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TELEROBOTS FOR INFORMAL LEARNING IN SCHOOLS

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ABSTRACT

In the pre-pandemic world, it was estimated that 2.5 million children in the US were restricted to their homes due to medical risk. Sadly, in the COVID-19 (C-19) world and post C-19 world this number is expected to be much larger. As communities and schools return to in-person gatherings, many children will not be able to return to in-person school either due to their own health risks or the health risks of a family member. Awareness of this global reality highlights the urgent need to explore the use of inclusive technologies beyond the static screens of Zoom and online schools. As in-person schools resume, there is much we can learn from children and adolescents who pioneered the use of telerobots to not only attend school—but also to play.

1 Introduction

The importance of play in child development is widely accepted. The United Nations High Commission for Human Rights by Play highlighted that play is so important to optimal child development that it is recognized as a right of every child [1]. In both 2007 and 2012, the American Academy of Pediatrics published clinical reports on the importance of play [2, 3] and the World Health Organization, in its ICF-CY (International Classification of Functioning and Disabilities, version for Children and Youth) publication considers play as one of the most important aspect of a child's life to be considered when assessing children's quality of life [4, 5]. Additionally, research shows that the benefits of play are found in a mix of physical, social, emotional, and intellectual rewards at all stages of life [6].

In our work, we deploy telerobots to enable children restricted to home environments to remotely attend school. In this paper, we present a planned case study of "learning through play" as a subsection of our larger study on robot deployments, where children used telerobots to attend class, extracurricular activities, and social events. Empirical data on learning through play will allow for an in-depth exploration of the robot-mediated activities that occurred outside of formal learning activities and centered around self-directed "play."

2 Background and Research Questions

In our planned case study, "play" is operationalized as a self-directed activity that is 1) intrinsically motivated, 2) entails active engagement, and 3) results in joyful discovery [6]. In earlier work, we found participants to be motivated to attend school via telerobot even though the technical experiences may not have been ideal [7]. For many of our participants, the motivation to use the telerobot was social [8]. While all participants in our study used telerobots to attend school, a few of our participants extended their use of the robot to remain actively engaged in activities that were not required but desired for learning and play. Play activities were intrinsically motivated, displayed active engagement, and resulted in discovery.

The **research questions** driving our work for this planned case study include: 1) How do children use telerobots for informal learning? 2) What are the play activities that facilitate immersive learning experiences for remote children?

In our ongoing, national, multi-case study, telerobots are used for social and academic learning. These are commercially-available telepresence robots with varying degrees of semi-autonomous features (e.g., obstacle avoidance). As the main purpose of a telerobot is to facilitate communication and interaction between two humans, some participants were able to design and create their own social and play experiences with human peers in real-world environments. We

Figure 1: **VGo Robot in School**

found that children built on their foundational knowledge of social interactions and situations to create new scenarios of robot-mediated learning and play.

For our planned case study, we will use *Expectancy-value Theory*, a motivational theory that encompasses expectancies for success and subjective task values [9], and the Presence and Social Connectedness (PASC) framework [10] that identifies levels of robot-mediated 1) engagement, 2) self-perceived levels of presence, 3) peer-perceived levels of presence.

3 Design

Learners in our study are children who are medically restricted to their homes or hospitals due to medical conditions. In earlier work, some of our participants requested to use their telerobots to attend activities outside of formal learning. Our planned case study will explore in depth the activities that occurred in schools and centered around using robots for learning through play. Scholars have identified the difficulty in defining "play" and recommend that play be viewed as an aspect—and a function of—human development [11].

Scholars also posit that play is practice for the body, exercise for the feelings, and training for the mind [12]. As our planned case study is centered on the use of telerobots for play, our learning objective is "play" as an aspect of human development that affords exercise for the feelings and training for the mind.This learning objective takes place in the school environment in both formal and informal learning experiences.

In our work to date, we have empolyed VGo and Double telerobots as they are commercially available and are being used in our partner schools. (See Figure 1). Future work will use a mobile manipulator, the Stretch robot, by Hello Robot.

4 Assessment

In our prior work, we collected data as part of a larger case study that explores the interconnectedness of all participants in robot-mediated school experiences. Empirical data were collected via holistic case studies in a multi-case, qualitative exploratory study.

For our planned case study on robot-mediated learning through play, we will conduct cross-case analysis of data on play activities. We will use the Presence and Social Connectedness (PASC) framework [10] to analyze observation and interview data on robot-mediated presence and engagement in real-world extracurricular learning through play activities. The PASC framework will provide a consistent measurement tool for evaluating presence and engagement in these learning activities. The goal for our planned case study is twofold: 1) to explore robot-mediated learning through play, and 2) to provide recommendations on the design and social practices of telerobots to encourage play activities that promote informal learning experiences for remote children.

5 Related Work

Our planned case study on robot-mediated learning through play will be informed by our earlier work and also build on related work in the field. Prior research on child robot interactions [13, 14, 15, 16], culturally aware robots [17, 18], and anthropomorphism [19] will inform our work on social learning. Additionally, work on robots in learning and schools [20, 21, 22, 23] and robots in the wild [24, 16] will inform our research design as we plan future studies in our partner schools. We are also interested in leveraging recent work on robots in groups [25, 26, 27, 28, 29], to explore human-robot teaming within the context of students in schools.

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