My Student is a Robot: How Schools Manage Telepresence Experiences for Students

Veronica Ahumada Newhart
University of California Irvine
School of Education
Irvine, CA, USA
vnewhart@uci.edu

Judith S. Olson
University of California Irvine
Department of Informatics
Irvine, CA, USA
jsolson@uci.edu

ABSTRACT

Homebound students, those who can learn but have a serious health issue (e.g. cancer, heart disease, immune deficiency) that prevents physical attendance at school, are now able to go to school using telepresence robots. Telepresence robots are generally video conferencing units on remote-controlled robots. Previous research has shown that using these robots allows homebound students to interact with classmates and teachers as if they are physically present. But, what does this mean for teachers and administrators? We present a qualitative study of 22 teachers and school administrators who worked with telepresent students and 4 who decided against adopting the robot. Our goal was to learn how decisions are made to adopt the robot, what issues arise in its use, and what would make adoption easier. This study contributes new insights on teacher and administrator perspectives on what is needed for effective use of this technology in educational settings.

Author Keywords

telepresence; education; robots.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION

Due to advancements in pediatric medicine, many previously fatal childhood diseases are now chronic illnesses [5,10,16]. As a result, millions of children and adolescents in the US now live with chronic illnesses such as cancer, sickle cell anemia, asthma, etc. [1]. This has led to a growing population of children who are unable to physically attend school but still need to grow socially and learn. Traditional services for these students consist of 4-5 hours of home instruction per week. Unfortunately, traditional home instruction services are not designed to fully support these students' needs and do not provide any avenue for the students to establish or maintain social connections to their school communities. Studies show that inclusive educational practices result in better outcomes for students [4,9], yet current educational practices reinforce the exclusion of some children with chronic illness from school.

CHI 2017, May 06-11, 2017, Denver, CO, USA

DOI: http://dx.doi.org/10.1145/3025453.3025809

Recently, technology has created the opportunity to include the homebound child in school. Videoconferencing has been used in schools, [6–8] but very few studies have explored the use of this technology for homebound children with chronic illness. Some studies examined a technology solution for hospital-bound children, using a non-mobile telepresence robot, PEBBLES [2,17], shown on the left of Figure 1. The "face" of the robot showed the hospital-bound child's face, and the "head" could move to view different parts of the classroom, allowing others to know what the hospital-bound student was looking at. Since PEBBLES did not have independent mobility, it needed assistance when moving from one classroom to another, incurring a social debt to the helpmates.

Figure 1.From left to right, PEBBLES, VGo, and Double Robots used in schools

More recently, mobile telepresence robots, originally built to allow adults to work at a distance, have now been introduced into classrooms for homebound children. Both the VGo and Double (shown on the right in Figure 1) have videoconferencing on a screen and allow the homebound child to control both the camera and the wheel/s from home. The child can move the robot around the classroom and is also able to go to lunch, music classes, assemblies and even field trips.

Our research on these robots is guided by Deci and Ryan's self-determination theory (SDT). SDT argues that all humans have universal, innate psychological needs (i.e., competence, autonomy, relatedness) and that if these needs are met, people will function and grow optimally. However, in order for humans to actualize their inherent potential, the social environment must nurture these needs. Our research focuses on the social-contextual conditions of telepresence robot use in classrooms. More specifically, we look at how these conditions facilitate learning and contribute to improved well-being for homebound students. In this study, we examine the factors that facilitate the use of this technology from the perspectives of teachers and administrators as these are the people at the front line of implementing this practice in existing school systems. Without these educators, the robots cannot reach the students.

In our initial study, five students found themselves fully capable of using the robot, offering them feelings of competence and autonomy, two of the three universal and innate psychological needs that are central to psychological health and well-being [11,13,15]. All students claimed to feel included in class; classmates referred to the robot by the homebound child's name as opposed to calling it a device or a robot. And, parents noted significant increases in their children's interest and happiness at being with their friends, fulfilling the third need for psychological health and well-being, relatedness [15]. In one striking case, before a child was offered the robot, his mother attributed the child's decreasing energy level to his worsening heart condition. She even worried that he wouldn't have enough energy to use the robot. But from the first day of going to school on the robot, he attended school 6-7 hours a day, five days a week. He was not only motivated to do well in his regular classes, but he also auditioned for and made it into the school choir using the robot. The child's earlier low energy was later attributed to depression. In addition, the teachers consistently talked about the child returning to school, which gave the homebound child hope and motivation to do well.

This case study also provided information about what features of the robot, originally designed for use by adults in an office setting, would better fit the needs of children in a classroom with classmates and teachers [12]. We highlight some of these design feature recommendations in this paper, as it is important for educators to understand some of the most common challenges to using this technology in schools. Key to robot functioning is Wi-Fi connectivity, which is often spotty when the child is driving the robot in the school halls. Batteries are occasionally limited, requiring the child to interact only from the docking station. A better solution for connectivity would involve equipping the robot with a hotspot.

The robot's audio is key; video is secondary to its presence in the classroom, but essential for the homebound child to see. A wide field of view is important especially in navigation. The user interface for the homebound child was not a problem, since both the VGo and Double use a mouse, track pad, or arrow keys to move. The interface is simple, but one child complained of pain in his finger from hitting the arrow key so much throughout the school day. We recommend a game interface for movement, something most children are familiar with. A number of other recommended features emerged in these cases and the full paper [12] contains many more details and the incidents that drove the recommendations.

Questions remain, however, about the settings in which these robots reside: The school and the home. The previous literature does not cover how the ***school*** should make decisions about allowing a child to come to school on a robot, what to do about the fact that schools are now ***connected*** to spaces outside the school, and what features would help the ***teachers***, who are already burdened with work, to accommodate the student attending school via robot. Schools are complex social settings where many different groups (e.g., teachers, students, administrators, and parents) interact to shape a child's life experiences. There is no research to inform the creation of guidelines for how to make the decision to offer the telepresence robot to a homebound student for school attendance. There is also no research that reveals the special issues surrounding the bridge from school to an outside place, the home or hospital. As the telepresence robot industry expands into schools, the information provided to educators varies by robot manufacturer. In order to successfully support the use of this technology for vulnerable students who are homebound, the HCI and education communities must pioneer the efforts to establish guidelines for educators based on formal objective studies. By interviewing teachers and school administrators, we sought to explore practices and design features that would help make adoption easier. This paper focuses on the following three questions:

- What line of decision making in the school system leads to successful adoption of the telepresence robot?
- What issues arise because the classroom and the home (or hospital) are now accessible to the other via the telecommunications link?
- What would make the adoption smoother for teachers?

METHOD

We conducted interviews of 14 teachers and 8 administrators in 9 different schools who had experience with telepresence robots being used by homebound students to attend schools. The homebound students were in the following grades: K, 2, 3, 5, 6, and 9. In addition, we interviewed 2 administrators and 2 teachers who explored the use of the robots and declined to use them, one even after having purchased it. All interviews were semi-structured and lasted 20 to 60 minutes. Interview topics included the administrative decision-making process for allowing a robot in school, how the robot was introduced to the school and classmates, teacher/administrator perspectives on robot use, and any reports of resistance to using the robot.

Interviews were recorded, transcribed and coded to identify patterns, similarities, and dissimilarities across the cases. We used open coding with iterative labeling of sections of data with testing of the labels across all data sets until they settled into a consistent set [3]. The constant revision allowed for some codes to be subsumed under broader and more abstract categories.

RESULTS

Although there were a number of findings, we focus on the three research questions: The decision making process that led to successful adoption, the issues that arise because the robot provides a "bridge" between the classroom and the home or hospital, and ideas that would make the adoption smoother for teachers.

The Decision Process

Three major stakeholders were identified in all successful cases of robot deployment—parents, teachers and administrators. Any one of the stakeholders could veto the adoption. In the 9 schools where we conducted interviews, a school district administrator initiated 3 of the robots, a hospital administrator initiated 3 of the robots, 1 was initiated by a teacher, 1 by a former teacher, and 1 by a parent.

Getting Parent Support

All participants agreed that for the homebound student to use the robot, parent support was key. Administrators and teachers could initiate the idea, but the full support and cooperation of the parents/guardians was credited for success. All 22 participants who accepted the robot were strong supporters of the technology and were "excited," "thrilled," and "happy," that the child would be able to attend school via robot.

Gaining Board Approval

Once parents approved of the use of the robot for their child, district or school board approval was required. One school principal took a creative approach to gaining support from her district board. To demonstrate the potential of the robot as a participant in a learning environment, she attended the district board meeting via the robot. She rolled in as a robot and participated throughout the entire meeting as she normally would. She then made the formal request for one of her students to attend school via the robot. After the board gave her an "eye test" (i.e., made her go to the back of the room and read the board) and a "hearing test" (i.e. also made her go to a back corner of the room to see if she could still hear them), they approved the use of the robot.

Getting Teacher Support

Having parental support and district approval are two steps on the road to deploying a robot for a student. The third step is gaining support from teachers who will be interacting with the robot on a daily basis. Although all teachers were enthusiastic about the robot, one teacher reported feeling "nervous" and a little "scared." When questioned what motivated her to move ahead and do it, she replied, "I knew it was what he [her student] needed, so I did it." Her hesitations centered on being physically responsible for the robot and not knowing how to control it.

In schools where the decision was made to NOT use the robots, privacy concerns were cited as the main reason. In one school where two teachers were offered the opportunity to use a robot for a 1st grader with cancer, the teachers were strongly resistant. The student had been in their classrooms before diagnosis and they were not willing to reintroduce him to the classroom via the robot. Their main cause for resistance was fear that use of the robot would also allow the mother and other adults in the home to witness what happened in the classroom; posts about what they heard or saw might be made on social media sites. They knew that the mother of the child was active on Facebook and not always in positive ways. At another school, the deployment of a purchased robot was postponed indefinitely due to administrator concerns over a similar fear of the child's mother having access to the classroom and posting what she saw or heard on social media. We elaborate on this point in the next section about the "bridge" between classroom and home or hospital.

The Bridge Between Home and School

The robots used for students to attend school were off-the-shelf robots designed for use in offices and medical settings in the adult world. The only privacy/security features are the login password, an encrypted link, and the inability to video or audio record. There is nothing that ensures that only the student is seen in the classroom or that others in the home or hospital cannot see the classroom. One principal felt that her teachers needed what she called "safe space," echoing the major concern of the schools that did not adopt the robot.

Once the telepresence bridge between home and school is made, then aspects of the home (other children, dogs, parents, their objects and tidiness, etc.) are visible in school. Likewise, the bridge may allow for more people than just the homebound student to see and hear what is happening in school. Privacy of both settings is potentially violated.

Safe Space for Teachers and Classmates

One school created a safe space for teachers and classmates by requiring the at-home parent or adult to fulfill all the requirements and follow the school guidelines for a parent volunteer in the classroom. School administrators did not want to be excessively restrictive with the homebound parent so they transitioned the parent into the existing school structure of a classroom aide. By officially taking this role, it allowed the at-home adult to effectively 'enter' the classroom. In this role, the adult needs to be trustworthy and working within the parameters of school and teacher expectations to maintain student privacy and not discuss, verbally or online, what is observed in the classroom. In addition to officially becoming a classroom aide, the at-home parent/adult also had to agree that when the homebound student was attending school, the student would be seated where no one else in the home could view the classroom. We recommend that, when others are present in the home, the student wear headphones so others cannot hear the teacher or classmates and that the homebound student self-mute to minimize home noises from disrupting the class.

Safe Space for Homebound Students and Families

Viewed from the reverse direction on the bridge, classmates, teachers, and other school personnel now have access to the remote student's home. Most school children do not visit the homes of all their peers but the robots create an open bridge straight into that child's living room, dining room, bedroom, etc. It is just as important to have a safe space for the homebound student where items that are viewed or conversations that are overheard are not repeated or commented on. The VGo screen is fairly small and not much can be viewed beyond the student's head but other robot models, including the Double, have larger screens and may provide increased views of household items and people. In addition to visuals coming through the screen, sounds come through speakers and classmates in our study were aware of siblings, pets, and general household noises. An administrator made the recommendation that a curtain or screen be used behind the at-home student to prevent classmates and school personnel from seeing personal objects and to free parents from the pressures of "having visitors" view their house every day.

How To Make Adoption Easier for Teachers

Most educators have had little training on the needs of children with medical conditions in the classroom [14]. Teachers in our study were also not given much training on the function of the robot and no instruction on how to deal with the social complexities of the robot. One of the teachers who was excited to try it found herself "afraid to touch it" after it arrived. She was not sure what all the buttons were for or if she would inadvertently disconnect the student. One substitute teacher was unaware that a student would be logging in to the robot and turned it off against the homebound student's wishes. This prompted the homebound student to say he "hated" her. Most teachers found the physical robot fairly easy to accommodate in the classroom, not requiring any special arrangements beyond what a student in a wheelchair would need.

Experience with the robot led to a number of suggestions for design changes, which are detailed in Newhart and Olson [12]. Key for the teachers was the fact that the battery life was not sufficient for the student to stay connected for six hours of the day and to have the full mobility they needed. Inadequate battery life required intermittent docking throughout the school day. And, the Wi-Fi connectivity was often lost at router transition points, requiring the robot to be moved by hand to the next area. A teacher mentioned that "in between the hallways there were dead spots so that we would have to like push the robot a little to get it going again."

The VGo is equipped to announce its presence when it is first connected and its departure when disconnected. These announcements were annoying when they occurred because the robot inadvertently disconnected and then reconnected during lessons. This occupancy awareness feature could be replaced with a visual feature that goes on when the robot is occupied and turns off when it is not.

One frustration with everyday tasks for the teacher was that if there was a handout like a quiz or worksheet that was not delivered to the student at home in their box with the upcoming week's worth of material, it was difficult to include the homebound student in the exercise. One student cleverly helped the homebound student take a quiz by putting on earphones to hear the homebound student's answers as she read the questions to him. The ability to fax material back and forth would be a welcome addition.

The placement of the camera near the projected eyes on the face of the robot was important for keeping the student engaged, especially younger ones. One teacher reported that she made every attempt to keep the remote student engaged by "looking at his eyes and making sure he saw my eyes." When questioned about this practice she said it was what she did for all of her 2nd graders.

Several teachers expressed worry that they would be held responsible for any damage to the robot. To continue the theme of "safe space" for the teachers and increase teacher buy-in, administrators should make clear that the physical and financial responsibility for the robot lies with the school or district and not the individual teacher. Of all 14 teachers interviewed, no one knew who paid for the robot, who paid the monthly robot access fee, or who paid for the student's laptop or tablet. Transparency on financial responsibility of the program may ease teacher worries about an expensive piece of technology that is being placed in their classroom.

Schools should have clear guidelines on the selection criteria for use of the robot in order to provide equitable access to the technology. Once selection is made, how a robot is introduced to the school should be tailored along parent and student preferences. While a large production at a school assembly where the robot is rolled out and introduced to the entire school may suit some students, other students do not like being in the spotlight. One student in our study returned her robot because she "didn't like all the attention." The robot physically represents the student in her school community; how she meets and engages with peers should also socially represent the student.

RECOMMENDATIONS

From the descriptions above, we have recommendations for the social practices surrounding the adoption of the telepresence robot for including a homebound child in class.

For The Parents

We know that the parents' cooperation and support of the robot's use is key. Sometimes the parent has to be the initiator, advocating because they believe that having their child attend school on a robot will contribute to their child's well-being [15].

We recommend that the parent and child place the computer that the child will be using in a location that does not violate the household's privacy. Often this is the dining room or a study, not in the living room where there is a lot of traffic and visibility. We recommend that the child communicate with headphones and a microphone so that the classroom activities are not broadcast to others in the household and household activities are not broadcast to the classroom. Privacy is important for both home and school.

In addition, we recommend that the parents go through training as a classroom aide, so that they are aware of what appropriate behavior is for adults in the classroom. In particular, they are not to breach the privacy of their child, the teacher, or their classmates on social media. In many ways, the parent who is near the homebound child on the computer is like a parent attending the class.

For The School Administrators

The school administrators should bring the parents and teachers together to make the decision of whether the homebound child can attend school on a robot. Together, they will come to an understanding of the ground rules as well as the responsibilities and opportunities available. By working it out, they can become a model of inclusion for others.

The school administrators should make sure that the robot's communication path between the school and the home is encrypted, and that the parent has gone through training as a classroom aide. In addition, school administrators should take physical and financial responsibility for the robot, and communicate that to teachers.

School administrators should also plan for equitable access to the technology and how to introduce the robot to the school community and perhaps to the parents of classmates. Some homebound children welcome the attention; some do not. The robot introduction should include the needs and wishes of the parents, homebound children, and teachers.

For The Teachers

Like the parents and administrators, successful adoption requires the teachers' buy-in. But to make the teachers comfortable, they need the assurances from the school administrators that they are *not* responsible if something happens to the robot.

The teachers should be informed about the homebound student's capabilities and schedule. Some homebound children are undergoing therapy treatments, for example, and will need lesson schedules adapted for them when possible.

Teachers need to be trained on how to operate the controls on the robot itself. They need to know how to adjust the speaker volume, how to turn it on and off, how to move it if it gets disconnected, and how to dock it for power. These instructions should remain in the classroom in case a substitute teacher comes and needs to work with the robot.

Before formal introduction of the robot in the classroom, the child should have a special session with the teacher to determine the best placement of "the desk" so the child can see and be seen, hear and be heard adequately. If the child needs to move from room to room, this early session can include a guided tour of where they have to go (e.g. to the music room or the lunch room) and the student should be provided with a map of the school. The student can plot on the map where the connectivity is spotty so the teacher is aware of problem areas and the student can avoid those areas until the connectivity issues are resolved.

To support the inclusion of the child in spontaneous new lessons that involve handouts or quizzes, the school and the home should include fax machines or comparable transmission of tangible documents.

CONCLUSIONS

There is mounting evidence that using a telepresence robot to include homebound children in school is important for their social as well as academic development. In other papers, we have focused on the experience of social inclusion of the child, and design recommendations for modifying a robot so that it is a better fit for children in schools. In this paper, we focused on what school professionals can do to make the appropriate decisions about whether to attempt this intervention, and if so, what to do to prepare. Teachers and parents need adequate training on the technology and provision of safe spaces both in the home and school. We believe through better understanding of teacher and administrator perceptions and attitudes, more children with chronic illness will have the opportunity to experience school attendance via robot. Providing the opportunity for this practice is the first step towards conducting future studies to evaluate the effectiveness of this practice and improve the standard of educational services afforded to homebound students.

ACKNOWLEDGMENTS

This work is supported by the National Science Foundation, under grant ACI-1322304, a Focused Faculty Research Award from Google, and the Children's Hospital of Orange County, Hyundai Cancer Institute.

REFERENCES

1. Bruce E. Compas, Sara S. Jaser, Madeleine J. Dunn, and Erin M. Rodriguez. 2012. Coping with chronic illness in childhood and adolescence. *Annual Review of Clinical Psychology* 8: 455–480. http://doi.org/10.1146/annurev-clinpsy-032511-143108.Coping
2. Deborah I Fels, Judith K Waalen, Shumin Zhai, and Patrice Tamar Weiss. 2001. Telepresence under exceptional circumstances : enriching the connection to school for sick children. In *Proceedings of Interact*, 617–624.
3. Barney G. Glaser and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory*. Weidenfield & Nicholson, London.
4. James G. Gurney, Kevin R. Krull, Nina Kadan-Lottick, et al. 2009. Social outcomes in the childhood cancer survivor study cohort. *Journal of Clinical Oncology* 27, 14: 2390–2395. http://doi.org/10.1200/JCO.2008.21.1458
5. Neal Halfon, Kandyce Larson, and Shirley Russ. 2010. Why Social Determinants. *Healthcare Quarterly* 14, October: 8–20.
6. Susan B. Hopper. 2014. Bringing the World to the Classroom through Videoconferencing and Project-based Learning. *TechTrends* 58, 3: 78–89.
7. Jukka Hussa. 2012. Distance education in the school environment: Integrating remote classrooms by video conferencing. *Journal of Open, Flexible, and Distance Learning* 2, 1: 34–44.
8. Tony Lawson, Chris Comber, Jenny Gage, and Adrian Cullum‐Hanshaw. 2010. Images of the future for education? Videoconferencing: A literature review. *Technology, Pedagogy and Education* 19, 3: 295–314. http://doi.org/10.1080/1475939X.2010.513761
9. Gary R. Maslow, Abigail A. Haydon, Annie-Laurie McRee, Carol Ann Ford, and Carolyn Tucker Halpern. 2011. Growing up with a chronic illness: Social success, educational/vocational distress. *Journal of Adolescent Health* 49, 2: 206–212. http://doi.org/10.1016/j.jadohealth.2010.12.001
10. Lidwine B. Mokkink, Johanna H. Van Der Lee, Martha A. Grootenhuis, Martin Offringa, and Hugo SA Heymans. 2008. Defining chronic diseases and health conditions in childhood (0-18 years of age): National consensus in the Netherlands. *European Journal of Pediatrics* 167, 12: 1441–1447. http://doi.org/10.1007/s00431-008-0697-y
11. Veronica Ahumada Newhart. 2014. Virtual inclusion via telepresence robots in the classroom. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems*, 951–956. http://doi.org/10.1145/2559206.2579417
12. Veronica Ahumada Newhart and Judith S. Olson. 2016. Going to school on a robot: A case study to illustrate important design considerations of telepresence robots. *Manuscript in Preparation*.
13. Veronica Ahumada Newhart, Mark Warschauer, and Leonard S. Sender. 2016. Virtual inclusion via telepresence robots in the classroom: An exploratory case study. *The International Journal of Technologies in Learning* 23, 4: 9–25.
14. Ardis L. Olson, A. Blair Seidler, David Goodman, Susan Gaelic, and Richard Nordgren. 2004. School professionals' perceptions about the impact of chronic illness in the classroom. *Pediatrics & Adolescent Medicine* 158, 1: 53–58. http://doi.org/10.1001/archpedi.158.1.53
15. Richard M. Ryan and Edward L. Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American psychologist* 55, 1: 68–78. http://doi.org/10.1037/0003-066X.55.1.68
16. Sandra B. Sexson and Avi Madan-Swain. 1993. School reentry for the child with chronic illness. *Journal of Learning Disabilities* 26, 2: 115–125, 137. http://doi.org/10.1177/002221949302600204
17. Jason Yeung and Deborah I. Fels. 2005. A remote telepresence system for high school classrooms. In *Canadian Conference on Electrical and Computer Engineering*, 1465–1468.