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A telepresence robot for a better orientation at university

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Abstract. This article presents the first results of the use of telepresence robots to allow high school students absent from our University, to discover our courses in telepresence, and assist them in their academic pathway. After presenting the project, we detail the process built to use the robot. Then we give the results of a survey conducted among the first pilots regarding the immersive activity itself, and the impact of the use of the telepresence robot

Keywords: telepresence robot, orientation in higher education

1 Introduction

In recent years, telepresence robots have appeared in the French educational environment. A major project of the French Ministry of National Education, Youth and Sports, called TED-i, is currently underway to deploy 4000 of these robots in French schools [1]. They are used to enable students, unable to attend classes for health reasons for a long period of time, to maintain social ties with their classmates and the teaching staff, and to participate in real time to the educational activities of their class. The robot is positioned in the classroom with the rest of the group and the student who is unable to attend can connect to the device during lesson times. The absent student is thus totally immersed in the educational session, at the same time as his/her classmates. The mobility of the robot allows the student to multiply the activities to be carried out: choose the positioning of the robot in the classroom, participate to group work, visualize manipulations in practical works, discuss with his/her peers, . . . The student can also follow classmates during interactions, lunch breaks, . . . and thus recover the generational social tie essential, especially for adolescents.

The student, homebound for medical reasons, is not the only application context for telepresence in education. The French PIA 3 ACCES [2] project, which brings together the Universities of Bordeaux (Pau and Pays de l'Adour, Bordeaux, Bordeaux Montagne), aims to improve the orientation of high school students (especially during their final year) in education. One of the actions implemented to achieve this objective is the use of telepresence robots. Students use it to be present in a university course, without leaving their high school. They can then discover these courses and the University environment without being physically present at the university.

This article is a feedback of the first telepresence immersive sessions carried out at the University of Pau and Pays de l'Adour.

Section 2 gives a short state of the art of the use of telepresence robots in education. Section 3 succinctly presents the ACCES project and its objectives. Section 4 details the organizational set up to use the robot in the immersive sessions. Section 5 is devoted to the analysis of a post-activity questionnaire conducted among high school users. Finally, section 6 concludes and gives perspectives to this work.

2 Related works

The use of telepresence robots in the classroom dates back to more than 10 years. Tanaka and al. [3] experiment how to link children across the world through telerobotics. They demonstrate that, even if the students do not speak the same language, interactions are more important when using a telepresence robot than using a visio-conference system. Bell and al. [4] experiment several kind of telepresence solutions in class: visioconference (called 2D telepresence), "table" telepresence robots (called 2,5D telepresence) and mobile telepresence robots (called 3D telepresence). They conclude that 3D telepresence gives a higher feeling of immersion to distant students. Coureau-Falquerho and al. [5] make a very comprehensive study of the use of 60 telepresence robots in France for students absent from their school for medical reasons. They conclude that the main benefits are: not dropping out, maintain social ties with peers, more solidarity between students, and play a part in an innovative project. On the other hand, the main negative points are essentially technological issues: hearing and vision problems, difficulty to move within the classroom, bad connections ... They also point out that a human assistance is necessary to troubleshoot when technical issues occur. Newhart and al. [6] study the reasons why teachers and administrators adopt or reject the robot, and propose some elements to improve the robot acceptance. In [7], they explore potential design improvements of the robots to better fit childrens' needs. Gleason and al. [8] study the potential of teaching and learning with robot-mediated communication. They conclude that it "offers advantages over traditionally used video-conferencing, including affordances for fostering students' embodiment in the classroom, their feelings of belonging and trust, and their ability to contribute ideas in authentic ways". In [9], the authors explore the motivation of students in using the robot in time (persistence). They also analyse the impact of using additional educational connected environments to increase the feeling of presence, and then the engagement in pedagogical activities. All these works confirm that the use of the robot gives a strong feeling of presence to the pilot. But that it is also necessary to support its use to solve technical problems, and reassure the pilot and remote people. Under these conditions, the use of the robot can be optimal. This is what we experienced in the context of remote immersion of high school students in higher education, without being physically present at the university. We evaluate both the interest of the immersive sessions, and the impact of the robot on the quality of this immersion. These experimentations are supported by the French PIA 3 ACCES project.

Table 1: Details of telepresence sessions

H. School	Session	Course typo.	Taught subject	#students
1	1.1	pract. work	Chemistry	3
	1.2	pract. exerc.	Chemistry	2
	1.3	lecture	Law	4
2	2.1	pract. work	Chemistry	2
	2.2	pract. exerc.	Chemistry	4
	2.3	lecture	Law	3
3	3.1	pract. work	Chemistry	2
	3.2	pract. exerc.	Chemistry	1
	3.3	lecture	Law	2

3 Presentation of the ACCES project

In France, the last year of high school ends with a national exam, called baccalaureate. Students must pass it to continue their studies in higher education (universities, engineering schools, ...). While on the territory of the French South-West area (Bordeaux Academy), the baccalaureate success rates are higher than the national average, the rate of perpetration of new baccalaureate holders to higher education is lower, regardless of the type of baccalaureate (scientific, literary, technological, ...).

Social and geographical origins of high school students weigh on their choice of orientation and can also constitute obstacles to the pursuit of studies. The objective of the ACCES project is to reduce these inequalities to allow everyone's ambition and the construction of a chosen and thoughtful orientation.

During the project, several tools were tested and assessed to improve the orientation of high school students towards higher education. One of these tools is the use of telepresence robots. These robots allow geographically distant high school students from University to participate in telepresence immersive sessions in some courses, in order to better understand what University is. We chose to only offer these sessions during school time. The students stand from the high school to which they belong (and not from their homes), and are supervised during the activity by a referent teacher and a University referent. This latter serves as technical support, collects the results of the post-activity questionnaire (see section 5.1) and does a quick debrief with the students at the end of the immersions.

4 Setting up experimentations

For the preliminary phase (testing phase) of the project, which is the subject of this article, we selected 3 high schools in the Bordeaux Academy, and identified 9 final year students potentially interested in this approach. For efficiency and time reasons, we chose to allow a group of students (4 at most) to participate to each immersion session rather than only one student per session. This permitted to organize only three immersive sessions per high school: one lecture session, one practical exercise session and

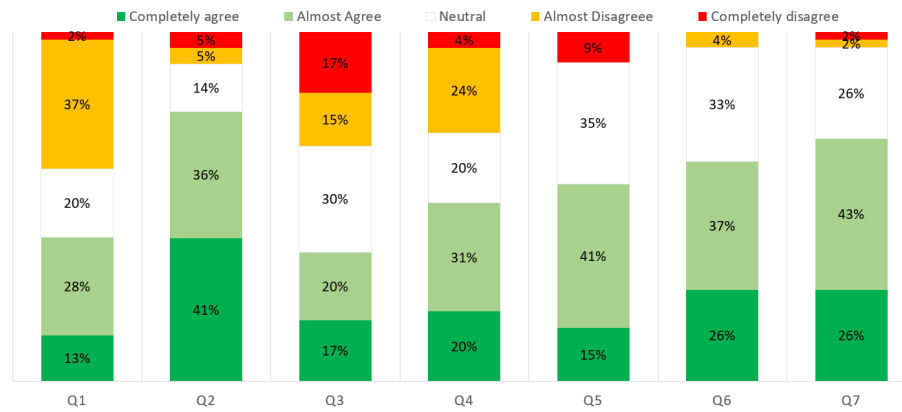


Fig. 1: Activities assessment results

one practical work session. Unfortunately, sometimes, one or more students were absent because of the COVID-19 pandemic, so the number of participants to each session was variable. Table 1 gives details of these sessions.

It is highly recommended to have a preliminary encounter with the robot before the first immersive session, in order to solve handling problems, but also to mitigate potential fears. There was always a preliminary session for at least a week before the first immersive session. The robot was located in a neutral place, for example in desk spaces. The university referent would be present in the high school to help students with connections, to present them the cockpit, give a demonstration, and answer their questions. They use a pre-configured computer (the robot cockpit is a dedicated application) connected to the wired network of the high school. On a voluntary basis, students could drive the robot to familiarize themselves with it and its cockpit. We did not force them to drive it, to avoid any rejection phenomenon. The sessions lasted a maximum of 40 minutes.

During the immersive sessions, we did not give any guidelines to the teachers for the reception and integration of telepresence students. Surprisingly, we observed that the level of interaction in each course typology was different, which was particularly interesting for us, giving us the opportunity to analyze the impact of this dimension on the quality of the immersion. More precisely:

- During lecture sessions, there was no interaction between the high school students and the students or the teacher of the University (no hello, no explanation, no good-bye);
- During practical exercise sessions, the amount of interaction was low: the teacher welcomed the high school students at the beginning of the session, quickly explained to them what a practical exercise session was, and the high school students remained passive during the rest of the session;
- During practical work sessions, the amount of interaction was high: the teacher welcomed the high school students at the beginning of the session, quickly explained

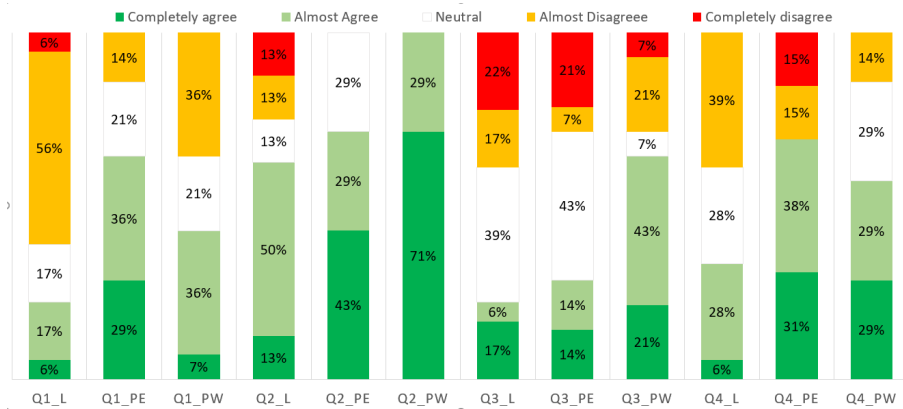


Fig. 2: Details of questions Q1 to Q4

to them what a practical work session was, and encouraged them to interact with the students, move among the different pairs to watch and discuss about the different manipulations student were doing. High school students also discussed with students about courses, student life and their future orientation.

At the end of each session, each student completed a questionnaire. The university referent was present to answer any questions from students, but also to ensure that the questionnaire was completed correctly to then collect the answers. Thus, out of the students who were present in the immersive sessions, we collected 23 answers.

After having been immersed in the three different typologies of courses (lecture, practical exercise and practical work), 8 out of 9 students were individually interrogated to have a better understanding of some points. More precisely, the questionnaire was more deeply explored for which we obtained a high variety of answers. We also explored the question of the positioning of the robot in the classroom during the immersion. Finally, some other points were detailed, depending on the students' prerogatives.

5 Analysis of the robot usage

5.1 Post-activity assessment questionnaire

The analysis of the robot usage is based on the results of a post-activity questionnaire. This questionnaire is divided into two categories : assessment of the immersive activities, and assessment of the impact of the use of the telepresence robot. At least two questions composed each item Q*. The list of these items is given below:

1. Activity assessment

- Q1 Sufficient activity duration
- Q2 Need to interact with distant people
- Q3 Sufficient amount of interactions
- Q4 Understanding of the course typology
- Q5 Activity representative of the University ?
- Q6 Impact on the future orientation of the student
- Q7 Overall satisfaction of the activity

2. Telepresence assessment

- Q8 Representation of remote space
- Q9 Orientation in remote space
- Q10 Pilot's sense of presence
- Q11 Pilot thinks he is considered like a human by others
- Q12 Mobility usability
- Q13 Ease to communicate via the robot
- Q14 Sound quality
- Q15 Image quality

5.2 Immersive activities assessment

Figure 1 shows the answers given to the seven questions concerning the immersive activities (Q1 to Q7). Each column combines the answers to the same question, without taking into account the course typology (lecture, practical work and practical exercise).

For Q5, Q6 and Q7, the opinions are clearly positive (resp. 56%, 63% and 69% positive answers, less than 10% negative answers). Thus, we can say that the students judged the immersive activities convincing and enabled them to make a better choice in their orientation. In general, they were definitely satisfied.

Results of Q1 to Q4 are different depending on the typology of the course. Figure 2 gives the answers to these questions per course typology.

Concerning Q1 (activity duration), notice that during the experimentation, the duration of immersive session was the same independently of the typology (approximately 40 minutes). The results show that the students consider the duration of the practical exercise sessions adequate (14% of negative opinions for Q1_PE). They are less convinced by the length of the practical work sessions (36% of negative opinions for Q1_PW), and clearly consider those of lecture sessions not adapted to all (62% of negative opinions for Q1_L, they got bored). However, during the interview, half of the students said that if the sound was clearer (without any echo) and the video-projection vision better, they may have considered time shorter. So, the lack of quality in terms of listening and watching induced a loss of interest. Finally, the duration of practical work sessions, according to the interview, is a little short. The majority of high school students were willing to extend its duration. The fact that they had to explore the practical work room (move the robot), talk and interact with the students and the teacher, strongly engaged them in the activity and make them eager to prolong their participation.

Q2 focuses on the need of interaction with the distant space and people. Globally, students considered that interactions were needed, but the answer is quite different depending on the typology of the course. In lecture courses, a minority of students consider interactions useless (26%) and 13% do not have an opinion. In practical exercise

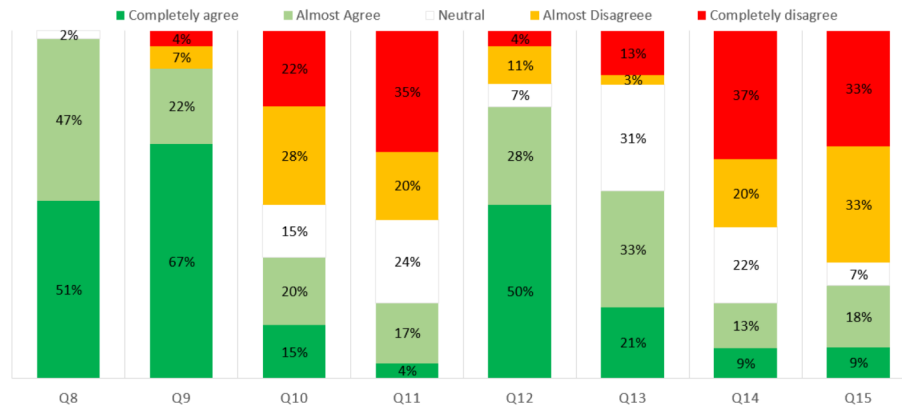


Fig. 3: Telepresence assessment results

courses, 72% of the students' interactions are useful, and 29% stay neutral. There is no negative opinion. Finally, in practical work courses, for 100% of the students' interactions are useful.

The results of Q3 are logical: the students estimate that there is no sufficient interaction during lectures (no exchange with any distant people : only 23% of positive answers), idem for practical exercises (the teacher welcomed the students, but no interaction after this preliminary phase : 28% of positive answers), on the other hand, they are sufficient during practical work (frequent exchanges with distant people : 58% of positive answers, 14% of negative answers).

Finally, Q4 indicates that practical work and practical exercise sessions are well understood by students, while lecture sessions are not convincing (34% positive answers, 39% negative answers).

As a conclusion, it can be said that students appreciate these immersive sessions. The three kind of course typologies had their interest. Even if some technical issues degraded the quality on the interactions, they assess this experimentation as being positive. Lecture sessions are the less convincing, mainly because of lack of interaction. This point needs to be improved in the future, maybe by asking the teacher to welcome the distant students, and proposing a feedback time at the end of the sessions, whenever possible.

5.3 Assessment of the telepresence robot usage

Figure 3 shows the answers to the eight questions concerning the use of the telepresence robot. Figure 4 gives details of questions Q10, Q11, Q14 and Q15.

We can see that Q8 and Q9 (representation and orientation in remote space) have relatively good results. Clearly, sensors and actuators of the robot seem to be sufficient for a good appropriation of the remote space. This is confirmed by question Q12, which focuses on mobility usability, and for which only 15% of the answers are negative.

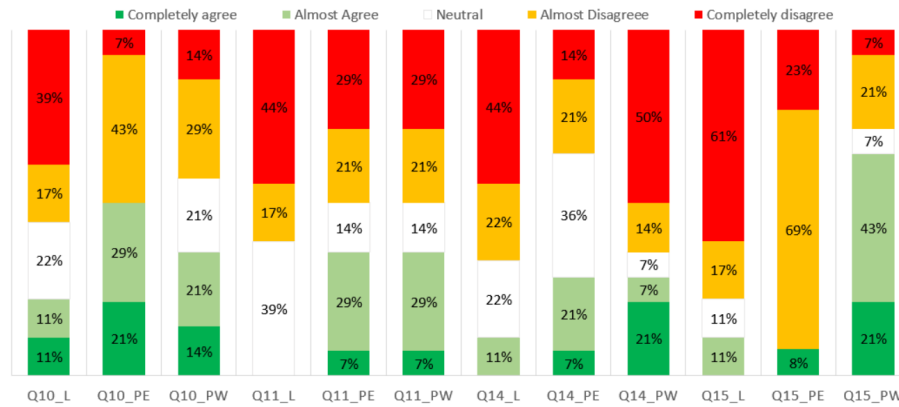


Fig. 4: Details of questions Q10, Q11, Q14 and Q15

Note that, without any surprise, students found it more difficult to drive the robot in practical exercise sessions, than in the other typology sessions. The reason is that in practical exercise courses, the room is generally narrow (space between tables, school bags, chairs, ...). In practical work courses, the room is more spacious. And in lecture courses, it is not necessary to move. By consequence, the feeling of difficulty in driving the robot is more important in a practical exercise room, especially if the conductor uses the robot for the first time.

Q13 (easy to communicate via the robot) is slightly more mixed than Q12. Communication quality between people is dependent on the image quality, the sound quality and the network quality of service. So the results of Q13 are strongly linked to the results of Q14 and Q15 (sound and image qualities).

Q15 answers are really different depending on the typology of the course. For lecture and practical exercise courses, student in general considered the video quality to be poor. This was due to a too large distance between the robot and the whiteboard, or reflection on the whiteboard (sun, video-projector lamp, lighting, ...). Conversely, in their opinion the image quality acceptable in practical work sessions is better (64% of positive answers). In fact, high school students observe and imitate the university student behavior: in lecture and practical exercise sessions, university students are seated without moving. Consequently, high school students dare not "move" (the robot) to be closer to the blackboard, and thus better see what is written. This is particularly true in practical exercise sessions, in which students cannot understand the exercise corrections if the robot is not well located compared to the whiteboard. Note that it is not the case in practical work courses, in which students have the ability to move and interact with other students. So the robot can move and relocate to the right place without disturbing the course.

Q14 deals with the sound quality. Results are not excellent, especially in practical works and lectures (with respectively 50% and 44% of completely disagree answers). The post-interview allows us to have a better understanding of these results. The fact

that the network connection was not good enough during two practical works prevented high school students from fully interacting with the distant students and the teacher. They considered this frustrating. During lecture courses, the teacher voice was amplified in the amphitheater, and this caused a kind of echo that disturbs and makes difficult to listen through the robot. Once again, technological issues had a bad impact on the quality of the relationship between humans.

Concerning questions Q10 and Q11, which deal with the feeling of presence in the distant space, several points must be highlighted. In Q11, we can see that the feeling of having been seen like a human by the teacher and university students, and not a robot, is low, whatever the typology course is. Q10 shows that the pilot's feeling of presence in the distant place is also low, between 22% and 50% of satisfaction. As for questions Q2 and Q3, numerous bad issues with the connection (lot of shutdown, video frozen or degraded, very chopped sound) during these immersions could have ruined these feelings. The lack of interaction initiated by the teacher could also be an explanation: there were not asked for anything, and it made them feel "invisible".

6 Conclusion

In this paper, we relate the first experimentations of the use of telepresence robots to improve high school students' orientation in higher education. After giving some elements on the planning of immersive activities, we detailed the results of a post-activity questionnaire filled by the robot pilots after each session.

Results show that high school students are globally satisfied with the immersive activities proposed. Concerning the use of the robot, some results are disappointing. First, several technical issues occurred and strongly degraded the quality of the immersion. Video and sound quality were strongly dependent on the network quality of service. Moreover the robots are not really conceived especially for educational purposes, and some issues are not considered : reflection of the sun on the whiteboard, video-projection, unreadable handwriting.

Second, the integration of the robot into the course of the session was not always well done, and has induced a feeling of isolation (no interaction), which is not very positive for a discovery session possible future orientation.

In a close future, we will continue to experiment the use of telepresence robots in immersive activities, in order to increase the number of experiments, and consolidate these firsts results. We will also better prepare these sessions, in particular by talking with teachers to have more interactions with students in telepresence. Some additional components need to be added to the robot in order to improve the quality of stimulus coming from the distant space : Bluetooth microphone for the teacher, dedicated additional camera for the whiteboard, ...

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