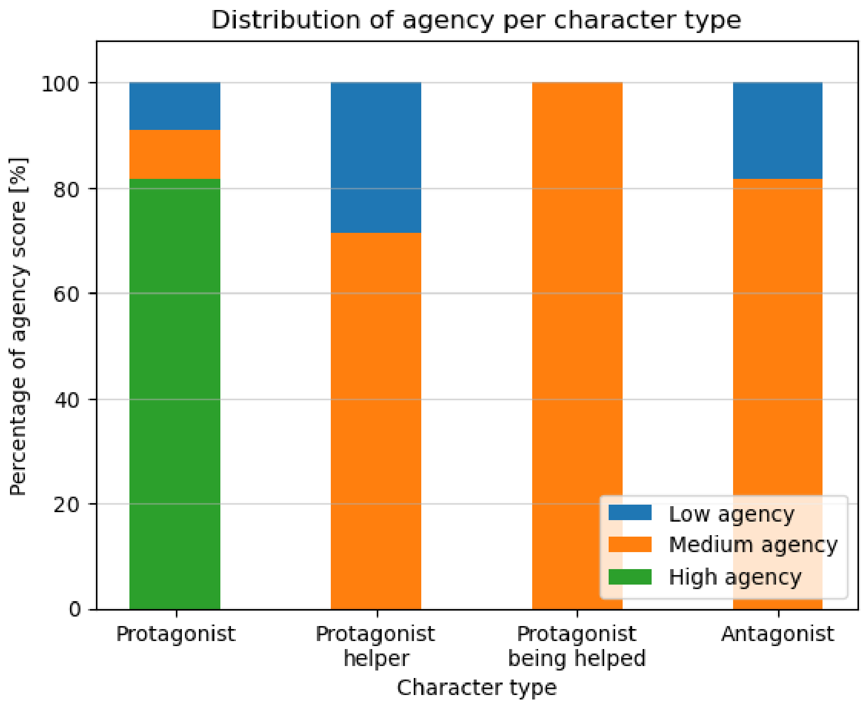


Figure 3.10: Distribution of agency per character type.

The results of the Agency lens are shown in Figure 3.10. Among the main protagonists, 81.8% obtained a score of 3 for successfully solving the main problem. One of the stories featured as main protagonist a robot that did not manage to solve the problem but actively tried to solve it. A score of 2 was therefore given to it. Only one story mentioned a main protagonist who did not manage to solve the problem and who put no particular effort into solving it. This character was therefore given a score of 1. Among the protagonist helpers, 71.4% were given a score of 2 for successfully providing their help to the main protagonist. A score of 1 was given to two protagonist helpers for their passiveness and inability to provide assistance to the main protagonist. Concerning the antagonists, 81.8% were attributed a score of 2. The antagonists were usually active and directing the plot of the story. For the two stories which described the antagonist as a societal problem, a score of 1 was given. Finally, 100% of the protagonists being helped received a score of 2. Similarly to the antagonists, these characters were usually active and directing the story's plot, but were not the ones that would make the story move to the next level as the main protagonist would do, so a score of 2 was given to them.

Regarding the coding of the Embodiment lens, the same approach as the one proposed by Rubegni et al. [28] was used i.e., we used the textual and pictorial formats of the stories to analyse how the characters were described. We noticed however that, in all the stories, the textual format always focused on describing the different events of the stories rather than the embodiment of the characters. Therefore, only the pictorial format was actually used. To make the distinction between neutral and gendered characters, we tried to find cues which are generally assigned to a specific gender. For example, women drawn with long hair and a skirt and men drawn with short hair and pants were considered gendered-

looking characters. On the other hand, characters for which the distinction between men and women could not be made were considered neutral-looking characters.
Based on these criteria, eight out of the eleven stories represented men and women with a clear gendered look, while the distinction between men and women could not be established among all the characters of three of the stories. Concerning the robot's embodiment, an opposite trend could be observed, nine out of the eleven robots were represented with a neutral look, and two were represented with gendered cues, mainly male.

For the Personality lens, Rubegni et al. [28] base their analysis on the adjectives used to describe characters' actions and beliefs. However, similarly to the embodiment lens, the textual format was mainly used by the children as a way to describe the different events occurring in their stories and very few adjectives concerning the characters' personality were mentioned. We thus provide a qualitative analysis not only based on the adjectives provided but also on the characters' way of behaving in the stories.
Most of the time, the robot characters were described as enthusiastic and proactive in resolving the stories' problems. For instance, an adjective that has been used to this extent was "determined". The robots were also usually shown as calm characters favouring discussion over violence. Women exhibited similar behaviour but were also more expressive by showing their discontent when they faced inequalities and contentment when these were resolved. Two stories qualified women to be serious and hardworking, and one story showed a woman to be smart, independent and persevering. On the other hand, men were often the ones initiating the inequalities and were negatively described in several stories. For instance, one story used the adjective "jealous", while another used the word "mocking". Two stories also described men to be lazy. Although men were often the ones initiating the inequalities, several stories also represented them to be calm, listening and able to reflect on their mistakes regarding gender (in)equality. Finally, one story showed a man who firmly opposed gender inequalities.

3.4 Limitations and recommendations

In this section, we discuss some limitations encountered during the second and third iterations of the participatory design. We also summarize recommendations provided by the teacher who autonomously supervised the third iteration, during the interview that took place after that session.

As introduced in Section 3.3.2, most children that participated in the ODE iteration did not work on or finish the story creation part. The most likely explanation is the short amount of time at our disposal to conduct the activity, which was bound to 30 minutes. On the other hand, the iteration carried out in school was performed in 90 minutes. All the participants managed to complete the story creation part using the textual format, but not all of them finished the pictorial format of the story. The teacher thus deemed the period of 90 minutes to be limited and recommended a duration of 120 minutes for the participatory design activity. To account for the long duration of the activity, a break in between two one-hour periods would also be favourable for the children to rest.
As already mentioned in Section 3.2, the questions sheet, which was originally designed to provide children with avenues of reflection for their stories, appeared to block them rather

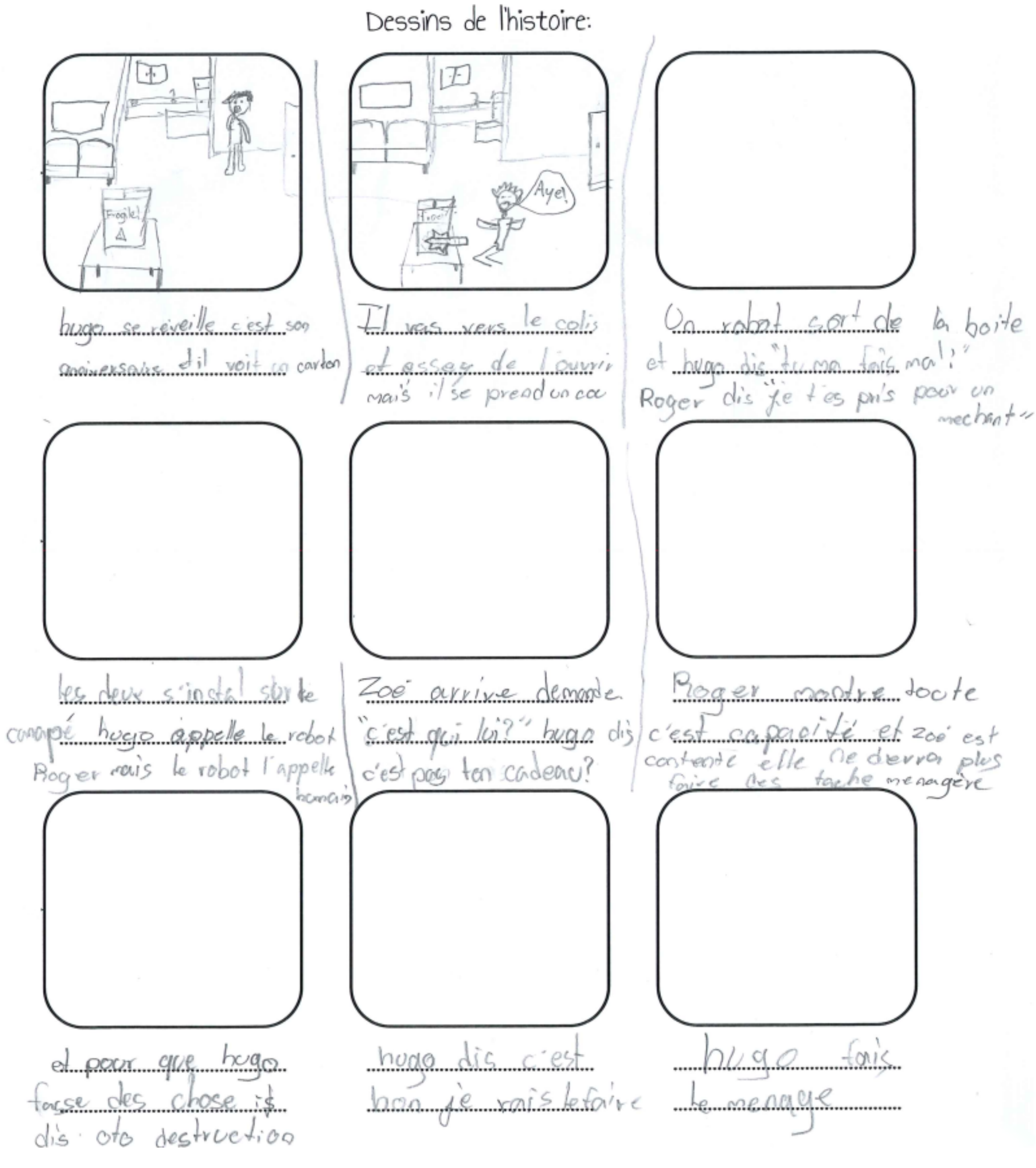


Figure 3.11: A story in which a robot intervenes to solve the unequal distribution of house chores between a man and a woman living together. Note that the child who created the story managed to finish the textual format but not the pictorial format of the story (more discussed in Section 3.4).

Figure 3.12: A robot-based story discussing salary inequalities among the employees of a ski resort. The robot acts as a protagonist helper and helps in computing salaries equally.

Figure 3.13: A robot-based story in which the main protagonist is refused to become an astronaut because of her gender. The robot acts as a protagonist helper and helps the main protagonist in building a rocket to go to the moon.

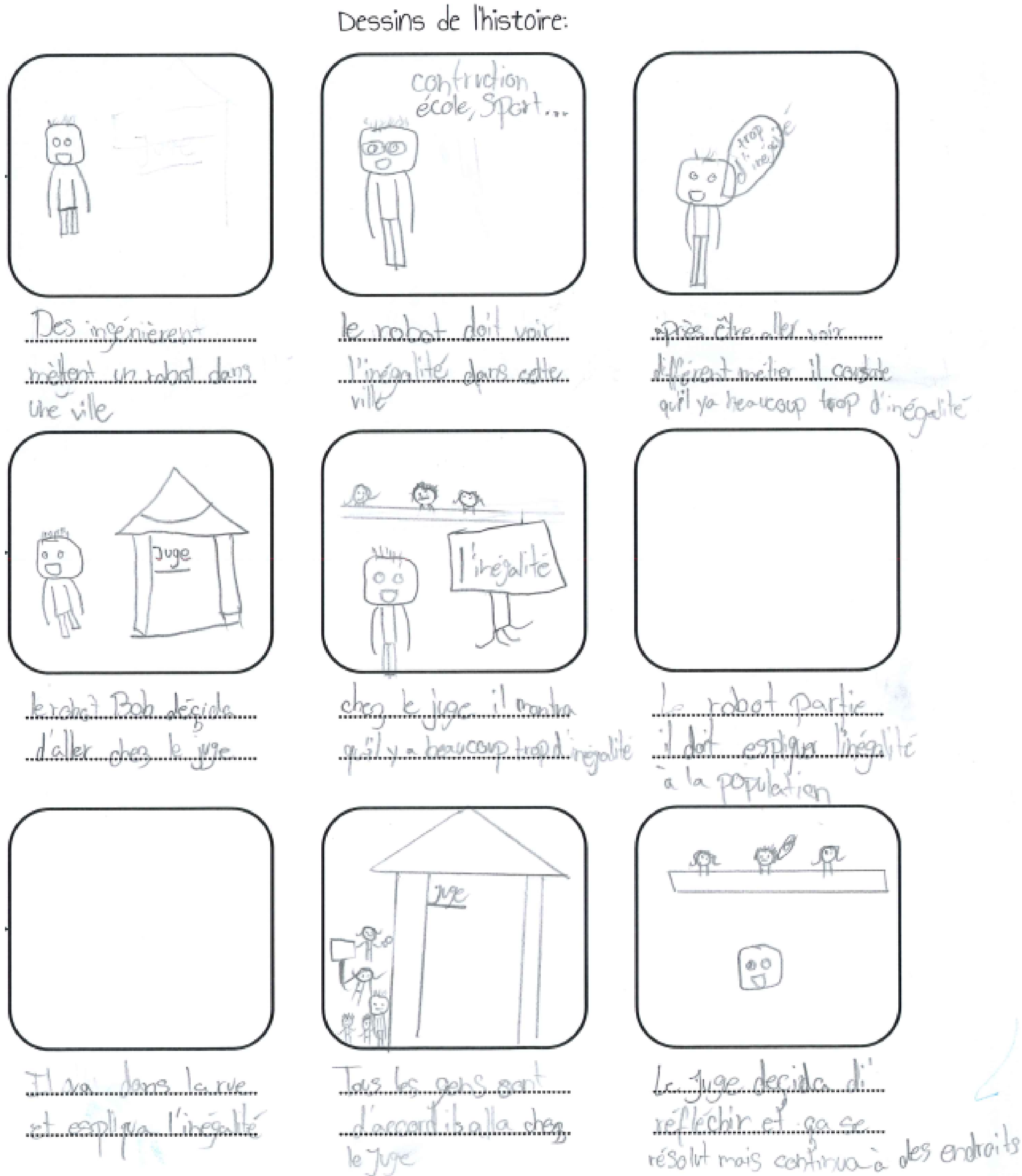


Figure 3.14: A story in which a robot has to analyse the gender-based inequalities present in a city, and report to a judge to help him create new laws that will solve these inequalities.

than guide them and could be a second factor explaining why the children who participated in the ODE iteration did not finish their stories. This undesired effect has also been observed during the iteration conducted in school. Rather than asking questions to children, the teacher suggested presenting them with real and current cases, which could even be complemented with quantifiable examples (e.g. taking the form of a difference in salary, or number of spectators). Similarly to the questions sheet, these examples would provide the children with avenues of reflection without appearing as an additional workload to be completed to progress in the activity.

4 Robotic platform and learning activity

4.1 Robotic platform

In this section, we present the design of the robot[6], and how it has been shaped by the participatory design discussed in Section 3.

4.1.1 Mechanical design

The first element taken into consideration for the design of the robot was its overall shape. As discussed in Section 3.3.1, children who participated in the school experiment showed a clear preference for human-like forms while most children who participated in the experiment during the ODE preferred zoomorphic robots. To consider both these preferences, we designed a robot whose overall shape is the one of a humanoid, but which also features some animal characteristics, such as antennae.

With regard to the robot's communication, the participatory design approach informed us that the children deemed the ability to move to be the most vital method for a robot to communicate. In this regard, we chose to motorize the robot's arms and antennae. Following movements, sounds and facial expressions were also considered to be important features for a robot to have. To this end, we designed the robot's torso to incorporate a speaker, and the robot's head to incorporate an LCD (Liquid-Crystal Display) that would act as the robot's face. We did not consider using light as a means of communication for the robot, as it was the least desired feature according to children.

Concerning the robot's mobility, children showed a slight preference for legs over wheels which fitted nicely with the initial choice of giving the robot a humanoid shape. However, unlike the arms and antennae, we decided not to motorise the legs as making the robot dynamically stable would have added a lot of complexity. To give the robot some semblance of walking ability, we decided to use the motorisation of the arms to perform a walking gesture.

With respect to the robot's ability to sense its surrounding, vision was considered the most important, while hearing was deemed important but not as much as vision. Concerning touch sensing, the opinions were quite mixed. Some children considered it as important as vision, while others considered it the least needed sense. For the sake of design simplicity, we made the choice to provide the robot with touch sensing only. The main motivation for not considering hearing as a robot feature is based on the shortcomings of available libraries to provide consistent accuracy in speech recognition [32] and which could be a possible factor negatively affecting human-robot interaction [33]. Regarding vision, the algorithms used in the field of HRI (features, face and gaze recognition) are usually computationally intensive, which makes them difficult to integrate into low-cost embedded systems. On the other hand, touch sensing can be achieved very easily through the use of simple hardware such as buttons. Buttons are typically interfaced with hardware having limited computing power, like microcontrollers, and their complexity is minimum compared to computer-vision-based algorithms. Buttons also offer an interactive way for a child to communicate with the robot. The robot's torso has thus been designed to incorporate two buttons.

[6] Github repository: `https://github.com/RomainMaure/PixelBot`

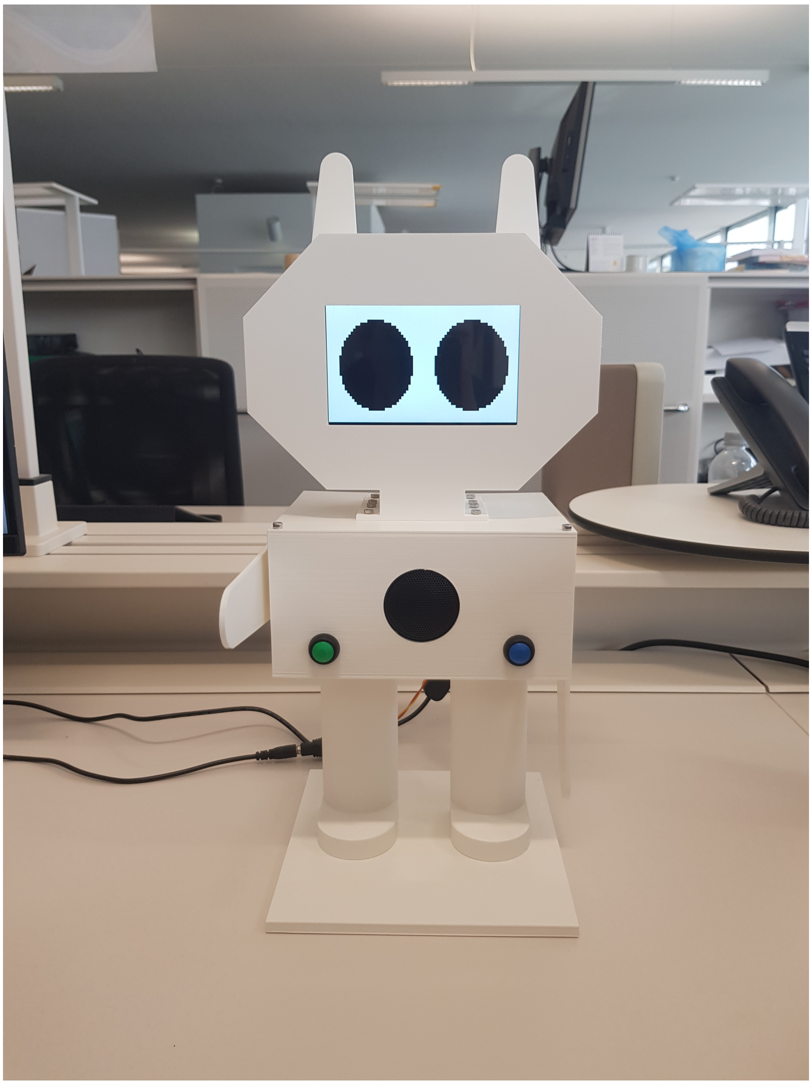


Figure 4.1: PixelBot: the robot co-designed with and for children.

Regarding the material the robot should be made of, children expressed a clear preference for metal. However, we chose to use plastic over metal for several reasons. The main motivation is that plastic can leverage fabrication technologies such as 3D printing. 3D printing allows for rapid prototyping and has the advantage of being very accessible. Additionally, plastic is cheaper than metal, which contributes to the development of low-cost technologies. Finally, 3D printing offers the possibility to use plastic filaments of various colours, which was an important aspect in our case. On this note, the robot has been completely printed using white filament, as it was one of the most mentioned colours by the children. The developed robot is shown in Figure 4.1.

4.1.2 Electronic design

The brain of the robot is a Raspberry Pi 4 (model B with 8 GB of RAM)[7]. A Raspberry Pi is a small, low-cost, single-board computer which has been initially designed to promote

[7] https://www.raspberrypi.com/products/raspberry-pi-4-model-b/

the teaching of basic computer science in schools and which is now increasingly being used in robotics. Similarly to an ordinary computer, a Raspberry Pi has a wide range of peripherals and connectivity options, including USB, Ethernet, and HDMI ports, as well as support for Bluetooth and WiFi. Additionally, a Raspberry Pi features a set of forty General Purpose Input/Output (GPIO) pins that provide a programmable interface between the Raspberry Pi and external devices. These pins can be configured as either input or output pins, allowing the Raspberry Pi to send or receive signals to and from other devices.
In our specific case, the two buttons of the robot were connected through the GPIO pins of the Raspberry Pi, which were configured as input to read the buttons' state. The buttons used were push-pull buttons. A push-pull button is a momentary switch i.e. it only stays "on" as long as it is pressed and returns to the "off" state when it is released.
Concerning the motorization of the arms and antennae, four servo motors were used. A servo motor is a type of motor characterised by precise control of position. We chose to use SG90 servo motors[8] for being cheap, widespread and easy to control. A Raspberry Pi, however, is generally unable to control more than two motors of this kind due to its inability to provide them with enough current. We thus used a PCA9685[9] which is a very common integrated circuit that can control up to sixteen servo motors simultaneously when powered by an external power supply. The PCA9685 was connected through the GPIO pins of the Raspberry Pi and would generate appropriate motor commands after receiving the desired motors' position through the Raspberry Pi's I2C interface.
Concerning the robot's face and ability to display facial emotions, we used a 5" LCD. We connected it to one of the HDMI ports of the Raspberry Pi and powered it with one of the Raspberry Pi's USB ports. Similarly, we used a speaker to provide the robot with the ability to speak. We connected it to the Raspberry Pi's audio jack and powered it with another USB port. The complete circuit schematic is shown in Figure 4.2.

4.1.3 Software architecture

Concerning the software environment, we decided to use Ubuntu instead of Raspberry Pi OS, the default and optimized operating system for a Raspberry Pi. This choice is motivated by our intention to use ROS2[10] (Robot Operating System), which is a de facto standard middleware for building robotic applications, allowing programming a robot using concurrent processes which can communicate with each other. ROS2 also provides package management, which promotes code modularity, sharing and reusability. While ROS2 is provided with a tier-1 support on Ubuntu, Debian-based distributions such as Raspberry Pi OS only receive a tier-3 support. Finally, the latest version of Ubuntu (22.04) has been optimized to work on Raspberry Pi, which takes away the main advantage of Raspberry Pi OS over previous versions of Ubuntu.

The architecture of PixelBot's ROS2 packages can be divided into three levels (Figure 4.3). At the lowest level, the *PixelBot msgs* package defines custom ROS2 messages and service headers to mediate the communication between the nodes of the higher-level

[8] `https://www.towerpro.com.tw/product/sg90-7/`
[9] `https://www.adafruit.com/product/815`
[10] `https://docs.ros.org/en/humble/index.html`

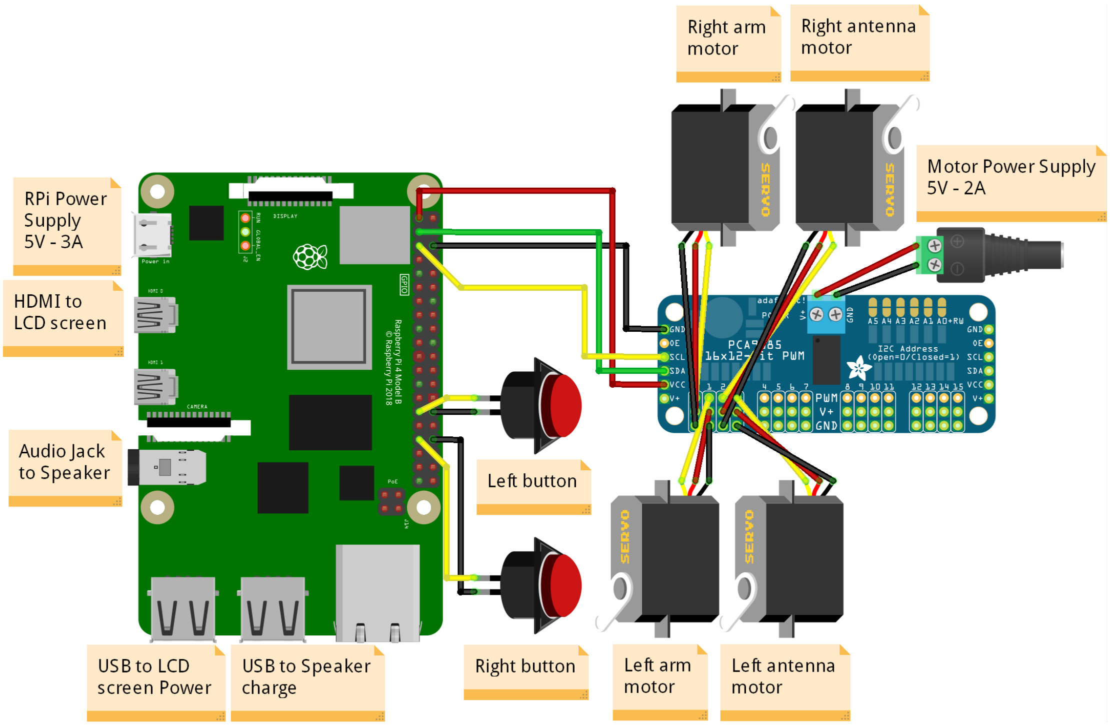


Figure 4.2: Wiring diagram of PixelBot's electronic.

packages.
On the intermediate level, each package interfaces with an element of the robot's hardware and provides a set of services related to it. The *PixelBot Display* package interfaces with the robot's LCD and offers an animated face feature. The package's node consistently displays blinking eyes and offers a service for the robot to express emotions such as happiness, anger, sadness, and surprise. Another service allows to display any given image on the robot's screen. The animations are created using Pygame[11], a Python library for designing video games, and all images used are self-made using an open-source pixel-art software[12].
The *PixelBot Motors* package interfaces with the PCA9685 to control the motors. Its node provides a low-level service allowing to move a set of given motors to a set of desired positions. It also provides high-level services performing gestures. Two services use the arms to perform, respectively, a walking gesture and a hand-waving gesture. Another service uses the antennae to perform gestures complementing the robot's emotions described above.
The *PixelBot Audio* package interfaces with the robot's speaker and allows the robot to speak. It is mainly achieved through text-to-speech (TTS) libraries such as pyttsx3 and gTTS. The package also uses a diode ring synthesizer which we developed during a previous project, and which allows distorting the TTS output to make the robot's voice sound more "robotic".
Finally, at the highest level, the *PixelBot Interaction* package uses the functionalities pro-

[11] `https://www.pygame.org/news`
[12] `https://github.com/Orama-Interactive/Pixelorama`

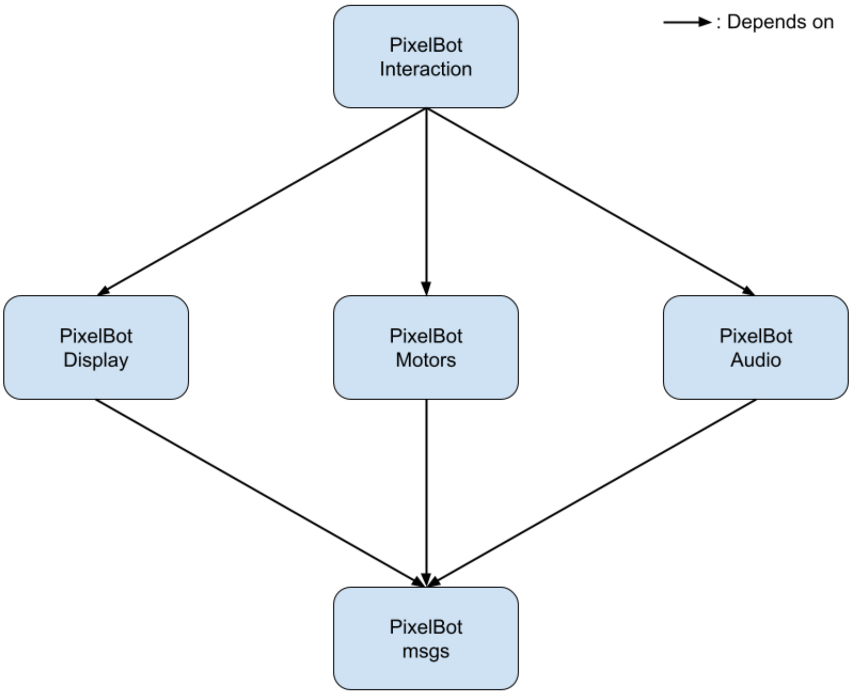


Figure 4.3: Architecture of PixelBot's ROS2 packages.

vided by the intermediate-level packages and implements the robot-based learning activity aiming at raising awareness of gender inequality among children (more discussed in Section 4.2). It is worth mentioning that the robot's buttons were directly interfaced in the *PixelBot Interaction* node, and unlike for the other hardware devices, no specific packages have been developed to interface with them.

4.2 Robot-based learning activity

The robot-based learning activity follows an interactive storytelling approach inspired by four stories created during the participatory design iteration conducted in school. We summarize these stories below:

- **Unequal house chores distribution story:** Alice and Hugo live together in a flat. However, Alice does all the house chores and is not helped by Hugo. The robot Roger (shown in Figure 3.8a) intervenes to promote an equal sharing of household tasks (Figure 3.11).
- **Unequal salary story:** In a ski resort, several men and women work as lifeguards. However, men are paid more than women. The robot G-maths (shown in Figure 3.8b) intervenes to compute salaries equally (Figure 3.12).
- **Unequal career opportunity story:** Marie is a female engineer who dreams of becoming an astronaut. She goes to the NASA, but she is not accepted as an astronaut

because of her gender. Marie, with the help of her robot named Tika (shown in Figure 3.8c), builds a rocket and goes to the moon by herself (Figure 3.13).

- **Gender inequalities observation story:** The robot Bob (shown in Figure 3.8d) is tasked to observe the different gender-based inequalities present in a city. After doing so, the robot reports these to a judge to help him create new laws aiming at solving the inequalities (Figure 3.14).

The main plot of the developed storytelling activity is based on the fourth story. PixelBot narrates the story in first-person perspective, as the robot that has been tasked to observe the gender inequalities present in a city and report those to a judge to help him create new laws promoting gender equality. The story then implements a mise en abyme (i.e., the technique of inserting a story within a story, as done for example in the "One Thousand and One nights" tale). On his journey, PixelBot visits three places and unveils the gender inequalities happening therein, which corresponds to the situations described by the first three stories listed above. PixelBot first visits Hugo and Alice and observes a case of gender inequality happening in the private sphere: an unequal sharing of house chores. PixelBot then visits the ski resort where the salaries given to the male and female employees are unequal. Finally, before returning to the judge, PixelBot visits the NASA and meets Marie, which is confronting a case of unequal career opportunity because of her gender. It is interesting to mention that the robot, as a non-human being, acts as an impartial observer and brings in a perspective that no person could as believably bring.

The first three stories were selected as they highlight distinct instances of gender inequality, providing the children with a broad overview of the existing and current gender inequalities in our society. The storytelling activity and robot characteristics and capabilities were concurrently refined to ensure they align with each other. The robot tells its story via its speaker, and its motion capabilities are used to make the storytelling more lively and engaging. For instance, at the story's beginning, the robot performs a greeting gesture with its arms when presenting itself and the mission it has been given. When moving from one place to another, the robot uses its arms to mimic a walking gesture. When confronting a case of gender inequality, the robot exhibits emotions using its LCD and antennae. Initially, in the developed activity, after describing a case of gender inequality, the robot would ask the children to discuss and give their opinion with respect to the fairness of the situation. To answer, the children would use the buttons on the robot's torso.

The developed activity was first tested informally with the teacher only, resulting in several adjustments. We first noticed that the activity was progressing too slowly, which could cause children to lose focus. The processes of asking questions and explaining which buttons corresponded to which answers were slow and repetitive. Instead of giving this task to the robot, we decided to let the teacher ask the questions and lead the discussions. The role of the robot would resume at telling the story and receiving the children's answers to the teacher's questions.
The second major refinement concerned the impact of the children's answers on the course of the story. Initially, at the end of the story, we would ask the children to propose and present to the judge solutions which could resolve the different cases of gender inequality encountered. However, these solutions did not impact the story's course, reducing the

role-playing aspect of the activity initially envisioned and described in Section 3.1. Instead of asking for possible solutions at the end of the story, we chose to let the teacher ask them during the discussions occurring right after the description of each case of gender inequality. The teacher would suggest two options for the robot to solve each situation, which would consistently be either talking to the protagonist or talking to the antagonist. The robot would consider the solution chosen by the children and adjust the scenario slightly, giving the children a sense of the significance of their answer. It is worth mentioning that there were no correct or wrong answers, each solution proposed by the teacher would lead to the resolution of the situation. The refined story script can be found in Annex C.

5 Experimental Evaluation

5.1 Participants

The co-designed robot and robot-based learning activity were tested in two different iterations. Both of them took place in the same school where the third iteration of the participatory design was carried out. They were led by the same teacher, while the researcher observed but did not actively participate in the activity. To avoid any bias, different children from the ones who participated in the third iteration of the participatory design were involved. The first iteration involved seven children (4 males and 3 females, Age=9.57, SD=0.49) and lasted approximately 18 minutes (Figure 5.1). Due to seasonal flu and holidays, the second iteration was conducted with only one child (female, age=9) and lasted approximately 11 minutes. Audio recordings were collected during the iterations, which were then transcribed and anonymized[13] (See Annexes D.1 and D.2). The results of their analysis are discussed in Section 5.2.1. Finally, children who participated in the first iteration also completed the Godspeed questionnaire [34] about their perception of the PixelBot robot, whose results are presented in Section 5.2.2.

5.2 Results

5.2.1 Robot-based learning activity

In this section, we present the results related to the robot-based learning activity.

We start by defining what we consider to be a *comment*. A comment corresponds to a child's intervention. The most common representation of a comment is the utterance of a sentence from a child. We also consider a response provided by a child in the form of a mimic (such as a head movement to express agreement or disagreement) or an onomatopoeia as a comment. However, an onomatopoeia showing that a child is thinking ("hummm...") is not considered to be a comment. We also only take into account individual comments i.e. comments involving several children simultaneously were not taken into account, in particular due to the difficulty to identify, from the audio recording, who is speaking and who is not.

Based on the above definition, the children who participated in the first iteration made 68 comments, while the teacher made 79. It is worth noting that every child participated by making at least one comment, indicating their involvement in the activity. The average number of comments of the children was 9.71 (SD=5.72). Girls made slightly more comments than boys. On average, the girls made 11.0 (SD=5.66) comments, while the boys made 8.75 (SD=5.58) comments. In the second iteration, 30 comments came from the only child participating, while 36 came from the teacher.

We then analysed the number of *on-topic* comments with respect to the number of *off-topic* comments. A comment that pertains to the activity or is related to it in some way

[13] Ethical approval for this study was granted by the EPFL Human Research Ethics Committee (HREC) via decision HREC No: 082-2022.

Figure 5.1: Setup of the first iteration evaluating the co-designed robot and robot-based learning activity for raising awareness about gender (in)equality.

is considered on-topic. On the other hand, a comment that has no connection to the activity, such as "Can I go to the toilet?" would be classified as off-topic. In both iterations, 100% of the comments were on-topic, which again suggests the activity was considered engaging by the children. During the first iteration, however, there was one instance where two children started to whisper to each other, which caused the teacher to remind them to focus. As we could not identify the subject of their conversation, we could not evaluate if their comments were on-topic or off-topic and thus did not consider them for the count reported above.

We also analysed the number of comments *about gender equality (GE)* with respect to the number of comments *not about gender equality*. Below, we define what is considered to be a comment about GE and the different classes among this type of comment:

- **Description:** A comment describing a case of gender (in)equality, either the ones described in the storytelling activity or others.
- **Solution:** A comment providing a solution to a case of gender inequality.
- **Emotion:** A comment expressing an emotion about the topic of gender (in)equality.
- **Agreement/Disagreement:** A comment expressing an agreement or disagreement with another child on the topic of gender (in)equality.
- **Answer:** A comment answering a teacher's question related to the topic of gender (in)equality.

We argue that making a comment of the types listed above implies that the child engaged in a moment of reflection over an aspect of gender (in)equality (e.g. ways in which it can manifest, possible solutions, effects it has on the people affected by it...) and thus contributes to raising their awareness about it. Conversely, we define below what is a comment not about GE:

- A general assessment not related to gender (in)equality (e.g. "It's hard to find a job").
- A comment expressing an emotion not related to gender (in)equality (e.g. "I'm afraid of black holes, I don't like them.").
- A comment expressing an agreement or disagreement with another child on something unrelated to gender (in)equality.
- A comment related to the activity but not specific to gender (in)equality (e.g. "Can I press the robot's button?").
- A comment from a child who has no opinion on the topic/question (e.g. "Humm, I don't know").

Based on the above definition, 86.8% of the comments made by the children who participated in the first iteration were about GE. The comments made by the girls were slightly more related to GE than the ones made by the boys: 90.9% for the girls against 82.9% for the boys. Finally, 100% of the comments made by the child who participated in the second iteration were about GE.

The distribution of comments about GE over their classes was also analyzed and is provided in Figures 5.2 and 5.3. In the first iteration, the most represented comments were comments providing a solution to a case of gender inequality and comments answering the teacher's questions, which is not surprising considering the young age of the participants (9-10). In the second iteration, the most represented comments were comments answering the teacher's questions. These results indicate the involvement of the children in the activity: they actively answered the teacher's questions and were motivated to help the robot solve the cases of gender inequality. It is worth noting that, for the first iteration, the proportion of these two classes of comments was similar between boys and girls. The three other classes (Description, Emotion and Agreement/Disagreement) were more unbalanced. Girls made twice as many comments belonging to the Emotion class as boys, which in a way, goes with the stereotype that women are more emotional and sensitive than men [35]. On the other hand, boys made more comments belonging to the Description and Agreement/Disagreement classes than girls. It is worth mentioning that all comments belonging to the Agreement/Disagreement class were, in fact, only disagreements. There were as many disagreements between two boys as between a boy and a girl.

We also analysed the choices taken by the children to solve the cases of gender inequality that the robot confronts. In the first iteration, the children suggested the robot to speak to the antagonist in two of the three presented stories (the unequal house chores distribution story and the unequal career opportunity story). In the second iteration, the

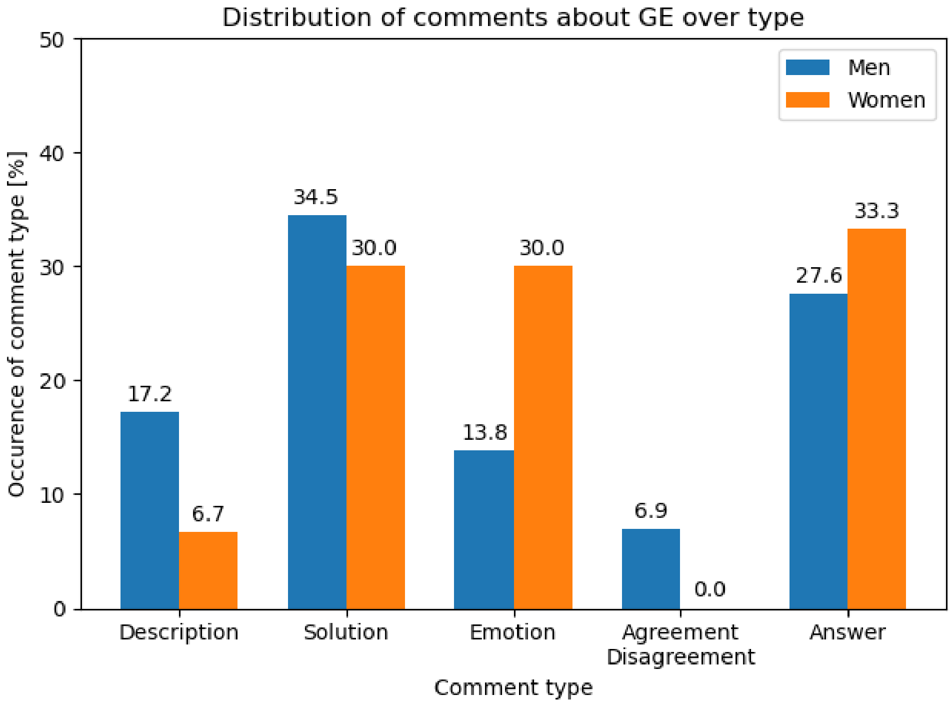


Figure 5.2: First iteration: distribution of comments about GE over their classes.

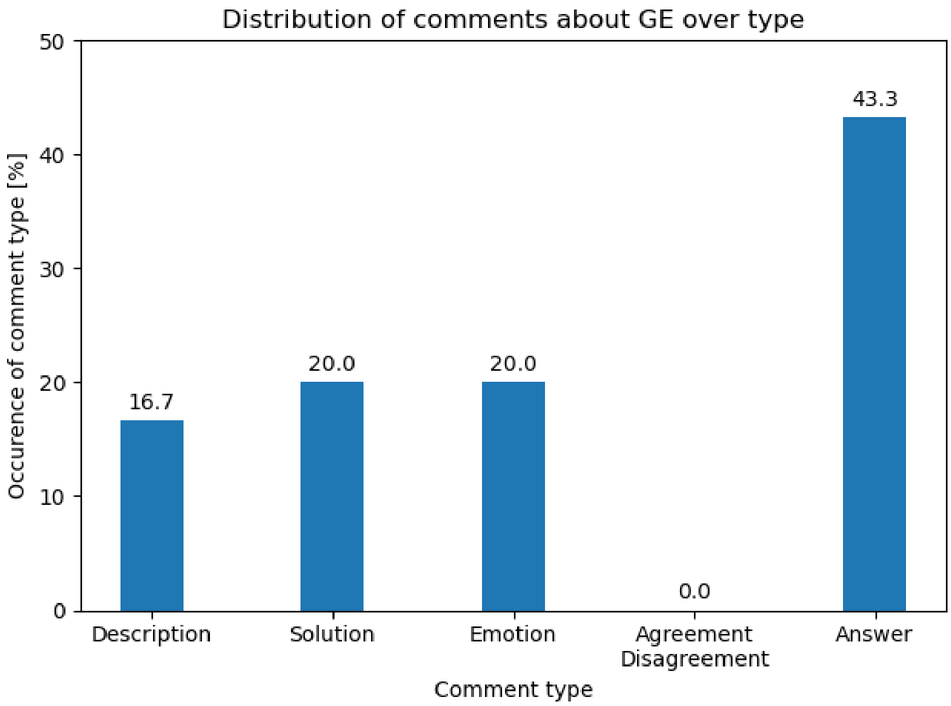


Figure 5.3: Second iteration: distribution of comments about GE over their classes.

child always asked for the robot to speak to the antagonist. We could hypothesise that, according to children, making the antagonist change his mind and behaviour is the most efficient way to solve a case of gender inequality.

Finally, a qualitative analysis has been performed on the comments about GE belonging to the Solution class with the aim of analysing the constructiveness of the solutions provided by the children. Concerning the case of the unequal distribution of household tasks, constructive comments promoted mutual help, sharing and discussion.

- *"The girl and the boy should be given tasks. Both of them."*
- *"We help each other."*
- *"Talk to them."*

On the other hand, the less constructive solutions would promote inaction or quarrel. Some of them might also reveal gender biases in the language spoken [36].

- *"I would do nothing."*
- *"We get angry."*
- *"We hire a cleaning lady."*

Concerning the case of salary inequality, the constructive comments promoted equality, sharing and discussion. In both experiments, the children did not make unconstructive comments about this case.

- *"They should be paid exactly the same, as they do exactly the same thing."*
- *"We share."*
- *"Speak to the director."*

Finally, the constructive comments about the case of unequal career opportunity promoted perseverance and revealing the unfairness of the situation. Similarly to the previous case, the children did not make any unconstructive comments.

- *"Humm, persevere."*
- *"We say that it's unfair."*

5.2.2 Co-designed robot

To evaluate how the children perceived the co-designed robot during the activity, we used the Godspeed questionnaire [34]. This questionnaire is a standardized measurement tool for Human-Robot Interaction (HRI) to assess people's perception of robots. It evaluates five concepts: anthropomorphism, animacy, likeability, perceived intelligence and perceived safety of a robot. Each of these concepts is measured using semantic differential scales [34]. Below, we define each robot aspect evaluated by the godspeed questionnaire:

- **Anthropomorphism:** Anthropomorphism refers to the attribution of a human form, human characteristics, or human behaviour to non-human things such as robots, computers, and animals [34].
- **Animacy:** Tendency of human users to consider the robot alive and to attribute intentions to it [37].
- **Likeability:** Tendency of human users to attribute desirable characteristics to a robot [37].
- **Perceived intelligence:** Tendency of human users to consider the behaviour of a robot intelligent [37].
- **Perceived Safety:** Perceived safety is a user's perception of the level of danger when interacting with a robot and the user's level of comfort during the interaction [34].

Only the children who participated in the first iteration filled out this questionnaire. The questionnaire was filed one week after the experiment took place, in class, and under the guidance of their teacher. On this day, two children were absent. Only five out of the seven children who initially participated in the activity have therefore filled it (3 males and 2 females, Age=9.4, SD=0.49). Finally, one child did not complete the last two parts of the questionnaire (perceived intelligence and perceived safety). The results concerning these two parts are therefore based on the perception of four children only.

For each child, the mean score of each robot aspect has been computed. We then averaged the mean scores of each robot aspect over all the children and computed the corresponding 95% confidence intervals (CI). The results are shown in Figure 5.4.
Anthropomorphism obtained an average score of 2.68 (CI=±1.0). A score near the midpoint (2.5) indicates that the children considered the robot halfway between human and non-human. This result is consistent with our initial intention to design a robot featuring both human (human shape with legs, arms, torso, etc) and animal (antennae) characteristics. As the obtained score is close to the desired one, we think that no particular changes should be made to the robot with regard to its anthropomorphism.
The average score for Animacy was 3.5 (CI=±0.49), which suggests that the children primarily viewed the robot as having animation, rather than being inanimate. We believe this result to be consistent with the way the robot-based learning activity was carried out. When the story was being told, the robot used a combination of speech, arm and antennae movements and facial expressions, giving it a lively appearance. However, when the activity would shift to a discussion between the teacher and his students, the robot would act rather passively by waiting for one of its buttons to be pressed, rendering it mostly inanimate. From our point of view, it is crucial for the robot to remain unobtrusive during discussion periods. These interactions between the students and their teacher are crucial, and the robot should not distract the students during those. Therefore, we believe that the robot's animation level should remain as it is, and no modifications should be made.
The likeability aspect obtained the highest score among the aspects evaluated by the questionnaire (4.2, CI=±0.43), indicating that the children developed positive impressions of the robot. This result is expected as the robot has been co-designed with and for children. As intended, the participatory design of the robot allowed the creation of a product which

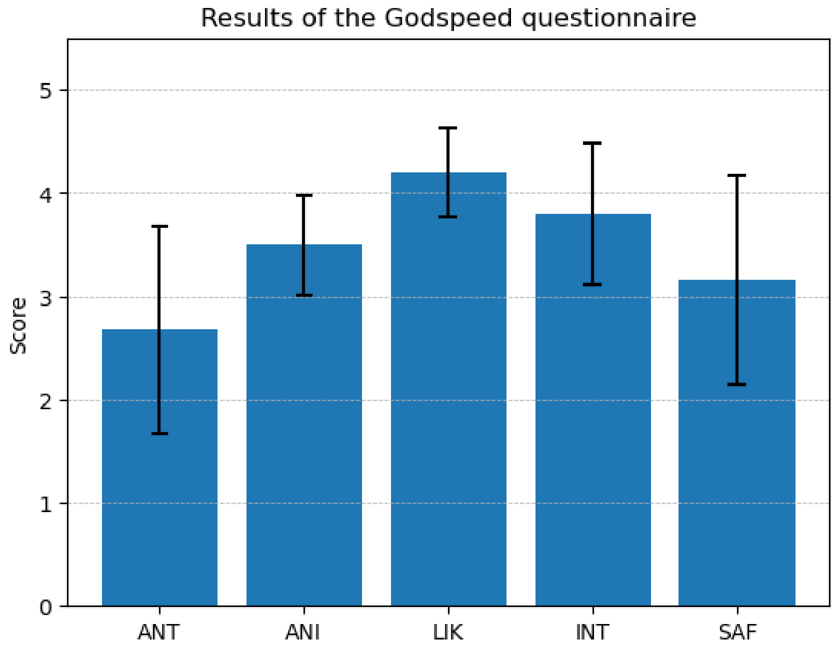


Figure 5.4: Results of the Godspeed questionnaire. Used abbreviations: ANT - anthropomorphism, ANI -animacy, LIK -likeability, INT -perceived intelligence, SAF - perceived safety.

meets most of the needs of its intended user base. It is worth mentioning, however, that the novelty effect might have positively affected the children's responses.
The average score for perceived intelligence was 3.8 (CI=±0.68), which suggests that the children primarily viewed the robot as being intelligent. According to Bartneck et al., the perceived intelligence of a robot corresponds to its ability to adapt its behaviour to varying situations. Although the robot's behaviour was mainly pre-programmed, it was able to adapt slightly its speech based on the children's responses which might have contributed to raise its perceived intelligence. On the other hand, the robot's reliance on the children's assistance in resolving the issues that arose in the stories may have led to a lower perception of its intelligence. We believe that no further improvement of the robot's perceived intelligence should be made as it has been shown that there is an inverse correlation between a robot's perceived intelligence and the amount of feedback given by the children interacting with it [38].
Finally, the perceived safety obtained a score of 3.16 (CI=±1.01). We deem this score reasonable but not sufficient. Indeed, it indicates that several children felt uncomfortable interacting with the robot. One possible explanation could be the speed of the robot's movements which some children may have perceived as too rapid. Efforts should be made in the future to improve the children's perceived safety with respect to the robot.

5.3 Recommendations and further improvements

In this section, we discuss the feedback and recommendations given by the teacher who led the two iterations of the final experiment aiming at raising awareness of gender (in)equality among children. This feedback was given in a written format after completing the two iterations.

We start by presenting some key features of the robot and robot-based learning activity that have been identified as crucial. The first element highlighted was the researcher's presentation of the robot to the children before beginning the activity. This step was deemed important as allowing the children to feel comfortable.
During the activities, the robot was put at the same height as the children, which contributed to foster a peer-to-peer relationship. However, the children were all in front of the robot. The teacher would rather recommend using a circular placement to encourage discussions among them.
Another factor which helped the children to feel comfortable was the robot's visual appearance, especially its animal features, which, according to the teacher, had a positive impact on the children.
According to the teacher, the robot's emotions, movements, and sounds prompted the children to react spontaneously, which helped them to establish a connection with the robot.
Finally, the teacher believed that giving the children the ability to make choices in the stories was crucial, as it enabled them to fully engage in those.

Three recommendations to improve the robot-based learning activity were given. The first one concerned the neutrality of the scenario. Indeed, all the cases of gender inequality involved women as victims. To this extent, the teacher recommended adding stories in which men are also subjects of gender inequalities.
The teacher also commented on the pace of the robot's speech, which was considered rather slow and could increase the risk of students losing focus. The teacher thus highlighted the importance of keeping the stories short and concise.
The last recommendation concerned the number of children involved in the activity. Intrinsically, the more student there are, the more challenging it becomes to manage the discussions. From the teacher's perspective, the ideal group size for the activity is between five and ten students.

Finally, the teacher emphasized the importance of communication between himself and the researcher, which helped to accommodate the various constraints encountered.

6 Discussion

To raise awareness of gender inequality among children, we developed a social robot, named PixelBot, and an associated robot-mediated learning activity. The robot acts as a tool whose goal is to confront the learner with cases of gender inequality and help them understand why these cases are problematic. The children are the main actors in the activity and have to solve the inequalities presented to them.
To design the robot and the robot-based activity, we used a participatory design approach. This approach involved the development of a toolkit that has been informed by a literature review and refined through iterative testing. Twenty children aged 10-13 completed the designed toolkit. The first part of the toolkit involved them in drawing their ideal robot and describing its main features. The second part involved them in creating a story featuring the created robot and relating to gender (in)equality. The results from the first part of the kit informed the design of our robot. Similarly, the robot-based learning activity used a storytelling approach, whose scenario was inspired by the prompts provided by the children in the second part of the kit. Finally, we conducted a study, involving eight children aged 9-10, to test the co-designed robot and robot-based learning activity. Our analysis showed that children were actively involved in the activity: all of them provided at least one comment and more than 85% of their interventions were related to gender (in)equality.

Devising, planning and conducting multiple experiment sessions with children proved to be the most challenging part of the thesis. For example, timing constraints prevented the children involved in the second iteration of the participatory design to complete the activity. Another challenge encountered was an unexpected consequence of the subject being tackled. Gender inequality is a sensitive and high-profile topic, which led many parents not to allow their children to participate in the activity. Finally, experiments are always subject to unpredictability. The second session aiming at testing the developed robot-based learning activity was scheduled to involve as many participants as the first one. However, due to a virus circulating in the school, it happened that only one participant was present on the day of the experiment.

The work undertaken in this thesis has limitations. The solution presented in this thesis is based on storytelling and its mediation by a robot. We believe that the robot, by embodying one of the characters in the story, brings liveliness to the activity, which improves the immersion and involvement of the children, and, possibly, the learning outcome. In this thesis, however, only the involvement of the children has been examined, through the analysis of the discussions. It would have been interesting to use pre-test and post-test to assess the extent to which the children learnt about gender (in)equality. However, the tight timing constraints and the lack of valid measurement instruments for this purpose made us ultimately decide to not pursue this goal. Additionally, to more objectively assess the benefits brought by the robot, it would have been interesting to perform a control experiment. The control experiment would not involve the robot, and the role of the teacher would not resume only in asking questions, but also in telling the story. Again, due to the tight schedule of a master thesis, we decided to prioritize the testing of the condition in which the robot was involved.

Finally, we hope that the work undertaken in this thesis opens the way to the use of robots, not only to promote gender equality but also many other forms of respect.

7 Acknowledgments

I would like to express my deepest gratitude to the teacher who helped me throughout my research project. His participation in one of the participatory design iterations, as well as his help in revising and testing the robot-based learning activity with his students, was incredibly valuable. I would also like to thank the direction of the associated school for allowing me to conduct my experiments within their establishment.

I am extremely grateful for the support and guidance of Melissa Skweres. Her educated advice with respect to the development of the participatory design toolkit, as well as her assistance in testing the toolkit during the Swiss Robotics Days, was invaluable. I thank Sophia Reyes Mury for her help in organizing the experiment during the ODE.

I also want to thank all the children who participated in my experiments. They were the main actors of this research, which would not have been possible without them.

I would like to express my gratitude to Pierre Dillenbourg for allowing me to do my master's thesis in his laboratory. Finally, I would like to give my warmest thank to my supervisor, Barbara Bruno. Barbara allowed me to work on something that was originally a personal project and gave it meaning. She guided me, with valuable advice and encouraged me through all the stages of this thesis.

A Classification of the reviewed studies

Author (publication date)	Publisher	Title
Björling (2021)	MDPI	Engaging english language learners as cultural informants in the design of a social robot for education
Kouri (2020)	ACM digital library	Customized Robot-Assisted Language Learning to Support Immigrants at Work: Findings and Insights from a Qualitative User Experience Study

Table A.1: Curricular education: list of the reviewed studies.

Author (publication date)	Publisher	Title
Alves-Oliveira (2021)	ACM digital library	Children as robot designers
Darriba (2019)	Springer	Towards participatory design of social robots
Prabha (2022)	ACM digital library	A minimalist social robot platform for promoting positive behavior change among children
Sanoubari (2021)	ACM digital library	Robots, bullies and stories: a remote co-design study with children
Zubrycki (2019)	Taylor & Francis Online	Participatory design of a robot for demonstrating an epileptic seizure

Table A.2: Non-curricular education: list of the reviewed studies.

Author (publication date)	**Publisher**	**Title**
Ahumada-Newhart (2019)	ACM digital library	Going to school on a robot: Robot and user interface design features that matter
Ghosh (2022)	Springer	Iterative user centered design of robot-mediated paired activities for older adults with mild cognitive impairment (MCI)
Hirsch (2017)	ACM digital library	Investigating design implications towards a social robot as a memory trainer
Li (2020)	ACM digital library	Non-participatory user-centered design of accessible teacher teleoperated robot and tablets for minimally verbal autistic children
Mahdi (2021)	IEEE Xplore	User-centered social robot design: Involving children with special needs in an online world
Metatla (2020)	ACM digital library	Robots for Inclusive Play: Co-designing an Educational Game with Visually Impaired and sighted Children
Neto (2021)	ACM digital library	Community based robot design for classrooms with mixed visual abilities children
O'Brien (2021)	ACM digital library	Exploring the design space of therapeutic robot companions for children
Ramírez-Duque (2021)	Springer	Collaborative and Inclusive Process with the Autism Community: A Case Study in Colombia About Social Robot Design

Table A.3: Remediation: list of the reviewed studies.

B Participatory design kit

B.1 First prototype

Adresse e-mail: romain.maure@epfl.ch

Crée ton propre robot

Surnom: ....

Genre: ....

Âge: ....

But: Crée ton propre robot!

Consignes:
- Décris les caractéristiques de ton robot: Dans le premier tableau, en écrivant des chiffres dans les cases à cocher, classe selon tes préférences chacune des caractéristiques décrivant un aspect du robot. Dans le second tableau, pour chaque aspect du robot, choisis **une seule** des possibilités proposées. Si tu as une idée qui n'est pas présente parmi celles proposées, tu peux aussi la mentionner dans la cellule "Autre"!
- Décris ton robot en le dessinant, en lui donnant un nom et une couleur.

Caractéristiques du robot:

Communication:	Son: ☐	Visage: ☐	Lumières: ☐	Mouvements: ☐	Autre: .... ☐
Sens:	Ouïe: ☐	Vue: ☐	Touché: ☐		Autre: .... ☐
Émotion:	Heureux: ☐	Sans émotion: ☐	Colère: ☐		Autre: .... ☐

Forme:	Rond: ☐	Ovale: ☐	Cubique: ☐	Type humain: ☐	Type animal: ☐	Autre: .... ☐
Matériau:	Plastique: ☐	Bois: ☐	Métal: ☐			Autre: .... ☐
Mobilité:	Immobile: ☐	Roues: ☐	jambes: ☐			Autre: .... ☐

Dessin du robot:

Nom: ....

Couleur: ....

Adresse e-mail: romain.maure@epfl.ch

Crée une histoire avec ton robot

Surnom: ....
Genre: ....
Âge: ....

But: Crée une histoire sur le respect des genres, c'est-à-dire une histoire qui décrit un cas d'égalité ou d'inégalité entre filles et garçons. Ton histoire doit inclure le robot que tu as crée précédemment et peut inclure d'autres personnages tels que des enfants, des adultes ou même d'autres robots!

Consignes:
- Commence par la partie de gauche en décrivant les éléments principaux de ton histoire.
- Dessine ton histoire dans les cases à droite. Décris le contenu de chaque case en utilisant les lignes en dessous de celles-ci.

Plan de l'histoire:

Personnages:

Cadre (temps / lieu):

Début de l'histoire

Milieu de l'histoire

Fin de l'histoire

Problème:

Solution:

Dessins de l'histoire:

B.2 Second prototype

Adresse e-mail: romain.maure@epfl.ch

Crée ton propre robot

Surnom: ....

Genre: ....

Âge: ....

But: Crée ton propre robot!

Consignes:
- Décris les caractéristiques de ton robot: Dans le premier tableau, classe selon tes préférences chacune des caractéristiques décrivant un aspect du robot, en la reliant par une flèche à son rang. Dans le second tableau, pour chaque aspect du robot, choisis **une seule** des possibilités proposées. Si tu as une idée qui n'est pas présente parmi celles proposées, tu peux aussi la mentionner dans la cellule "Autre"!
- Décris ton robot en le dessinant, en lui donnant un nom et une couleur.

Caractéristiques du robot:

Communication:		Sens:		Émotion:	
Son: •	• 1	Ouïe: •	• 1	Heureux: •	• 1
Visage: •	• 2	Vue: •	• 2	Sans émotion: •	• 2
Lumières: •	• 3	Touché: •	• 3	Colère: •	• 3
Mouvements: •	• 4	Autre: .... •	• 4	Autre: .... •	• 4
Autre: .... •	• 5				

Forme:	Rond: ☐	Ovale: ☐	Cubique: ☐	Type humain: ☐	Type animal: ☐	Autre: .... ☐
Matériau:	Plastique: ☐	Bois: ☐	Métal: ☐			Autre: .... ☐
Mobilité:	Immobile: ☐	Roues: ☐	jambes: ☐			Autre: .... ☐

Dessin du robot:

Nom: ....

Couleur: ....

Adresse e-mail: romain.maure@epfl.ch

Crée une histoire avec ton robot

Surnom: ....

Genre: ....

Âge: ....

But: Crée une histoire sur le respect des genres, c'est-à-dire une histoire qui décrit un cas d'égalité ou d'inégalité entre filles et garçons. Ton histoire doit inclure le robot que tu as crée précédemment et peut inclure d'autres personnages tels que des enfants, des adultes ou même d'autres robots!

Consignes:
- Commence par la partie de gauche en décrivant les éléments principaux de ton histoire.
- Dessine ton histoire dans les cases à droite. Décris le contenu de chaque case en utilisant les lignes en dessous de celles-ci.

Plan de l'histoire:

Personnages:

Cadre (temps / lieu):

Début de l'histoire

Milieu de l'histoire

Fin de l'histoire

Problème:

Solution:

Dessins de l'histoire:

Surnom: ....
Genre: ....
Âge: ....

Questions pour te guider dans la création de ton histoire

Conseil: Pour répondre à ces questions et imaginer ton histoire, tu peux soit faire appel à ton imagination et inventer quelque chose de complètement nouveau soit t'inspirer d'une situation d'égalité/inégalité entre fille et garçon qui t'es arrivé ou que tu as vu se produire sous tes yeux.

- Les personnages de ton histoire sont-ils tous semblables, ou différents les uns des autres? Si ils sont différents, en quoi le sont-ils?
  ....
  ....
  ....
  ....

- Le robot est-il un outil que les personnages utilisent? Ou bien est-ce un des personnages de ton histoire? Dans ce cas, le robot est-il un personnage gentil ou méchant? Qu'en est-il des autres personnages?
  ....
  ....
  ....
  ....

- D'où vient le problème qui se pose dans ton histoire et en quoi est-il lié au respect des genres?
  ....
  ....
  ....
  ....

- Est-ce que ton histoire se finit bien ou mal (le problème n'est pas résolu)?
  ....
  ....
  ....
  ....

C Robot-based storytelling activity: script

Story script

Bleu: le robot parle et fait des actions.
Vert: le professeur parle et fait des actions.
Rouge: les enfants font une action.

- [WAITING FOR ONE OF THE BUTTONS TO BE PRESSED BY THE TEACHER TO START THE ACTIVITY]

- Bonjour, je suis un robot et je m'appelle PixelBot. [ARM MOVEMENT GREETING]

- Aujourd'hui, je vais vous raconter une histoire à propos de moi et de la mission qui m'a été confiée. J'espère que vous pourrez m'aider!

- Un jour, un juge d'une autre ville est venu à l'EPFL et a dit aux ingénieurs qu'il avait besoin d'un robot pour une mission délicate. Cette mission est de découvrir s'il y a des inégalités entre les hommes et les femmes dans sa ville. [SHOW JUDGE IMAGE]

- Une fois arrivé en ville, je me suis d'abord rendu chez des amis: Hugo et Alice [SHOW FLAT IMAGE, ARM WALKING MOVEMENT].

- Quand je suis arrivé, j'ai été très surpris [SURPRISED EMOTION (display and antenna)] car Alice faisait toutes les tâches ménagères alors que Hugo était assis sur le canapé.

- **Qu'est-ce que vous ressentez quand vous apprenez qu'Hugo reste assis alors qu'Alice fait tout? Est-ce que c'est normal pour vous?**

- Idées de réponses/discussion: injuste, triste, frustré, pas d'émotions particulières.

- (Discussion entre tous les élèves et le professeur)

- **Qu'est-ce que vous faites à la maison comme tâche ménagère?**

- Idées de réponses: la lessive, ranger sa chambre, nettoyer les sols, faire la vaisselle, faire les courses, etc.

- (Discussion entre tous les élèves et le professeur)

- **Proposition de solutions spécifique à l'histoire:**
    - Solution A: le robot encourage Alice à en discuter avec Hugo et lui demander son aide. **-> BOUTON VERT**
    - Solution B: le robot demande à Hugo de se lever et d'aider Alice. **-> BOUTON BLEU**

- (Discussion entre tous les élèves et le professeur)

- [WAITING FOR ONE OF THE BUTTONS TO BE PRESSED BY THE STUDENT]

- Si solution A choisie (bouton vert):
    - Super, je suis donc allé encourager Alice à en discuter avec Hugo et lui demander son aide.
- Si solution B choisie (bouton bleu):
    - Super, je suis donc allé demander à Hugo de se lever et d'aller aider Alice.

- Merci pour votre aide, Hugo aide désormais Alice à faire les tâches ménagères et Alice est très contente. [HAPPY EMOTION (display, antennae, congrat song]

- Après ma visite chez Hugo et Alice, j'ai décidé de partir à la station de ski la plus proche [SHOW SKI STATION IMAGE, ARM WALKING MOVEMENT].

- Là-bas, j'ai pu observer le métier des sauveteurs. Lorsqu'une personne est blessée en haut d'une montagne, les sauveteurs vont la secourir.

- Comme je suis un robot, je suis très bon en maths. Le directeur de la station de ski m'a donc demandé de l'aider à calculer le salaire de tous les sauveteurs.

- Lorsque nous avons comparé le salaire des sauveteurs avec celui que j'ai calculé, nous avons constaté quelque chose de très étrange: les hommes étaient mieux payés que les femmes alors que les femmes et les hommes faisaient exactement le même travail!

- **Qu'est-ce que vous ressentez quand vous apprenez qu'une fille est moins payée qu'un garçon pour un même métier? Est-ce que c'est normal pour vous?**

- Idées de réponses/discussion: injuste, triste, frustré, pas d'émotions particulières.

- (Discussion entre tous les élèves et le professeur)

- **Quel métier vous aimeriez faire plus tard?**

- Idées de réponses: Pilote, pompier, médecin, ingénieur, etc

- (Discussion entre tous les élèves et le professeur)

- **Cas d'un métier précis: imaginez qu'untel soit mieux payé qu'unetelle alors qu'ils font exactement la même chose. Qu'est-ce que vous feriez pour résoudre le problème à la station de ski?**

    - Solution A: le robot demande au directeur d'équilibrer les salaires. **-> BOUTON VERT**
    - Solution B: le robot en parle à un secouriste homme. Ce secouriste va lui-même en parler au directeur. **-> BOUTON BLEU**

- (Discussion entre tous les élèves et le professeur)

- [WAITING FOR ONE OF THE BUTTONS TO BE PRESSED BY THE STUDENT]

- Si solution A choisie (bouton vert):
    - Super, je suis donc allé voir le directeur pour lui demander d'équilibrer les salaires.
- Si solution B choisie (bouton bleu):
    - Super, je suis donc allé en parler à un secouriste homme. Ce secouriste homme est ensuite allé demander au directeur d'équilibrer les salaires.

- Merci pour votre aide, les femmes et les hommes travaillant à la station de ski ont tous le même salaire et sont très contents maintenant! [HAPPY EMOTION (display, antennae, congrat song]

- Après mon passage à la station de ski, j'ai découvert qu'une agence spatiale, affiliée à la NASA, se trouvait près de la ville. Je suis donc allé la visiter. [SHOW NASA IMAGE, ARM WALKING MOVEMENT]

- Alors que j'allais entrer dans le bâtiment, j'ai remarqué une jeune femme assise sur un banc et avec l'air triste. Cette femme s'appelle Marie. Marie est une scientifique qui aimerait devenir astronaute pour aller sur la lune!

- Elle est donc allée voir la directrice de l'agence spatiale pour lui demander si elle pouvait devenir astronaute. Mais celle-ci lui a dit qu'elle ne pouvait pas devenir astronaute car c'est une fille!

- J'étais très fâché [ANGRY EMOTION (display and antenna?)] car Marie est une scientifique très intelligente et qualifiée, elle a donc toutes les qualités requises pour devenir astronaute!

- **Qu'est-ce que vous ressentez quand vous apprenez qu'une fille ne peut pas être astronaute? Est-ce que c'est normal pour vous?**

- Idées de réponses/discussion: injuste, triste, frustré, pas d'émotions particulières.

- (Discussion entre tous les élèves et le professeur)

- **Est-ce que vous savez ce que c'est la NASA? Est-ce que vous savez que les tests sont durs pour être astronaute?**

- Idées de réponse: il faut être bon en math, sportif, courageux, etc

- (Discussion entre tous les élèves et le professeur)

- **Qu’est ce que vous feriez pour résoudre le problème?**
    - Solution A: le robot propose à Marie de persévérer jusqu’à ce qu’elle réussisse. **-> BOUTON VERT**
    - Solution B: le robot explique à la directrice qu’elle a été un modele de femme courageuse pour Marie. La directrice change alors d’avis. **-> BOUTON BLEU**

- (Discussion entre tous les élèves et le professeur)

- [WAITING FOR ONE OF THE BUTTONS TO BE PRESSED BY THE STUDENT]

- Si solution A choisie (bouton vert):
    - Super, je suis donc allé voir Marie et je lui ai conseillé de persévérer jusqu’à ce qu’elle réussisse.
- Si solution B choisie (bouton bleu):
    - Super, je suis donc allé voir la directrice pour lui dire qu’elle avait été un modele de femme courageuse pour Marie. La directrice a alors changé d’avis.

- Merci pour votre aide, Marie a réussi à devenir astronaute et est très contente maintenant! [HAPPY EMOTION (display, antennae, congrat song]

- Pour finir, je suis retourné voir le juge pour lui faire un résumé de ce que j’ai découvert à propos des inégalités entre hommes et femmes dans la ville. [SHOW JUDGE IMAGE, ARM WALKING MOVEMENT].

- J’ai raconté au juge toutes nos aventures et les solutions que nous avons trouvées. Le juge vous remercie pour toutes vos suggestions. Il va les utiliser pour réduire les inégalités entre les hommes et les femmes. Je suis très heureux! [HAPPY EMOTION (display, antennae, congrat song)].

- Au revoir!

D Robot-based storytelling activity: discussion transcript

D.1 First iteration

Transcription

Bleu: le robot parle et fait des actions.
Vert: le professeur parle et fait des actions.
Rouge: les enfants parlent et font une action.

ENFANT 1, 2 et 7: Fille
ENFANT 3, 4, 5 et 6: Garçon

- Robot: Bonjour, je suis un robot et je m'appelle PixelBot. Aujourd'hui, je vais vous raconter une histoire à propos de moi et de la mission qui m'a été confiée. J'espère que vous pourrez m'aider! Un jour, un juge d'une autre ville est venu à l'EPFL et a dit aux ingénieurs qu'il avait besoin d'un robot pour une mission délicate. Cette mission est de découvrir s'il y a des inégalités entre les hommes et les femmes dans sa ville. Une fois arrivé en ville, je me suis d'abord rendu chez des amis: Hugo et Alice. Quand je suis arrivé, j'ai été très surpris car Alice faisait toutes les tâches ménagères alors que Hugo était assis sur le canapé.

- Professeur: Alors, tout le monde a entendu la dernière phrase? Qu'est-ce que vous ressentez quand vous entendez ça? Donc Hugo il est assis sur le canapé et Alice elle fait toutes les tâches ménagères. C'est quoi le premier sentiment qui vous vient à l'esprit? On va faire comme en classe, on lève le doigt et je vous interroge. [ENFANT 7] ?

- ENFANT 7: Que c'est pas juste et …

- Professeur: Injuste? Ok, quelqu'un d'autre? [ENFANT 2] ?

- ENFANT 2: Bah c'est que les femmes elles font toutes les tâches ménagères et les garçons ils font rien.

- ENFANT 3: Pas forcément!

- Professeur: Ok donc là t'as déjà extrapolé mais ok. Mais un sentiment, vraiment qui vient de votre coeur, on vous dit ok, lui il fait rien et elle fait tout. Les garçons? [ENFANT 3] ?

- ENFANT 3: Ça veut dire le garçon c'est un bon à rien et la fille elle fait tout.

- Professeur: Ouai mais là je parle de vous, vous qu'est-ce que vous pensez, imaginez que vous êtes à la place de la fille ou les garçons vous pouvez vous mettre à la place de la fille aussi, si jamais l'autre il fait rien, vous ressentez quoi? Vous êtes énervé, frustré ?...

- ENFANT 2: De l'injustice?

- Professeur: Injuste ouai, [ENFANT 7] avait dit injuste. Le mot injuste? Bon ça marche. Qu’est-ce que vous connaissez comme tâche ménagère à la maison? Imaginez que vous vivez tous dans la même maison. [ENFANT 2] ?

- ENFANT 2: Passer le balai.

- Professeur: Ouai passer le balai. [ENFANT 5]?

- ENFANT 5: Faire la vaisselle.

- Professeur: Faire la vaisselle. [ENFANT 1]?

- ENFANT 1: Nettoyer la salle de bain.

- Professeur: Ouai salle de bain. [ENFANT 6]?

- ENFANT 6: Le repassage.

- Professeur: Repassage. Donc vous voyez ça fait déjà beaucoup. [ENFANT 3]?

- ENFANT 3: Faire le dîner.

- Professeur: Faire le dîner. Ouai?

- ENFANT 2: Mettre la table.

- Professeur: Mettre la table bien. Alors du coup [ENFANT 5], imagine que tu vis dans une maison et que du coup je te dis c’est toi qui fais tout ce qu’on vient de dire et [ENFANT 1], aller je prends comme exemple [ENFANT 1], elle est à côté et elle est devant la télé.

- ENFANT 5: Ah tu fais rien!

- TOUS LES ENFANTS: [Rires]

- Professeur: Tu fais quoi?

- ENFANT 5: Je vais rien faire.

- Professeur: Tu vas rien faire? Ça veut dire comme elle fait rien toi tu fais rien?

- ENFANT 5: oui.

- Professeur: Ok, si c’est quelqu’un d’autre vous faites quoi?

- ENFANT 7: On s'énerve?

- Professeur: Vous vous énervez ok. Et si jamais on évite de s'énerver alors comment on résout la situation? Parce qu'on peut pas laisser la vaisselle comme ça, on peut pas laisser le repassage comme ça. Vas-y.

- ENFANT 3: On prend une femme de ménage?

- Professeur: Alors maintenant du coup le robot pour continuer son histoire, faut qu'on l'aide. Donc lui il a dit: Alice fait tout et Hugo fait rien. Qu'est-ce qu'on peut dire? Comment on peut agir sur l'histoire? Quelqu'un a une idée? Qu'est-ce que Hugo peut faire et qu'est-ce que Alice peut faire? [ENFANT 6]?

- ENFANT 6: Regarder la télé.

- Professeur: Il faut que Alice… Non mais pour que les tâches elles soient faites. [ENFANT 2]?

- ENFANT 2: On répartit les tâches.

- Professeur: Ouai alors pour ça il faut faire quoi?

- ENFANT 6: On s'entraide.

- Professeur: Oui il faut s'entraider, il faut …

- ENFANT 2: Il faut donner des tâches à la fille et au garçon. Les deux.

- Professeur: Oui, il faut aussi discuter on est d'accord?

- TOUS LES ENFANTS: [Acquiescent]

- Professeur: Ok, donc qu'est-ce qu'on fait? Est-ce que Alice elle en discute avec Hugo? Ou est-ce que… Parce que le robot il est dans l'histoire aussi, qu'est-ce que le robot peut faire?

- ENFANT 2: Ils vont au juge!

- Professeur: Avant d'aller au juge, qu'est-ce que le robot peut faire avec Alice et Hugo?

- ENFANT 2: leur parler.

- Professeur: Ouai, il peut parler à qui?

- ENFANT 2: euh bah aux gens.

- Professeur: Ouai mais c'est qui qui fait rien?

- CERTAINS ENFANTS: Hugo.

- Professeur: Hugo. Qu’est-ce que le robot peut faire?

- CERTAINS ENFANTS: Parler à Hugo.

- Professeur: Ok parler à Hugo. On reste concentré s’il vous plaît. Alors du coup est-ce que le robot parle à Hugo ou est-ce que Alice en discute avec Hugo?

- TOUS LES ENFANTS: Le robot parle à Hugo.

- Professeur: Le robot parle à Hugo? Très bien alors il faut appuyer sur le bouton bleu.

- ENFANT 5: [Appuie sur le bouton]

- Robot: Super, je suis donc allé demander à Hugo de se lever et d’aller aider Alice. Merci pour votre aide, Hugo aide désormais Alice à faire les tâches ménagères et Alice est très contente. Après ma visite chez Hugo et Alice, j’ai décidé de partir à la station de ski la plus proche. Là-bas, j’ai pu observer le métier des sauveteurs. Lorsqu’une personne est blessée en haut d’une montagne, les sauveteurs vont la secourir. Comme je suis un robot, je suis très bon en maths. Le directeur de la station de ski m’a donc demandé de l’aider à calculer le salaire de tous les sauveteurs. Lorsque nous avons comparé le salaire des sauveteurs avec celui que j’ai calculé, nous avons constaté quelque chose de très étrange: les hommes étaient mieux payés que les femmes alors que les femmes et les hommes faisaient exactement le même travail!

- CERTAINS GARÇONS: Yes!

- Professeur: Alors, j’ai eu deux réactions des garçons qui disaient “Yes!”. Et du coup les filles elles disent quoi?

- CERTAINES FILLES: Nooon!

- Professeur: Non, ok. Alors, imaginez les garçons que vous soyez des filles.

- CERTAINS GARÇONS: Oh non, je veux pas être une fille!

- ENFANT 2: C’est juste de l’injustice!

- Professeur: Attendez chacun son tour. [ENFANT 5], [ENFANT 3], si on vous dit, on inverse tout aujourd’hui, on disait les filles sont mieux payées que les garçons. C’est plus un “Oh non” qu’un “Oh oui”?

- ENFANT 3: Humm, non moi je m’en fiche si je suis moins payé que les filles.

- Professeur: C’est vrai?

- ENFANT 5: Au moins on a de l’argent.

- ENFANT 3: Oui, au moins on a de l'argent.
- Professeur: Ok.
- ENFANT 3: C'est mieux que être rien payé.
- Professeur: Intéressant. Alors, ma première question: on revient sur les sentiments. [ENFANT 6] s'il te plaît. Le sentiment, le sentiment c'est énervé, frustré, triste ou content hein, vous pouvez être content si vous voulez. Donc si je vous dis, les filles elles sont secouristes, elles sauvent des gens, les garçons font le même métier mais les garçons gagnent plus. Quel sentiment vous vient à l'esprit? [ENFANT 2]?
- ENFANT 2: Déjà c'est de l'injustice.
- Professeur: Un sentiment, un mot. Injuste?
- ENFANT 2: Oui.
- Professeur: Bien. [ENFANT 6]?
- ENFANT 6: Triste.
- Professeur: Ok.
- ENFANT 3: C'est pas triste!
- Professeur: Chacun son tour. Oui?
- ENFANT 7: Énervé.
- Professeur: Énervé, ouai, pas mal. [ENFANT 3]?
- ENFANT 3: Humm…
- Professeur: Si jamais t'as pas d'émotions…
- ENFANT 3: Mécontent!
- Professeur: Ok, bien. Et du coup, si on prend ça pour d'autres métiers. Quel métier vous voulez faire, vous plus tard? Voyons un peu, [ENFANT 6]?
- ENFANT 6: Policier.
- Professeur: Policier.
- ENFANT 3: Architecte.

- Professeur: Architecte.

- ENFANT 7: Pédiatre.

- Professeur: Pédiatre, donc médecin pour les enfants.

- ENFANT 1: Policière.

- Professeur: Policière du coup? Ok ba c'est parfait, on a les mêmes métiers. Tout le monde sait ce que c'est un salaire?

- TOUS LES ENFANTS: Oui!

- Professeur: On travaille toute la semaine. À la fin du mois, j'ai tant de francs qui arrivent sur mon compte en banque. [ENFANT 1], [ENFANT 6], vous faites le même métier, vous travaillez le même nombre d'heures mais toi tu gagnes 7000 francs et [ENFANT 1] elle gagne 5000 francs. Ou inversement tient, [ENFANT 1] elle gagne 7000 et toi tu gagnes 5000.

- ENFANT 6: C'est parce qu'elle fait un autre …

- Professeur: Non, vous faites la même chose. Elle a mis des gens en prison et toi t'as mis des gens en prison pareil et peut-être même vous avez travaillé ensemble. Du coup, qu'est-ce qu'on fait?

- ENFANT 6: On partage.

- Professeur: Tu partages? Ça veut dire que si elle elle gagne plus que toi elle te donne 1000 francs et toi tu gagnes 1000 francs?

- ENFANT 6: [Acquiesce]

- Professeur: Pourquoi pas, c'est une solution. Oui?

- ENFANT 3: Mais aussi par exemple, si un est policier et l'autre est avocat. Mais par exemple si le policier il gagne beaucoup beaucoup et l'avocat il gagne beaucoup beaucoup mais un avocat ça gagne quand même plus qu'un policier donc …

- Professeur: Ok mais je crois que c'est hors-sujet, on compare vraiment, pour le même métier, femme et homme, garçon et fille, mais oui peut-être qu'un avocat il gagne plus. Non mais [ENFANT 6] c'était intéressant ce qu'il disait. Ça veut dire que lui, il disait on partage, c'est-à-dire que si tu gagnes 7000, tu donnerais 1000 à [ENFANT 1].

- ENFANT 6: Oui.

- Professeur: Ok, c'est bien. Et du coup c'est qui qui donne les salaires? C'est qui qui choisit?

- ENFANT 3: C’est le chef des policiers.

- Professeur: C’est le chef. Alors qu’est-ce qu’ils peuvent faire par rapport à la station de ski?

- ENFANT 2: Parler au chef.

- Professeur: Parler au chef. Donc il y a deux solutions. Bouton vert: parler au chef, le directeur.

- ENFANT 3: Je peux appuyer ?!

- Professeur: Attendez! Et bouton bleu, c’est un peu ce que [ENFANT 6] a dit: c’est pas partager mais celui qui gagne plus et ba il va dire “je gagne plus”. [ENFANT 6], [ENFANT 2], [ENFANT 2], Oh! Attendez, c’est chacun son tour. [ENFANT 3] a levé son doigt, il a demandé donc pour celui-là, on le laisse. Est-ce qu’on demande au directeur, ou est-ce que c’est celui qui gagne plus qui va dire "bah tiens", il va partager peut-être. Lequel vous préférez?

- TOUS LES ENFANTS: Directeur!

- Professeur: Directeur. Donc c’est le bouton vert.

- ENFANT 3: [Appuie sur le bouton]

- Robot: Super, je suis donc allé voir le directeur pour lui demander d’équilibrer les salaires. Merci pour votre aide, les femmes et les hommes travaillant à la station de ski ont tous le même salaire et sont très contents maintenant! Après mon passage à la station de ski, j’ai découvert qu’une agence spatiale, affiliée à la NASA, se trouvait près de la ville. Je suis donc allé la visiter. Alors que j’allais entrer dans le bâtiment, j’ai remarqué une jeune femme assise sur un banc et avec l’air triste. Cette femme s’appelle Marie. Marie est une scientifique qui aimerait devenir astronaute pour aller sur la lune! Elle est donc allée voir la directrice de l’agence spatiale pour lui demander si elle pouvait devenir astronaute. Mais celle-ci lui a dit qu’elle ne pouvait pas devenir astronaute car c’est une fille!

- [ENFANT 2]: J’en étais sûr!

- Robot: J'étais très fâché car Marie est une scientifique très intelligente et qualifiée, elle a donc toutes les qualités requises pour devenir astronaute!

- Professeur: Alors, [ENFANT 2] a dit “J’en étais sûr”, comme si elle s’attendait à ce qui allait se passer. Alors sentiments? Est-ce que c’est toujours le même qu’au début?

- [ENFANT 2]: Oui.

- Professeur: Oui, injuste, énervé.

- [ENFANT 1]: Colère.

- Professeur: [ENFANT 1] aussi. Les garçons, colère? Imaginez-vous les garçons, tiens policier. [ENFANT 6] il va au concours de policier et on lui dit “Non non [Enfant 6] c’est que pour les filles”

- ENFANT 6: Quoi!!

- Professeur: C’est pas mal ça comme émotion, surprise!

- ENFANT 3: Mais moi je m’en fiche, je vais juste chercher un travail qui paie mieux.

- ENFANT 2: Oh mais [ENFANT 3]!

- Professeur: Mais toi j’ai l’impression, bon déjà il faut un autre mot que “tu t’en fiches” mais admettons.

- ENFANT 6: C’est dur déjà de trouver un métier.

- Professeur: Oui, moi je pense que si tu as vraiment envie d’être pompier et que c’est ton rêve, je pense que tu prends un coup quand même. Donc, ma question c’est: déjà la NASA, qu’est-ce que la NASA? [ENFANT 7]?

- ENFANT 7: Une station spatiale?

- Professeur: C’est pas une station spatiale.

- ENFANT 7: C’est une…

- Professeur: Mais c’est un centre aux États-Unis qui envoie des hommes dans l’espace, notamment à l’époque sur la lune. Et pour rentrer à la NASA à votre avis, c’est facile ou difficile?

- TOUS LES ENFANTS: Très difficile.

- Professeur: C’est très très très difficile. Mais surtout à la NASA il y a plein de métiers mais ceux qui vont dans l’espace, les astronautes, est-ce que vous avez une idée de ce qu’il faut savoir faire pour être astronaute? [ENFANT 6]?

- ENFANT 6: Des maths.

- Professeur: Il faut être super fort en maths. Quoi d’autre?

- ENFANT 2: Savoir utiliser le matériel dans une fusée.

- Professeur: Savoir utiliser le matériel, donc en général ils sont déjà pilotes d'avion, ils ont déjà des métiers qui sont assez durs. Quoi d'autre?

- ENFANT 3: Être bon informaticien.

- Professeur: Ouai faut savoir aussi l'électronique, l'informatique, la programmation, ouai. Vous avez oublié juste quelque chose de très important. Qu'est-ce qu'il faut faire pour être en forme là-haut dans l'espace pendant plusieurs mois?

- ENFANT 1: Faire du sport.

- Professeur: Faire du sport, il faut être super sportif. Ok, et faut aussi au niveau du mental, de la psychologie. Imaginez que vous êtes là-haut et que vous avez peur de tout. C'est compliqué, donc faut quand même être courageux, faut être persévérant etc, faut pas trop avoir peur là-haut.

- ENFANT 2: Moi je veux pas, moi j'ai peur des trous noirs, j'aime pas ça.

- Professeur: Ouai il y a pas des trous noirs partout dans l'espace. Ok donc, maintenant faut faire un choix, qu'est-ce qu'on fait pour Marie? Marie, elle veut être astronaute, elle est super forte en maths, elle est sportive etc. Elle va voir la directrice de la NASA et la directrice lui dit "Non non il y a que des hommes en tant qu'astronaute". Qu'est-ce qu'on fait? [ENFANT 1]?

- ENFANT 1: Humm, dire que c'est injuste et …

- Professeur: Qui dit? Le robot? Marie?

- ENFANT 5: Le robot.

- Professeur: Le robot. Donc il explique à qui? À la directrice? Que c'est injuste. Qu'est-ce qui peut lui dire comme arguments? Il peut lui dire que c'est injuste parce que… Qu'est-ce qu'on peut dire?

- ENFANT 1: Juste parce que les hommes… c'est un métier pour les hommes?

- Professeur: Ok, mais du coup pourquoi ça devrait être un métier pour tout le monde, femmes et hommes? Qu'est-ce que Marie elle a autant que les hommes? [ENFANT 7]?

- ENFANT 7: L'intelligence.

- Professeur: Ouai elle est forte en maths ouai. Quoi d'autres? [ENFANT 6]?

- ENFANT 6: Heu je sais pas.

- Professeur: Au niveau du sport, au niveau du reste?

- PLUSIEURS ENFANTS: La force.
- Professeur: On est d'accord qu'elle est assez sportive, Ok. Et aussi en fait, il y a une directrice, c'est une femme la directrice de la NASA.
- ENFANT 1: Oui.
- Professeur: Donc elle-même si elle en est arrivé là c'est que ba du coup elle a été aussi forte que les hommes. Donc elle en tant que femme, elle pourrait dire, moi j'ai inspiré d'autres femmes et j'ai pas le droit de dire non du coup à Marie. Alors, qu'est-ce qu'on fait? Marie elle peut aussi continuer et persévérer on est d'accord que c'est pas parce qu'on lui dit non que elle va se dire "Ah ba ok du coup je reste chez moi". Elle a aussi le droit de dire non, j'ai envie de faire ça. Elle va persévérer et devenir encore plus forte. Donc on a deux choix. Est-ce qu'on dit à Marie de continuer, de persévérer? Ou est-ce qu'on dit au robot d'aller voir la directrice et lui expliquer que ba en fait elle a le droit.
- ENFANT 2: Est-ce que je peux appuyer sur le robot?
- Professeur: Avant ça dites-moi. Plutôt vert le premier ou bleu le deuxième? Directrice ou plutôt on dit à Marie de persévérer?
- PLUSIEURS ENFANTS: Directrice.
- Professeur: Directrice? [ENFANT 4]? Le deuxième? Directrice?
- ENFANT 4: Hmmm, persévérer.
- Professeur: persévérer?
- PLUSIEURS ENFANTS: Directrice.
- Professeur: Alors faut lever le doigt. J'ai entendu plus de directrice. Ça sera le bouton bleu et c'est [ENFANT 2] qui va appuyer parce qu'elle a levé son doigt. Et on écoute la fin de l'histoire.
- ENFANT 2: [Appuie sur le bouton bleu.]
- Robot: Super, je suis donc allé voir la directrice pour lui dire qu'elle avait été un modèle de femme courageuse pour Marie. La directrice a alors changé d'avis. Merci pour votre aide, Marie a réussi à devenir astronaute et est très contente maintenant! Pour finir, je suis retourné voir le juge pour lui faire un résumé de ce que j'ai découvert à propos des inégalités entre hommes et femmes dans la ville. J'ai raconté au juge toutes nos aventures et les solutions que nous avons trouvées. Le juge vous remercie pour toutes vos suggestions. Il va les utiliser pour réduire les inégalités entre les hommes et les femmes. Je suis très heureux! Au revoir!

D.2 Second iteration

Transcription

Bleu: le robot parle et fait des actions.
Vert: le professeur parle et fait des actions.
Rouge: les enfants parlent et font une action.

ENFANT: Fille

- Robot: Bonjour, je suis un robot et je m'appelle PixelBot. Aujourd'hui, je vais vous raconter une histoire à propos de moi et de la mission qui m'a été confiée. J'espère que vous pourrez m'aider! Un jour, un juge d'une autre ville est venu à l'EPFL et a dit aux ingénieurs qu'il avait besoin d'un robot pour une mission délicate. Cette mission est de découvrir s'il y a des inégalités entre les hommes et les femmes dans sa ville. Une fois arrivé en ville, je me suis d'abord rendu chez des amis: Hugo et Alice. Quand je suis arrivé, j'ai été très surpris car Alice faisait toutes les tâches ménagères alors que Hugo était assis sur le canapé.

- Professeur: Ok, alors la maintenant c'est à nous de discuter. Donc t'as compris ce qu'il s'est passé dans la maison entre Hugo et Alice?

- ENFANT: Oui.

- Professeur: Qu'est-ce que tu ressens si on te dit qu'il y en a un sur les deux qui fait rien sur le canapé, là c'était Hugo, et que Alice fait tout. Qu'est-ce que tu ressens comme émotion?

- ENFANT: Bahhh, que c'est pas juste.

- Professeur: Injuste, ok. Si toi t'étais à la place de Alice, comment tu aurais réagi?

- ENFANT: J'aurais dit non.

- Professeur: T'aurais dit non, t'aurais dit “tu te lèves et c'est toi qui fais”?

- ENFANT: [Rires, Acquiesce]

- Professeur: Ok ça marche. Qu'est-ce que tu connais comme tâches ménagères à la maison?

- ENFANT: Bahh…

- Professeur: Est-ce que t'as des idées? Qu'est-ce qu'on peut faire dans une maison pour la maintenir propre?

- ENFANT: La vaisselle.

- Professeur: La vaisselle.

- ENFANT: La serpillère.

- Professeur: Ouai.

- ENFANT: Euh la poussière.

- Professeur: Ok.

- ENFANT: Aspirer.

- Professeur: Ouai. Nettoyer, faire les courses etc. Ok donc comment tu ferais toi pour résoudre la situation? On a deux solutions dans cette situation. Soit le robot il peut demander à Alice de discuter avec Hugo et du coup elle lui dit “Est-ce que tu peux m’aider?” ou est-ce que le robot il demande à Hugo de se lever et d’aider Alice? Donc le premier c’est le bouton vert si tu veux que le robot il parle à Alice ou le bouton bleu, le robot demande à Hugo. Il y a pas de pièges c’est comme tu veux, c’est toi qui le sens. Imagines-toi à la place de… dans la maison si tu vois ça avec le robot.

- ENFANT: [Appuie sur le bouton bleu]

- Robot: Super, je suis donc allé demander à Hugo de se lever et d’aller aider Alice. Merci pour votre aide, Hugo aide désormais Alice à faire les tâches ménagères et Alice est très contente. Après ma visite chez Hugo et Alice, j’ai décidé de partir à la station de ski la plus proche. Là-bas, j’ai pu observer le métier des sauveteurs. Lorsqu’une personne est blessée en haut d’une montagne, les sauveteurs vont la secourir. Comme je suis un robot, je suis très bon en maths. Le directeur de la station de ski m’a donc demandé de l’aider à calculer le salaire de tous les sauveteurs. Lorsque nous avons comparé le salaire des sauveteurs avec celui que j’ai calculé, nous avons constaté quelque chose de très étrange: les hommes étaient mieux payés que les femmes alors que les femmes et les hommes faisaient exactement le même travail!

- Professeur: Ok. Alors une chose, qu’est-ce que tu en penses?

- ENFANT: Bah c’est toujours injuste.

- Professeur: C’est toujours injuste. Donc même émotion qu’au début, ok.

- ENFANT: Ils devraient être payés exactement la même chose.

- Professeur: Ok.

- ENFANT: puisqu’ils font la même chose.

- Professeur: Ok on est d'accord. Ils ont fait, Ils sont secouristes tous les deux, enfin les femmes et les hommes, du coup les hommes sont mieux payés. Humm, qu'est-ce que tu aimerais faire comme métier plus tard toi?

- ENFANT: Soit vétérinaire soit sage-femme.

- Professeur: Ok soit vétérinaire soit sage-femme et du coup hummm, tu remarques d'ailleurs qu'on dit sage-femme et pas sage-homme.

- ENFANT: [Acquiesce]

- Professeur: Est-ce que un homme pourrait faire sage-femme?

- ENFANT: Bah oui.

- Professeur: Ouai, ouai. Et imagine que il y a des sages-femmes du coup femmes et hommes et qu'on dise que, ba les femmes sont mieux payées que les hommes. Imaginons que, on dise, ba en fait, c'est un métier plutôt pour les femmes et du coup on paye mieux les femmes que les hommes. Comment tu résoudrais la situation? Qu'est-ce que tu ferais?

- ENFANT: Bahh, je donnerais exactement la même chose aux deux.

- Professeur: Ouai, et du coup, là, si on reprend notre situation, qui à ton avis donne les salaires dans une entreprise, ou …?

- ENFANT: Le patron.

- Professeur: Ouai le patron, le directeur. Donc du coup là on a deux choix. Tu vois si on fait le bouton vert, le robot il peut demander au patron, le directeur, de dire "Ok, l'homme et la femme ils ont exactement le même travail donc ils ont le même salaire". Ou sinon, avec le bouton bleu, le robot il peut aller voir un secouriste homme…

- ENFANT: Ok.

- Professeur: et il lui dit que "Ah tu gagnes 1000 francs de plus par mois que celle qui fait le même travail que toi" et après c'est ce secouriste qui va parler au directeur. Donc c'est toi qui choisis. Mets-toi dans la situation, qu'est-ce que tu ferais? Est-ce que tu préfères que le robot aille voir le directeur directement? Ou que ce soit l'homme qui se rende compte que, bah c'est bizarre il est plus payé que l'autre et du coup c'est injuste.

- ENFANT: [Appuie sur le bouton bleu]

- Professeur: Ok.

- Robot: Super, je suis donc allé en parler à un secouriste homme. Ce secouriste homme est ensuite allé demander au directeur d'équilibrer les salaires. Merci pour votre aide, les femmes et les hommes travaillant à la station de ski ont tous le même salaire et sont très contents maintenant! Après mon passage à la station de ski, j'ai découvert qu'une agence spatiale, affiliée à la NASA, se trouvait près de la ville. Je suis donc allé la visiter. Alors que j'allais entrer dans le bâtiment, j'ai remarqué une jeune femme assise sur un banc et avec l'air triste. Cette femme s'appelle Marie. Marie est une scientifique qui aimerait devenir astronaute pour aller sur la lune! Elle est donc allée voir la directrice de l'agence spatiale pour lui demander si elle pouvait devenir astronaute. Mais celle-ci lui a dit qu'elle ne pouvait pas devenir astronaute car c'est une fille! J'étais très fâché car Marie est une scientifique très intelligente et qualifiée, elle a donc toutes les qualités requises pour devenir astronaute!

- Professeur: Ok le robot est pas content. Est-ce que toi tu ressens la même chose?

- ENFANT: [Acquiesce]

- Professeur: Injuste pareil?

- ENFANT: [Acquiesce]

- Professeur: Est-ce que en termes d'émotions, je te donne d'autres exemples, tu serais plutôt triste, frustrée ou en colère, énervée?

- ENFANT: Bah assez triste.

- Professeur: C'est quoi le premier mot qui te vient à l'esprit, triste?

- ENFANT: [Acquiesce]

- Professeur: Ouai ok triste, injuste, ça marche. Alors, est-ce que tu sais ce que c'est que la NASA?

- ENFANT: Bah c'est un endroit où il y a des fusées et tout et puis des astronautes qui vont dans l'espace.

- Professeur: Ouai, c'est aux États-Unis. Et à ton avis, est-ce que c'est dur de rentrer dans la NASA? Est-ce que c'est dur d'être astronaute?

- ENFANT: Oui.

- Professeur: Ouai. Tu penses qu'il faut savoir faire quoi?

- ENFANT: Heuuu…

- Professeur: Faut être très fort en maths.

- ENFANT: [Acquiesce]

- Professeur: Humm, faut être sportif aussi.
- ENFANT [Acquiesce]
- Professeur: Tu vois parce qu'il faut être en bonne santé dans l'espace. Donc faut être sportif, faut être fort en maths. Les tests sont plutôt… il faut imaginer des tests super durs, dans les sciences notamment. Et même aussi mentalement aussi, faut être fort mentalement, faut être courageux, il faut réunir tout ça. Donc du coup, est-ce que tu penses que ça serait normal qu'il y ait plus d'hommes que de femmes à la NASA?
- ENFANT: Non.
- Professeur: Ok, est-ce que… qu'est-ce que tu pourrais rajouter par rapport à ça? Est-ce que tu penses que les femmes pourraient faire aussi bien tous ces tests là que les hommes?
- ENFANT: Bah oui.
- Professeur: Ouai, ok. Donc la question maintenant c'est: qu'est-ce que le robot va faire? Comment il peut faire pour résoudre le problème? Donc on a compris que Marie, elle avait tout-à-fait les capacités d'être astronaute mais on lui a dit non. Et en plus c'est une directrice qui lui a dit non. Donc c'est une femme qui est directrice de la NASA. Donc là, il y a deux choix: soit le robot il dit à Marie "Bah en fait il faut que tu persévères". Tu connais le mot persévérer?
- ENFANT: [Acquiesce]
- Professeur: Ça veut dire, il faut que tu sois courageuse, il faut que tu continues à travailler pour montrer que t'es capable.
- ENFANT: [Acquiesce]
- Professeur: Soit, le robot il va voir la directrice et il lui dit: "Bah, t'as pas le droit en fait de dire non à Marie et surtout que toi t'a été une femme et t'es arrivé à être directrice donc t'as été un modele aussi pour Marie, donc c'est un peu mal…, c'est un comble que tu lui dise non". Alors qu'est-ce que tu préfères? Que le robot aille voir Marie, ça serait le bouton vert, ou que le robot aille voir la directrice et que ce serait le bouton bleu.
- ENFANT: Directrice! [Appuie sur le bouton bleu]
- Professeur: Ça marche!
- Robot: Super, je suis donc allé voir la directrice pour lui dire qu'elle avait été un modele de femme courageuse pour Marie. La directrice a alors changé d'avis. Merci pour votre aide, Marie a réussi à devenir astronaute et est très contente maintenant! Pour finir, je suis retourné voir le juge pour lui faire un résumé de ce que j'ai découvert à propos des inégalités entre hommes et femmes dans la ville. J'ai raconté

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