Using a Telepresence Robot in an Educational Contex

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Abstract—*This paper deals with the use of telepresence robots in an educational context. To this day, these uses are often related to the problematic of "homebound students"* [1]. *The emphatic context associated with these students masks the pedagogical difficulties encountered by telepresence learners. In this article, we first detail the use of the robot by homebound students, highlighting motivational factors. Then we focus on persistence using the robot, once this emphatic context declines. Finally, we describe our attempts to reduce transactional distance by adding connected learning environments.*

Keywords: telepresence robots, motivation, transactional distance

1. Introduction

For the last few years, we have witnessed an intensification of the experimental use of telepresence robots in the educational system. In France, a recent study in the Auvergne Rhône-Alpes French area (AuRA) has reported the findings of a classroom use for students who are homebound[1]. Other studies [2] [10] have enforced these results and show that the main added value of telepresence in this context is the preservation of the social link between the students, the school, the teachers and especially the classmates. This preservation is an important guarantee of school continuity and the reduction of the risk of dropping out. However, beyond the psychosociological impact, questions about learning opportunities via telepresence robotics arise. Indeed, several difficulties come to disturb the distant student [3], for example the difficulties of perception of the teacher's and classmates' body language (virtual proprioception) due to a wide-angle camera, or the perception of the "Me-robotic" and the new form of socialization allowed by this mechanical avatar [4]. The teacher may also be disturbed in the realization of his/her task to take into account the specific "presence" of this student, including the student in the didactic situation and follow the evolution of his/her learning, especially in the case of practical and skill assessments. After the positive impact of the robot during the first uses, a dropout over time can sometimes be noted, due to a too large transactional distance [5] correlated to a lack of practical adapted features in the telepresence device. Several projects have begun to explore these difficulties. J. Bell [6] studied the feeling of presence (incarnation) of distant students in hybrid teaching, from videoconferencing to the use of the telepresence robots. It appears that the mobility of the robot is essential to getting closer to a feeling of physical presence. Gleason [7] confirms Bell's results and emphasizes the need for appropriate pedagogy. Newhart and al. [10] [11] study the feeling of acceptability of the robot from a teachers and administrators point of view. In all these works, the sociological and psychological aspects are taken into account, but the didactic part is little discussed. In addition, pedagogical situations of the use of a robot are limited to simple verbal and visual interactions (course / exercises). The use of a robot in practical work is little or not treated [8].

In this paper, we propose a preliminary analysis of the use in duration (perseverance) of telepresence robots in an educational context. We base our analysis on SDT theory [9] to assess the motivation while using the robot. More precisely, we focus on what happens after several sessions of robot uses in the classroom, that is, once the impact of novelty and empathy for the homebound student fades. We then relate some experimentations done to increase the capacity of the interactions of the robot with humans and distant space, in order to reduce the transactional distance [12], induce the student a perception of success and control, and then keep him/her engaged and motivated.

[1]as defined in [11], "homebound students" are students who are not able to attend school for a long time, due to symptoms, treatments, or recovery from illness, (e.g., cancer, heart failure,...)

2. Background

2.1 SDT theory

The Self Determination Theory (SDT) [13] is a psychological theory which can be applied to education in order to understand the learning process and how to motivate students and continue to attract their attention. It is based on the innate psychology needs of: autonomy (need of being actor of his/her own life, making his/her own choice according to his/her preference), competence (need of controlling and being competent in a domain in which he/she was interested) and relatedness (need of interacting with other people). Deci and Ryan [13] define student motivation as the combination of two factors : external motivation, which is provided by an outside help (teacher, classmate, ITS, chatbot, ...), and internal motivation, which is provided by the perception the student has of his/her ability to accomplish pedagogical tasks. Internal motivation is always stronger than external motivation. On this basis, the whole motivation of a person to accomplish a task can be classified into three levels: global, contextual and situational. Each level describes a different evolution time scale. The global level addresses motivation that comes from the social environment, religion, etc (long time range). The contextual level addresses motivation that comes from the context of the student's environment, as for example the school context (medium time range). The situational level addresses motivation from the current situation in which the student is at a given moment (short time range). Situational contexts are the strongest (but the shortest) contexts. On the other hand, global contexts are the weakest over a short period of time, but are persistent throughout life. Changing a contextual perception can only be only achieved by repeating many times over situational contexts in which the student has a feeling of success and control (positive perception of his/her skills).

In the case of the use of a telepresence robot by a homebound student, the first uses of the robot in the classroom are associated with a strong situational context (short range duration) in which the whole motivation is induced by novelty and empathy. At this time, the student, classmates and teacher are not guided by educational concerns. As described by Newhart in [10], a bridge is created between the teacher, classmates, and the homebound student. This bridge does not only include social aspects, but also the remote spaces. Some rules must be defined to ensure a safe bridge between stakeholders. We address this point in section 3.

Gradually, the initial context is replaced by the educational solely (contextual level, weaker but more persistent), in which the questions on how to learn through a robot, how to evaluate knowledge and skills through a robot, and how to insert a robot in pedagogical activities are asked. At this time, interactive capacity of the homebound student through the robot is leading motivation. The more functions are numerous and effective, the more motivation and persistence are present. The adequacy of the robot's capabilities with teaching tasks is closely related to the transactional distance.

2.2 Transactional distance

Transactional distance (TD) is defined by Moore [12] as the degree of psychological distance between the student and the teacher. It can be quantified as a function of three variables : dialogue, structure and learner autonomy. In [13] Zhang proposes to refine TD into three items : transactional distance between student and teacher (TDST), transactional distance between student and student (TDSS) and transactional distance between student and content (TDSC). Anderson [14] suggests that the smaller these measures, the more satisfying the learning experience, and as a result, more substantial erseverance. In online distance learning, traditional TD relies on technological mediation. Weidlich [5] proposes a definition of TDTECH, which assesses the transactional distance of the learner and the interface or technology. He argues that this extent depends on two factors: "(1) the basic proficiency of the student in using the necessary technology, (2) the design and functionality (e.g., usability) of the technology itself, as perceived by the student". TD is perceived as "an interplay of these two factors".

In [15], Hung proposes a framework to understand and assess students' readiness in online learning. He demonstrates that modern students are used to computer-mediated communication, with a high confidence in his/her computer/network skills. More precisely, in the context of online learning, students show a strong readiness in computer/Internet self-efficacy, motivation for learning, and online communication self-efficacy. Self-directed learning and learner control are the weakest items. In [5] Weidlich fits his first TDTECH factor (student proficiency) with Hung's computer/Internet self-efficacy. In other words, he demonstrates that modern students have a good proficiency in using new technologies in learning.

TDTECH mainly depends on the functionalities the robot offers. The course topology has also a major impact. The interactions between the distant student and others humans involved in the pedagogical situation (classmates, teacher), and also between the student and the distant space, are different depending on this topology. For example, in the case of a lecture, the student only needs to listen and take notes. In the case of lesson exercises, the student must be able to interact with the teacher, but also with his/her classmates, in order to ask questions or to show his/her work. Finally, in the case of practical work, the student must also be able to interact with the distant space, carry out practical manipulations, or when this is not possible, play a clearly identified role in the group of students to which he/she belongs. So, oral, visual, document sharing and physical capacities of the robot are primary.

3. Our project

3.1 Overview

Our project comes from the collaboration of the Computer Science Lab of the University of Pau, in France, and SAPAD 40 (organization for a pedagogical help of homebound students, department of the Landes (40) in France). These organizations help homebound students during their convalescence, and help to finance home classes. But it is not always easy to find teachers who agree going to a student's home, because of the geographical distance, or because there is are not enough teacher in the desired specialty. The use of telepresence robots is a solution. Since 2015, 24 students are benefitted from the use of a robot. In the following, we give a feedback of these uses, focusing on the efforts we made to ensure that the robot could be used in the students' incourses, all through their convalescence.

The description is chronological. First, we place ourselves in the first context where novelty and empathy induces the stakeholders's motivation. In this part, two sub parts are differentiated : the first (section 3.2) deals with the actions to prepare the arrival of the robot. The second (section 3.3) refers to the first uses in a classroom, and the creation of a safe bridge between stakeholders.

After some sessions of robot use, the initial context fades and is replaced by the educational context. In section 3.4, we relate the possibility of how to continue to be engaged in the use of a robot, by adding a dedicated connected learning environment that reduces the transactional distance, and the risk of dropping out.

3.2 Preparing the arrival of the robot

The preparation of the stakeholders at the arrival of the robot is essential. The more effective this preparation, the more involved the various stakeholders in the use of the robot, and the more the first context (the strongest in terms of motivation) lasts in time. On the other hand, poor preparation risks to see the first context quickly disappear and give way to the difficulties of teaching a robot, with a high risk of dropping out. In the remainder of this section, we describe the key points to which we paid particular attention for each stakeholder

3.2.1 Choosing the right robot

As we noticed before, the first uses of a robot are accomplished in a very strong context, driven by novelty and empathy. But this context fades quickly, and is replaced by the educational context, in which several pedagogical difficulties appear, and can be a reason for dropping out. At this time, the motivation is clearly impacted by the capacities of the interaction of the robot (TDTECH). Depending on the topology of courses the homebound student takes, the choice of the robot can be a benefit or an obstacle to motivation. For example, if courses are given in a small classroom, with little space between the tables, a cumbersome robot will make the distant student feel that he/she is disturbing the rest of the class from the moment he/she wants to move the distant robot. In the case of a lecture, a good video quality is a real advantage to see what the teacher is writing on the board. So the initial choice of the robot is essential for motivation, depending on the school environment, and the courses the homebound student is taking.

We have experimented 3 different robots : Double from Double Robotics, Beam from Awabot/Suitable Technology, and Ubbo expert from Axyn Robotics (Fig. 1).

Each robot has different technical characteristics which impact the perception the student has, and so TDTECH. A summary of some of these characteristics is given in Table 1.

Our experience shows that connection problems are the main factor of impact on motivation to use the robot.

Fig. 1: Used telepresence robots

Table 1: list of technical capacities of telepresence robots

	Beam	Double	Ubbo
cameras	2	2	2
video quality	++	+	+
audio quality	++	+	+
head height	fixed	variable	fixed
rotating head	no	no	yes
obstruction	medium	small	high
zoom	x2	x2	x2
weight	- (20kg)	++ (7 kg)	+ (13kg)
stability	++	-	++
battery life	2h	4h	4h
driving	easy	medium	medium
configuration/boot	easy	medium	too coplicated
network connection issues	variable	not a lot	medium
Impact on TDTECH	++(SMALL)	+(MEDIUM)	+(MEDIUM)

TDTECH is mainly impacted by this factor. The quality of video and sound is also important. This leads us to systematically use 4G connections, instead of Wifi, to avoid problems of sensibility, roaming while moving in the classroom, sharing of bandwidth, and sometimes authentication issues. The weight can also be a problem if the robot has to be carried by students, for example to go from one floor to another. Finally, obstruction can be a problem in some cases, especially in crowded classrooms (handbags on the floor), or in classrooms with little space between tables. Other characteristics seem to be less important. For example, a short battery life is not necessary a problem: homebound students are not connected all through the day long, because of a poor capacity of concentration, medical cares, …Furthermore, during a session, the robot rarely moves, which extends its battery life. Finally, a lunch break seems sufficient to recharge the battery.

Notice that connection issues do not only occur in school, they also appear at students' home. This leads us to also adopt 4G connections for the student. Unfortunately, this is not always possible at a hospital, or in some rural areas. In these cases, after one or two attempts, the connection problems become stronger than the need to recover the social link, and the student stops using the robot.

As mentioned by Newhart [10], ensuring a good technical bridge between distant spaces (classroom and student location) is essential for motivation.

3.2.2 Preparing the homebound student and his/her parents

The major issue for the family is the fear that the homebound student will be further marginalized by other students in his robotic form. This feeling is not related to technology, but to the social link with classmates. Moreover, they are convinced that the teachers will accept the presence of the robot in the classroom. This feeling comes from the educational background they experienced, where the teacher is seen as a caretaker, somewhat like a parent. It is difficult to make them accept that their child may not attend certain classes because the teacher refuses the robot in his/her class.

The first fears of the student are about self-image: some have not seen their classmates for a long time, and illness and treatment may have altered their physical appearance. They are reassured when they learn that they can choose the image they want to show the class (photo for example) or no picture at all. This technological functionality can generate strong motivation in this context, but even if the robot does not have this feature, it is always possible to disable or mask the webcam from the cockpit.

We always perform a pre-connection test between the robot and the homebound student. In order not to be disturbed by the desire to recover the social link with the school, for this test, the robot is located in a neutral place (in a room of our university), allowing to focus only on the technical aspects. At the end of this test, it is rare that the student does not want to continue, which shows that the ability to use this technology is strong (as mentioned by Weidlicch [5]). In the rare cases where the student refuses to use the robot after the first test, the reasons are mainly related to problems of self-image, not technical issues.

3.2.3 Preparing teachers

The introduction of a robot into the classroom generates a first reflex of mistrust from teachers. The presence of a camera in a classroom is not trivial. During his/her class, the teacher is master, and this moment is "sacred". Opening it to the outside world is not easy and the tool can be considered voyeur. We know perfectly well the excess in recent years of student publications on social networks, degrading videos of teachers in their classes, and the impact that these acts have had on the profession.

At this first point comes also the fear of being faced with the reality of the disease. The "world of absence" in the school environment is indeed devoid of all humanity: the disease gives rise to immediate empathy, but the daily routine of the class makes us accustomed to this absence. When the student is not present, he/she may be considered as not existing in the class group, that is to say that one does not measure (and one does not try to measure) the impact of the illness on the student and his/her schooling. Teachers discover the reality of this world of absence on the day the robot arrives in their classroom.
But our experience shows that the reality of using the robot is different. Indeed, as we already said above, the disease is far from being omnipresent in the image which is sent by the robot (we only see the face of the student). Its acceptance is all the more facilitated, and very quickly, when teachers behave with the robot as with an "ordinary" student. We have even experimented that a teacher, extremely reluctant to introducing the robot in his/her class, regrets at the end of the year not to having tried the experiment, convinced by feedback from his/her colleagues.

Another important point is that the teacher does not want to be responsible for any problems on the robot. This covers both the connection problems, but also potential breakage during his/her course.

All these reluctances can be eliminated by discussing with the teachers on the forehand, showing them the merits of the process, and especially by having them driving the robot, to reduce the fear of this new technology, reducing TDTECH from their point of view, and better understand how the student is perceiving the class.

3.2.4 Preparing school board

The school board has a key role in the initial context. As we have seen before, at this first stage, the main initial obstacle is the teacher. Obtaining the support of the administration (hierarchy of teachers) is very important to "help" him/her, when necessary, to make the effort to accept the robot in class. But the board must also be reassured on certain points. The robot appears as an expensive technological tool (each robot we use costs approximately 5000$), and the problem of responsibility which arise in case of breakage, theft or breakdown. Secure storage when the robot is not in use can also be a stuck point.

3.2.5 Preparing classmates and choosing referents

The role of classmates is central. The homebound student wants to be able to attend classes mainly to leave his/her medical environment, to find a "normal" environment. Classmates also want to understand why their friend is not present.

One important thing is identifying in the classroom one or two of the homebound students' friends who can become referents. To be a referent means to be the guardian of the robot, and thus the guardian of the homebound student. The main tasks that are assigned to a referent are: 1) collecting and returning the robot to its storage point as soon as possible (morning, noon, evening) preventing the battery from discharging 2) solving the technical problems encountered during lessons (sound, camera, disconnections, ...) 3) exchanging with the remote student as soon as the situation requires it (sending pictures of the whiteboard by MMS, specific request when the student does not want to disturb the teacher, ...). The referent is a key element that reassures the teachers, who do not have to deal with the robot during their course, and reassures the administration, knowing that the robot is never forgotten in a class. Nevertheless, this task is heavy, and should not become a burden for this referent student. So the best is to find two or three referents in the same class who can alternate, for example every day.

Clearly referents are a key point. They mask technical issues to teachers and the homebound student, increasing his/her motivation, and so decreasing TDTECH.

3.2.6 Summary

In Table 2 we summarize the main key points which have an impact on the motivation of the homebound student in using the robot at the first stage. Clearly, the most critical stakeholder is the teacher. From a student point of view, the more the teacher seems invested in the insertion of the robot in his/her classes, the more the student is persevering.

The use of referent students is a crucial point, which makes it possible to partially discharge the teacher and the distant student from technical problems, and allowing them to focus more on learning. This is the element of our process that significantly decreases the transactional distance at the start of the robot use.

Table 2: summary of key points for motivation at the first stage

	student	family	board	classmates	teachers
Illness				Empathy	Fear
Student image	Fear				
New technology				Exciting	Fear
Responsibility			Fear		Fear
Marginalization		Fear			
Video capture					Fear

3.3 First uses in classroom

The appearance of an ailing student in a classroom in the form of a robot at first generates surprise (see Fig. 2), and quickly empathy and solidarity among students. There is no problem of image or marginalization. It may even happen that the ailing student goes, in the class, from being in a position of weakness (because of his illness) to a position of envied (the "master" of the robot), a paradoxical situation that obviously has a strong impact on the motivation of the homebound student. We must admit that the image returned by a telepresence robot is easier to accept than the image of a student who is bedridden or physically impaired, especially since each student who uses the robot chooses the image he/she will present in front of the camera. This allows he to continue to benefit from the positive aura of the robot, without letting the image of the disease take over.

It is undeniable that the presence of the robot causes a "shock" in the class, and partly changes its atmosphere, apparently to us, rather positively. When the robot is present, each student becomes more responsible than normal. For example, students will more easily self-discipline at the level of chatter, to allow "the robot" or rather the homebound student

Fig. 2: Catherine driving the robot for the first time as part of practical work in aeronautical construction classroom

to hear well what the teacher says. They are silent when the homebound student wants to ask the teacher a question. Although we have been able to observe these behavorial changes, further study will be needed to determine what the real sociological levers on which the robot has an impact, are. This study has, in our opinion, all its interest in Middle Schools, where we know that relations to others are fragile and in full construction. It should show that the tripartite teacher-student-class social link is the main driver of the homebound student from using the telepresence robot, and that classmates are particularly attentive to this factor.

The arrival of the robot has at the start a positive impact on the motivation of all classmates. But quickly, new difficulties appear. Indeed, the interactions between the actors and the remote space are limited through the robot. This inevitably has a negative impact on the quality of the knowledge and know-how accumulated by the distant student. The use of the robot in an educational context is not enough. It must be complemented by interaction tools with the different stakeholders and also the remote physical space to get closer to a physical presence, and reduce the transactional distance. In the following, we describe some solutions we have experimented for that.

3.4 Decreasing transactional distance by adding a connected learning environment to the robot

This experiment was conducted at our university, after one of our undergraduates has injured his knee (Terry), and had to convalesce at home for several weeks. We proposed to use a telepresence robot to follow certain important courses (Mathematics (lecture and exercises), English (lecture and examination) and IP telephony (lecture, exercises, practicals and practical examination)), with different typologies: courses, exercises on the course and practical work. We created connected learning environments dedicated to each typology. By connected learning environment, we mean a set of digital tools, remotely accessible by Terry, which allow him to interact with the distant space, to perform the requested manipulations. The robot allows Terry to move

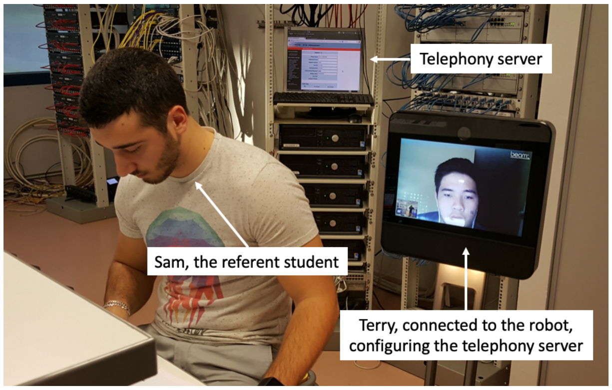

Fig. 3: Terry and Sam in the practical works room

around the room to collaborate with the other students in his group, and interact with his teacher. A referent student, Sam, helped Terry when he was using the robot (Fig. 3).

3.4.1 Course typology and transactional distance

In the case of a lecture, the student needs to see and hear the teacher, sometimes talk to him, and to see the whiteboard well. He does not need any interaction with other learners. Necessary documents can be distributed electronically beforehand. All these needs are covered by the intrinsic capabilities of the robot. It is not necessary, in this typology, to add additional functionalities. The transactional distance arising from the use of the robot is weak. It only has an impact on TDST. Note that, occasionally, having a good view on the whiteboard is not always possible, due to certain conditions such as brightness. An extra camera placed near the whiteboard, may be a good solution. Another sensitive point is the notification of request to speak. Often, students cut their microphone not to interfere with the teacher. Signifying that they want to ask a question then becomes an issue. Some robots offer a led panel that can be cloven to signal his request. For other robots, it is possible to add a small lamp on the webcam of the cockpit of the robot, in order to flash the screen, and report to the teacher.

In case of lesson exercises, things are different. In addition to the need for interaction with the teacher, the student must be able to interact with his/her classmates, especially in group work. The student must also be able to show his/her work to the teacher and classmates. This feature exists on some robots in the form of sharing the cockpit screen. However, in that case the image of the student cannot be seen anymore and interactions becomes thus less natural. Moreover, the student must also be able to see the work of classmates. Robots possessing the ability to climb / descend / turn the head, give the student this power. Without these capacities, the use of the robot increases TDTECH, with an impact on TDST and TDSS. A possible remediation is the taking of a photo and sending it using MMS between the referent and the student.

The more critical typology is practical work. As in the

Table 3: Impact of course topology on TDTECH

	TDST	TDSS	TDSC	TDTECH
lessons	X			small
lesson exercises	X	X		medium
practicals	X	X	X	high

case of lesson exercises, the student must be able to interact with classmates and the teacher. He/she needs to share documents. But he/she must also be able to perform physical actions in the classroom, at least to collaborate with his classmates. In this typology, TDTECH is high, and impacts TDST, TDSS and also TDSC. Adding functionalities to permit the distant student to interact with the distant space is not always possible, and depends on the subject. The transactional distance can be reduced in some cases by adding an adapted pedagogical connected environment. For example, in computer science practical work, it is quite easy to offer distant connections to computers, servers, IP telephons to the distant student. But the transactional distance can also be decreased by adapting the educational objectives set to the remote student. For example, during chemistry manipulations, if it is impossible for the remote student to handle dangerous products, he can, on the other hand, guide his colleagues in their manipulations, create curves, and search documents. He/she can also film manipulations, so that he/she can analyze it later. In this case, despite the difficulties in handling, the remote student still feels like being part of the group. He/she plays a role and participates in the realization of the training sequence (team cognition). This feeling of controlling his/her pedagogical activity is a mechanism that generates strong intrinsic motivation.

3.4.2 Description of the connected learning environments used

In our experimentation, for each lesson typology, we associated a dedicated connected learning environment (Fig. 4) without changing any pedagogical objective. For lesson exercises, we proposed Terry to use a shared whiteboard through a tablet, and a share file storage space for persistent works. These abilities could both be used when interacting with the teacher, or with classmates. Clearly, this solution was great for Terry, but faced another problem: some teachers were not used working with these numeric tools, and refused to use them in their class. TDTECH increased, not because of the student, but because of the teacher.

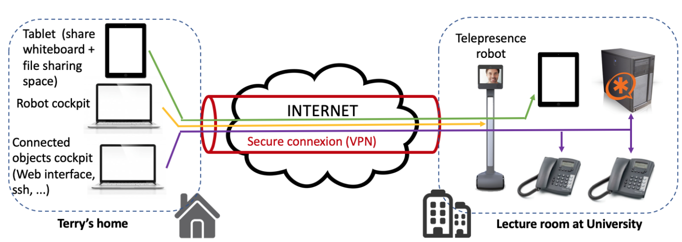

Fig. 4: Connected learning environments

For IP telephony practical work, we used a VPN connection between Terry's house and our university, to allow him to connect to servers, IP telephones and the robot. Notice that Terry made his practicals examination in telepresence, under the same conditions as his classmates. He also took the TOEIC exam[1] in telepresence. He had no problems with distance, and passed both exams successfully.

3.4.3 Analysis

We conducted interviews with Terry, Sam, and the teachers who participated in this experiment, to get their opinion on the positive or negative impact of the connected learning environments associated to the robot (see [8]). The results of these study are:

- knowledge and know-how (TDSC): the opinion is unanimous for knowledge, there is no difference between face-to-face and distance. At know-how level, Terry felt at ease. Teachers recognized that the essential topics were validated. The connected pedagogical environment has therefore played its role well at a TDSC level.
- interactions with teachers and classmates (TDST and TDSS): teachers recognized that their interactions in class with Terry were equivalent when using the robot compared to face-to-face. They observed the same qualities and deficiencies in Terry while communicating to his robotic form compared to face-to-face: very little intervention in mathematics, a lot of participation in English. In practical works, telepresence did not prevent him from chatting and laughing with classmates. Obviously, the use of the robot did not change his attitude, nor that of the teachers. Note that the math teacher, initially reluctant to use document sharing tools, acknowledged that this would ultimately be a good thing for her interaction with Terry
- interactions with distant space: in practical works, there was a before and after connected learning environment. Before, Terry was an observer, and could only observe the work of his classmates. Using the dedicated pedagogical connected environment, he was able to be active, to realize on his own remote manipulations, and learn by practice, a fundamental element of pedagogy. Comforted in his abilities, he agreed to take the risk of doing his IP telephony exam at the same time as classmates. He scored 12/20 with the same exam compared to others.

This study shows that the use of a connected learning environment greatly facilitates significantly the insertion of the telepresence robot into the pedagogical sequences, and reduces the transactional distance. A larger study, with a strong validation, should be conducted to confirm these preliminary results.

[1] https://www.etsglobal.org/

4. Conclusion and perspectives

In this paper, we tackled the problem of perseverance in using telepresence robots for homebound students. We have shown that once the initial emphatic context has passed, pedagogical difficulties appear when taking into account the student in his robotic form in the teachings. We have described several examples of connected learning environments that reduce the transactional distance.

In future work, we are thinking of consolidation our first results through a broader study, taking into account in particular the team cognition dimension, so important in the world of education. We haave started experimenting with a telepresence escape game, to see how the players collaborate in the same physical space, while they are all physically distant from this space. The conclusions of these works should allow us to create telepresence learning at our university, for professionals who can not move physically, or for lifelong learning.

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