InClass

PERFORMANCE MEASUREMENT

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Understanding the effects of telepresence robots in classrooms: performance measurements

1. Introduction

Telepresence robotics within educational settings employs wheeled, remotely operated devices featuring screens, cameras, and microphones. This technology allows students, hindered by illness, injury, or other impediments, to engage in classroom activities in real-time without being physically present. By maneuvering through educational spaces, these robots enable absent students to interact with educators and peers, facilitating questions and participation in group discussions as though they were on-site. Such advancements not only bridge the educational divide for homebound students but also support their academic continuity and social engagement. Importantly, telepresence robots foster an inclusive environment, providing all students, irrespective of physical limitations, equitable educational access and community integration. Additionally, they offer a novel approach to minimizing absenteeism and promoting uninterrupted learning. Telepresence robotics also prepares students for a future marked by increased digital and remote interactions, thereby improving their technological proficiency and adaptability.

However, the adoption of this technology is not without challenges. Privacy concerns, the need for regular updates to privacy policies, data protection, and usage guidelines are paramount. Moreover, educators require specific training to effectively operate and interact with these robots, ensuring their functional reliability. Another significant concern is maintaining digital empathy—the capacity to understand and share feelings in a virtual context—amidst reduced non-verbal communication, which may lead to miscommunication and a diminished sense of empathy among users.

The InClass Project has been instrumental in exploring the integration of telepresence robots in schools across Europe, with research conducted in Denmark, Italy, Germany, Latvia, and Cyprus.

2. What to measure in telepresence robotics

Measurement in the context of telepresence robotics in schools is particularly important from a psychological perspective, especially when considering student engagement, inclusivity, empathy development, and robot usability.

2.1. Student engagement

Measuring student engagement is crucial in telepresence robotics settings. Metrics such as participation rates, attention spans, and interaction levels offer insights into how students are connecting with the content and each other through the robotic platform. Psychological measurement tools can also gauge emotional engagement, helping to identify whether the telepresence technology fosters a sense of belonging and interest. If engagement metrics decline, educators can introduce interactive elements or group discussions to improve engagement and ensure that the telepresence experience is captivating and beneficial.

2.2. Inclusivity and Accessibility

Inclusivity and accessibility are essential for psychological well-being in educational settings. Telepresence robots help students who cannot attend school physically due to various reasons. However, continuous measurement is needed to ensure the technology meets individual needs and promotes social integration. Psychological assessments can identify whether all students feel included and participate equally, which is vital for their academic achievement and mental health.

2.3. Empathy between students

Understanding and measuring empathy between students in presence and those embodied in telepresence robots are vital. Tools like empathy scales and peer assessments help understand how students perceive and relate to each other's situations. This understanding is crucial for tailoring programs that strengthen empathetic connections, ensuring students using telepresence robots do not feel isolated.

2.4. Robot usability

Robot usability directly impacts students' ability to engage, integrate, and empathize. Usability measurement involves evaluating how easily students can operate the telepresence robots and how effectively the robots represent the remote students in the classroom environment. High usability is crucial to ensure that remote students can participate fully and are seen as equal members of the class, fostering a sense of belonging and mutual understanding.

Through continuous monitoring and assessment, schools can create more engaging, inclusive, and empathetic learning environments, maximizing the potential of telepresence robotics to meet diverse educational needs.

3. Measurement in psychological setting

Measurement in psychology is fundamental for understanding human behaviour and mental processes. It provides the necessary data to support theories, develop psychological assessments, and inform therapeutic interventions. Broadly, psychological measurement can be categorized into two approaches: qualitative and quantitative.

Qualitative measurement focuses on the descriptive and thematic analysis of non-numerical data. This approach is often used to explore complex, nuanced aspects of human behaviour that cannot be easily quantified, such as emotions, experiences, and perceptions. It emphasizes understanding the depth and context of human interaction, which is particularly relevant in fields like human-robot interaction, where emotional and social dynamics are critical.

On the other hand, quantitative measurement deals with numerical data and statistical analysis. This approach aims to quantify behaviour, attitudes, and other psychological variables, offering a more objective and measurable perspective. Quantitative methods are essential in testing hypotheses, establishing patterns, and drawing generalizable conclusions.

Both qualitative and quantitative measurements have their unique advantages and limitations, and the choice between them often depends on the research question at hand. In the burgeoning field of human-robot interaction, psychologists strive to understand not just how people use and respond to robots, but also the subtler aspects

of this relationship, such as trust, empathy, and social connection. Thus, a comprehensive approach that incorporates both qualitative and quantitative methods is indispensable.

The integration of these measurement strategies provides a more complete understanding of the human-robot dynamic, paving the way for advances in technology, therapy, education, and beyond. This resume explores the distinctions, applications, and synergies between qualitative and quantitative measurements in psychology, with a special focus on their roles in studying and improving human-robot interactions.

3.1. Qualitative measurement in psychology

Qualitative measurement in psychology refers to the collection and analysis of non-numeric data, typically aimed at understanding concepts, thoughts, and experiences. This approach is interpretative in nature, seeking to uncover deeper meanings and patterns within human behaviour and social phenomena. Methods commonly used in qualitative research include interviews, focus groups, case studies, and ethnography. These methods enable researchers to gather rich, detailed data that reflects the complexity of human experiences.

In the context of human-robot interaction and telepresence robotics, qualitative measures might involve conducting in-depth interviews with individuals who have interacted with robots in various capacities, such as in healthcare settings, domestic environments, or manufacturing industries. Researchers may explore participants' feelings, perceptions, and attitudes towards robots, aiming to understand the psychological impact of these interactions and the social and emotional bonds that may form.

The primary advantage of qualitative measurement is its ability to provide a deep, person-centred understanding of psychological phenomena. This approach is particularly valuable when exploring new or complex areas where little prior knowledge exists. In the case of telepresence robotics, qualitative research can uncover subtle nuances in human emotions, attitudes, and behaviours that quantitative methods might overlook.

However, qualitative measurement also has its limitations. The findings are often specific to the particular contexts or individuals studied, making generalization difficult. Moreover, the analysis can be time-consuming and subject to researcher bias, as it relies heavily on the interpretation of non-standardized data.

In the context of the *InClass* project, compelling qualitative measurement can be found in studies investigating children who attend school through telepresence robots due to long-term illness or other circumstances preventing physical attendance. Researchers might conduct in-depth interviews with these children, their parents, and teachers to explore their experiences with the telepresence robots. These qualitative studies aim to understand the children's emotional and psychological experiences of remotely participating in school activities and socializing with peers through the robot. They might investigate feelings of inclusion, alienation, or changes in self-esteem associated with using the robot. Furthermore, researchers could analyse how classmates and teachers perceive and adapt to the presence of a telepresence robot in the classroom, providing a comprehensive view of the social dynamics at play. By delving into these personal experiences, qualitative research can unveil the psychological impacts of telepresence robots on children's social interaction and education. These insights are invaluable for developing more inclusive, empathetic, and effective telepresence solutions that cater to the unique needs and challenges of children unable to attend school in person.

3.2. Quantitative measurement in psychology

Quantitative measurement in psychology involves the use of statistical methods to quantify behaviors, attitudes, and other psychological variables. This approach is characterized by the collection of numerical data that can be subjected to statistical analysis, providing a more objective and measurable understanding of psychological phenomena. Common methods include surveys, standardized tests, and experiments, which allow for the assessment of relationships between variables, comparison of groups, and the testing of hypotheses.

In the context of human-robot interaction, quantitative measures might involve the use of scales to rate the ease of use, effectiveness, and satisfaction with robotic systems.

Additionally, experiments could be conducted to quantitatively assess changes in children's academic performance or social skills as a result of interacting with educational robots.

The primary advantage of quantitative measurement is its ability to produce results that are generalizable to larger populations. This is due to the use of standardized measurement instruments and statistical techniques, which help ensure the reliability and validity of the findings. Furthermore, quantitative data can be used to identify trends, predict outcomes, and establish causal relationships.

However, the main limitation of this approach is its potential to oversimplify complex human experiences into numerical data, possibly overlooking the subtleties of psychological phenomena. Additionally, the reliance on pre-defined questions and scales may restrict respondents' ability to express their thoughts and feelings fully.

Consider the revised example of children using telepresence robots to attend school. In a quantitative study, researchers could utilize a variety of psychometric instruments to measure the impact of this technology on children's experiences. Standardized academic tests could assess the children's learning outcomes, while specialized scales like the Social Skills Improvement System (SSIS) could evaluate changes in social competencies. Additionally, well-being and adjustment could be measured using instruments like the Child Behavior Checklist (CBCL) or the Pediatric Quality of Life Inventory (PedsQL).

Surveys tailored to the context of telepresence and educational interaction could be used to gather data on students', teachers', and parents' satisfaction with the telepresence robot experience. These surveys might include Likert-scale questions to quantify levels of agreement or satisfaction across different aspects of the educational and social experience.

By employing these psychometric instruments, researchers could gather nuanced, quantitative data reflecting the children's academic performance, social skills, emotional well-being, and overall satisfaction with the telepresence robots. Such data would be instrumental in highlighting areas where the telepresence robots excel and where they might need improvement, offering a robust evaluative framework to guide future enhancements in remote learning technologies.

3.3. Integrating qualitative and quantitative methods

Integrating qualitative and quantitative methods in psychology, known as mixed-methods research, offers a comprehensive approach that leverages the strengths of both methodologies. This integration is particularly vital in fields like human-robot interaction, where understanding the full spectrum of human experience with technology requires both the depth of qualitative insights and the breadth of quantitative data. Mixed methods allow researchers to explore complex phenomena, validate findings across different types of data, and provide a more holistic view of research questions.

There are several strategies for integrating qualitative and quantitative methods in research. One common approach is the sequential explanatory strategy, where researchers first collect and analyse quantitative data, then follow up with qualitative research to explore certain findings in depth. Alternatively, the concurrent triangulation strategy involves collecting both types of data at the same time and comparing them to cross-validate or complement the findings. Another approach is the transformative strategy, which begins with a theoretical framework that guides the collection and integration of quantitative and qualitative data.

In the context of human-robot interaction, a researcher might start with quantitative methods to survey a broad population of users regarding their experiences with robots. Then, they could conduct in-depth interviews or focus groups with selected participants to explore unique or unexpected responses. This mixed-methods approach ensures that the statistical data has depth and context, providing clearer insights into user experiences and attitudes.

A practical example of mixed methods in human-robot interaction research involves studying children's engagement with educational robots. Quantitative data could be collected through pre- and post-intervention tests to assess cognitive and academic changes after interacting with the robots. Concurrently, qualitative interviews and observations could be conducted to understand the children's subjective experiences, emotional responses, and social interactions with the robots and peers.

By integrating these data sources, researchers can form a comprehensive picture of the educational impact of robots. For instance, if quantitative results show an

improvement in language skills, while qualitative findings reveal children's increased motivation and positive emotions towards learning with the robot, these combined insights can validate the effectiveness of the robotic intervention and guide future development.

4. Challenges for measurement in telepresence robotics

Integrating qualitative and quantitative methods comes with challenges, such as differing paradigms, methodological biases, and complexities in data analysis and interpretation. However, addressing these challenges through rigorous research design and collaborative efforts can lead to richer, more meaningful insights, especially in interdisciplinary fields like human-robot interaction and telepresence robotics..

As technology evolves, future directions in this area may include developing new methodologies to better capture the dynamics of human-robot relationships, as well as leveraging advanced analytics to integrate large-scale qualitative and quantitative datasets. These advancements will further enhance our understanding of the psychological aspects of interacting with robots, leading to more effective and human-centred robotic technologies.

One of the primary challenges in applying qualitative and quantitative measurements to telepresence robotics research is the integration of data from vastly different sources. Quantitative data can be straightforward to analyse and interpret, given its structured, numerical nature. However, merging these findings with the nuanced, context-rich insights from qualitative analysis often proves challenging. This difficulty stems from the different languages these data types speak: one numerical and the other narrative.

Furthermore, ensuring the reliability and validity of measurements is a significant challenge. In quantitative research, this involves creating instruments that accurately measure what they intend to without external influences. In qualitative research, reliability and validity are concerned with credibility and authenticity, often requiring thorough and transparent documentation of research processes.

Technological advancements introduce another layer of complexity. As robots become more sophisticated, understanding the subtleties of human-robot interactions requires increasingly nuanced research methods. Moreover, ethical considerations, such

as privacy and autonomy, become more pressing as robots play larger roles in sensitive areas like education, healthcare, and personal assistance.

The future of integrating qualitative and quantitative measurements in psychology, particularly within human-robot interaction, is promising but demands innovation and adaptation. One direction is the development of new methodologies that can seamlessly blend numerical data with narrative information, such as data visualization techniques that can depict qualitative findings alongside quantitative trends.

Another important direction is the focus on ethical research practices that address the evolving challenges posed by advanced technologies. This includes ensuring informed consent, respecting privacy, and considering the long-term implications of human-robot interactions.

Furthermore, there is a growing need for interdisciplinary collaboration, as understanding human-robot interactions fully requires insights from psychology, robotics, computer science, ethics, and more. By fostering cross-disciplinary partnerships, researchers can develop more holistic approaches to study and enhance human-robot relationships.

5. Measurement applied in the *inClass* project

To develop a deeper understanding of the dynamics among students, teachers, and telepresence robots within the intricate landscape of school environments, the consortium has employed a variety of measurement strategies. These approaches have been meticulously tailored to align with the specific context, the type of school, and the unique challenges or situations each institution encounters. This comprehensive methodology ensures that the investigation comprehensively addresses the multifaceted relationships and interactions that occur within educational settings, facilitating a nuanced analysis of how telepresence technology integrates into and impacts these environments. In particular, pre and post questionnaires are essential tools in research for measuring changes in participants' perceptions, attitudes, or knowledge before and after an intervention. They provide a structured method for collecting quantitative and qualitative data, enabling researchers to evaluate the effectiveness of interventions and understand participants' experiences. By comparing pre and post responses, researchers

can identify significant trends, changes, and outcomes directly attributable to the study's variables, enhancing the depth and validity of research findings.

In the following sections the instruments used throughout the project are described. All tools are fully available in the appendix, at the end of this document.

5.1. Pre and post questionnaire for students

The pair of questionnaires administered to students before and after the use of a telepresence robot in the classroom serves to measure the evolution of their perceptions and experiences regarding this innovative educational tool. The purpose of these surveys is to capture a wide range of student sentiments, from apprehension and curiosity to acceptance and integration, providing a nuanced understanding of the impact of telepresence technology on the educational experience from a student's perspective.

Pre-Use Questionnaire

The first questionnaire is designed to gauge students' initial reactions to the concept of telepresence robots. It explores their comfort levels, fears, and the potential distraction factor, alongside their curiosity and openness to the technology. This preliminary survey helps in understanding students' baseline attitudes towards new technologies in their learning environment. By identifying initial reservations or enthusiasm, educators can tailor the introduction of the robot to address concerns and leverage positive outlooks, ensuring a smoother transition and better initial engagement.

Questions about willingness to assist with the robot's management and potential challenges with new technology usage offer insights into students' readiness and ability to adapt to technological changes within the educational setting. This initial feedback is crucial for identifying areas where students might need more support or information to feel comfortable and engaged with the new learning tool.

Post-Use Questionnaire

The second questionnaire assesses students' actual experiences with the telepresence robot. This includes their sense of connection and interaction with the remote classmate,

the practicality of the technology, and its impact on their learning environment. This feedback is instrumental in understanding the effectiveness of the telepresence robot in maintaining educational continuity and social inclusion for absent students.

Comparing the pre- and post-use perceptions allows for an evaluation of how well the telepresence robot met or exceeded students' expectations and where it fell short. Insights into areas for improvement, such as functionality or integration into classroom activities, are invaluable for refining the technology and its application in educational settings.

The sequential administration of these questionnaires provides critical insights into the student's adaptive process and acceptance of telepresence robots in educational contexts. It allows educators to measure the success of the technology in enhancing learning experiences and maintaining classroom community despite physical absences. By understanding students' evolving perceptions, educators and technologists can work towards more effective and empathetic implementations of telepresence robots, ensuring that these tools genuinely enhance learning and social cohesion within the classroom. This iterative feedback process is crucial for making informed decisions that align technological innovations with student welfare and educational goals.

5.2. Pre and post questionnaire for teacher

The administration of two distinct questionnaires for teachers before and after the integration of a telepresence robot in the classroom serves as a strategic approach to understanding and evaluating the educational impact of this technology. These questionnaires are designed to capture the teachers' perceptions, concerns, and experiences with the telepresence robot, offering valuable insights into how such technology can be optimized for educational purposes.

Pre-Use Questionnaire

The first questionnaire, administered before the telepresence robot is introduced into the classroom, aims to assess the teacher's initial attitudes, expectations, and concerns regarding the use of such technology in an educational setting. Questions are formulated

to gauge the teacher's perspective on the potential benefits of the robot for student learning and socialization, as well as possible challenges, including distractions in the classroom, discomfort with teaching through technology, privacy issues, and difficulties in interacting with the student remotely. This preliminary assessment helps identify any reservations teachers may have, allowing for targeted interventions to address these concerns before the robot is implemented. It also serves as a baseline against which post-implementation experiences can be compared.

The pre-use questionnaire is crucial for several reasons. Firstly, it highlights the teacher's initial confidence and comfort level with technology, which can significantly influence the success of the telepresence robot's integration. Secondly, it reveals the teacher's expectations about the robot's potential to maintain educational continuity and contribute to the student's social integration. Understanding these aspects is essential for preparing the teacher and adapting teaching strategies to accommodate the new technology.

Post-Use Questionnaire

The second questionnaire is administered after the student has used the telepresence robot for a period. This set of questions seeks to evaluate the actual experiences and outcomes of using the robot. Teachers provide feedback on whether the student remained an active participant in the lessons, the ease of visibility and audibility of the student, the impact on classroom dynamics, and the effectiveness of material distribution. Additionally, the questionnaire probes the teacher's perceptions of the student's social integration and compares the telepresence robot's effectiveness with other remote learning tools like video conferencing platforms.

This post-use questionnaire is important for several reasons. It assesses the practical challenges and benefits experienced by the teacher, offering insights into the operational aspects of using a telepresence robot in an educational setting. It helps in understanding the real impact of the technology on teaching practices, student participation, and classroom environment. The feedback obtained can inform future decisions about the use of telepresence robots and guide improvements to ensure that they serve as effective educational tools.

Together, these questionnaires offer a comprehensive view of the teacher's journey from anticipation to actual experience with telepresence technology in education. By comparing pre- and post-use responses, educators and technologists can measure the effectiveness of the robot, identify unforeseen challenges, and determine areas for improvement. This feedback loop is essential for refining the implementation of telepresence robots, ensuring they meet educational objectives and enhance the learning experience without adding undue burden on teachers or disrupting classroom dynamics. The ultimate goal is to facilitate a seamless integration of technology that supports absent students' learning and social needs, while also aligning with the teacher's capacity to deliver quality education.

5.3. Observation checklist

To provide a standardised method to carry out observations within the classroom and gain comparable qualitative data an observation checklist has been devised within the project. The observation checklist provided is a structured tool designed to facilitate comprehensive and systematic monitoring of a classroom where a telepresence robot is being used by an absent student. This document is particularly useful for gathering detailed data on the dynamics and interactions occurring within the learning environment during the integration of telepresence technology.

The checklist covers a broad spectrum of variables, from basic logistical details like the names and types of participating institutions, to more nuanced aspects such as the social and educational engagement of both the remote and collocated students. The structured format allows the observer to systematically record essential information, such as the reason for the student’s absence, the total number of students present, and the specifics of the classroom activities observed.

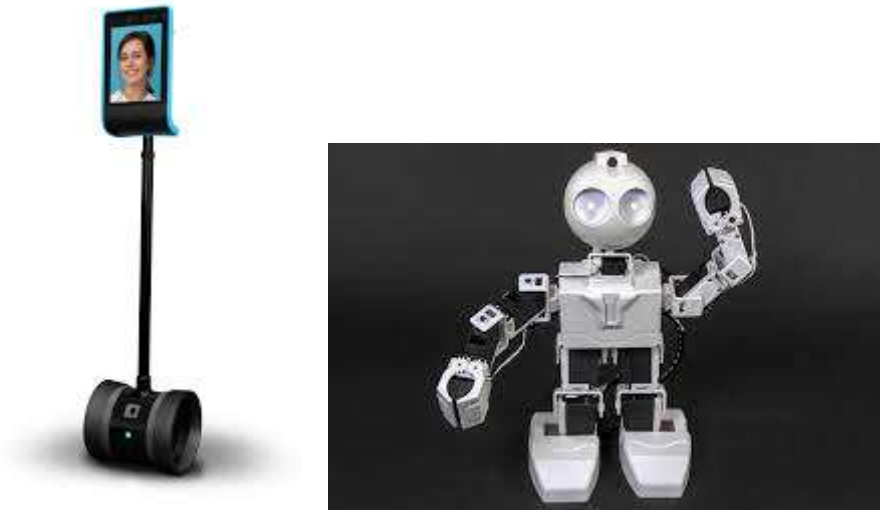
Notably, the checklist delves into the quality of interaction between the remote student and their peers, as well as between the remote student and the teacher. It assesses whether the remote student has access to necessary materials, participates actively, and is integrated socially and academically into the class. Moreover, it scrutinizes the telepresence robot’s functionality, identifying any technical issues and their impact on the session.

Additionally, the observer's perspective is considered, ensuring they have an adequate view and understanding of the classroom dynamics, and noting whether intervention was necessary at any point. This attention to the observer's experience helps validate the reliability and completeness of the collected data.

Overall, this checklist serves as an invaluable resource for evaluating the effectiveness and impact of telepresence robots in educational settings. It helps identify strengths and areas for improvement in remote learning technology, teacher strategies, and student interactions, contributing to the development of more inclusive, efficient, and engaging educational experiences for all students, regardless of their physical presence in the classroom.

6. Digital empathy

The research article "Mitigating the Negative Effect of Telepresence Robots via an Empathy-Eliciting Robot Moderator" by Asadi et al. (2023), presents a collaborative project between Unina and USD in Italy. This study investigates improving interactions with telepresence robots (a double robot) by introducing an empathy-eliciting moderator (a JD Humanoid social robot) within the robotic framework. It is particularly important, as it delves into the dynamics of middle school students' perceptions regarding their peers when interacting through telepresence robots, and how an empathy-eliciting intervention from a social robot moderator might influence these perceptions. The study is set against a backdrop where telepresence robots, despite their benefits in fostering connectivity and overcoming physical absence, often result in their users being perceived less favourably compared to those physically present.



A picture of the double 3 telepresence robot (left) and JD Humanoid social robot (right) used for the study.

6.1. Measurement and Psychometric Instruments

Central to this study are two main types of psychometric instruments: the sociometric test and personality tests, which include both self-evaluation and peer-evaluation components. These tools are pivotal for understanding the social dynamics within the classroom and assessing the shifts in perception due to the empathy-eliciting intervention facilitated by the JD Humanoid social robot.

Sociometric Test

The sociometric test is a fundamental component of this research, designed to gather data on the interpersonal relationships among the students (Ponticorvo et al, 2022). This tool is instrumental in exploring the group dynamics and the interconnectedness of students on two critical levels: affective and psychological affinities, and the organization and functional aspects of the group. The affective component addresses the students' emotional connections and preferences regarding their classmates. This is assessed through four questions that inquire whom they prefer or do not prefer as seatmates during a school trip, reflecting their social preferences and aversions.

This test's outcomes are crucial for forming groups for the study, ensuring that participants with the highest levels of mutual affinity are grouped together. This approach aims to create a naturalistic setting where pre-existing social relationships can influence the interactions, thereby minimizing external variables such as unfamiliarity,

which could skew the results. By understanding the students' social networks and preferences, the researchers can better interpret the impact of the telepresence robot and the subsequent empathy-eliciting intervention.

Personality Tests (Self-Evaluation and Peer-Evaluation)

In addition to the sociometric test, the study employs personality tests that serve both self-evaluation and peer-evaluation purposes. These tests are essential for assessing the participants' personality traits, particularly focusing on dimensions such as trustworthiness (adapted from Calvo-Barajas, Perugia and Castellano, 2020) and neuroticism-emotional stability, which are hypothesized to be impacted by the telepresence robot's use and the empathy intervention.

The self-evaluation segment allows participants to reflect on their own personality traits, offering insights into how they perceive themselves in terms of trustworthiness, sociability, and emotional stability. Conversely, the peer-evaluation component provides a perspective on how individuals are viewed by their peers, which is vital for understanding the social dynamics at play and the potential impact of telepresence on these perceptions.

The Big Five Inventory (Guido et al, 2015), adapted for children and adolescents, forms the basis of these evaluations, assessing key personality dimensions. Such inventory is based on the Big Five personality theory, a foundational concept in psychology that categorizes human personality into five broad dimensions: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, often remembered by the acronym OCEAN. These traits represent a range of human behaviours and emotional patterns, providing a comprehensive framework for understanding individual differences. The Big Five model is widely used in psychological research and practical settings to predict life outcomes, understand human behaviour, and tailor personal development strategies. It underscores the complexity of human personality and its impact on various life aspects.

By comparing the pre- and post-intervention responses, researchers aim to detect shifts in how participants are perceived by their peers following the empathy-eliciting intervention.

6.2. Empathy-Eliciting Intervention

At the heart of the research is the implementation of an intervention designed to evoke empathy, facilitated by the JD Humanoid robot. By asking the remote student operating the telepresence robot specific questions about their feelings and challenges, the study probes whether this intervention can foster empathy among the onsite students, potentially altering their perceptions of the remote student's personality.

The rationale behind this intervention stems from the understanding that empathy can significantly influence social interactions and perceptions. If the onsite students can empathize with the remote student's situation, they may view them more favourably, reducing the perceived distance and difference imposed by the telepresence technology.

The analysis of the collected data reveals that following the empathy-eliciting intervention, onsite participants rate the telepresence robot pilots as significantly more trustworthy and less neurotic, indicating a shift towards more positive perceptions. Conversely, the remote participants also perceive their onsite peers more favourably post-intervention, demonstrating the bidirectional benefits of eliciting empathy in mediated interactions.

The implications of these findings extend beyond the classroom setting, suggesting that empathy-eliciting interventions can mitigate some of the inherent challenges in telepresence-mediated communications. By enhancing the emotional connection and understanding between remote and onsite participants, such interventions can improve collaborative experiences, reducing the social isolation often associated with remote participation.

References

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Appendix

Questionnaire before robot usage (students)

7-point Likert scale

- I would feel uncomfortable if a classmate was working through a telepresence robot.
- It could be interesting to use a telepresence robot.
- If I couldn't make it to school, I'd like to try the telepresence robot.
- I'd be a bit scared to work with someone in a telepresence robot.
- Using a telepresence robot could distract me for an hour.
- Using telepresence robots can be a great way for a classmate to communicate with us.
- Using telepresence robots can be a great way to keep track of lessons.
- I would be willing to help manage the robot (e.g.: switch on, switch off when the class is over, charge the battery, etc.).
- I may have problems with the use of new technologies, such as telepresence robots.

Questionnaires after robot usage (students)

7-point Likert scale

- It was as if the person on the telepresence robot was really part of the class.
- I was not comfortable when my classmate used the telepresence robot.
- I would like to see telepresence robots in the classroom in the future.
- I was able to meet my classmate without any technical problems.
- I heard my classmate without technical problems.
- If I can't go to school, a telepresence robot could be a great way to keep track of my lessons.
- The telepresence robot distracted my classmates.
- A telepresence robot is more useful than Skype, Zoom, Microsoft Teams, etc.
- Using the telepresence robot helped my classmate stay in touch with the class.
- I would like to use a telepresence robot if I can't go to school for a while.
- Why I wouldn't want to use a robot if I couldn't attend school.
- There are things to improve in the telepresence robot.
- What needs to be improved?
- I liked the telepresence robot.
- If my classmates had been there in person, they would have participated more.
- I always felt calm when talking to the person in the telepresence robot.

Questionnaires before robot usage (teacher)

7-point Likert scale

- The student can benefit from the use of a telepresence robot.
- Before the absence, the student took an active part in the lessons.
- A telepresence robot can be a useful tool to keep a student up to date with learning and school life.
- In general, a telepresence robot could be useful in the classroom.
- Using a telepresence robot in the classroom could distract classmates during lessons.
- I would feel uncomfortable teaching a student who is driving a telepresence robot.
- I may have problems working with new technology, such as a telepresence robot.
- Using a telepresence robot in the classroom can cause privacy issues.
- Interacting with a student using a telepresence robot could be difficult.
- A telepresence robot could contribute to a student's socialisation/integration into the classroom.

Questionnaires after robot usage (teacher)

7-point Likert scale

- The student did not benefit from using the telepresence robot.
- The student who piloted the telepresence robot took an active part in the lessons.
- The student could be seen without problems.
- The student could be heard without any problems.
- If there is a telepresence robot in the classroom, more effort is required from the teacher.
- The distribution of didactic materials does not involve any additional teacher intervention if the student uses a telepresence robot.
- I would like to have telepresence robots in my classroom in the future.
- I had difficulties communicating with a student using a telepresence robot.
- The distribution of learning materials was as easy as if the learner was not using a telepresence robot.
- A telepresence robot can be a great way for students to keep up with their schoolwork and studies.
- A student using a telepresence robot would have been more active in the lesson if he had been physically present in the lesson.
- Using a videoconferencing system (Microsoft Teams, Skype, Google Meet, etc.) can generally be more useful than a telepresence robot.
- The student using the telepresence robot seemed to be physically present in the classroom.
- The presence of a telepresence robot in the classroom did not attract the attention of classmates.
- Classmates addressed the robot as student.

Observation checklist

- Name of partner's university/institution: - Name of observer: - Name and type of school contacted: - Date of observation:	
Relevant info. - What is the name/pseudonym of the remote student? - How old is he or she? - What is the child's state of health or reason for being away from school (please don't report sensitive information)? - How many students are present? - What's their age group? - What is the subject of the lesson? - How long does the observation take? - Where is the robot (remote student) located? - Is the session being video recorded? - If so, where are the video cameras installed? - Where is the observer seated?	____ years old. Quarantine ⬚ Chronic illness ⬚ Hospitalization ⬚ Injury ⬚ Anxiety ⬚ Other _____ Start time: _____ End: _____ Yes ⬚ No ⬚ ---

Class activities Briefly describe all the activities observed. Please specify for each activity, for example: - What is the activity type? - How long does it take? Are special materials involved? - What is the remote student doing during the activity? Other students? Teacher? - How does it go? - Anything else?	Lecture ⬚ joint discussion ⬚ group work ⬚ Pair work ⬚ Individual task ⬚ Other _____ Yes ⬚ No ⬚ Please specify _____
Remote student - Does the remote student have access to the same materials and handouts as collocated students?	Yes ⬚ No ⬚

- Does the remote student attend the whole session? - Does the remote student actively participate in classroom activities or is s/he less active than other students? Please elaborate. - Does the remote student hear the teacher and other students clearly? - Is the remote student able to respond to the teacher and other students clearly? - Do any other unanticipated problems occur? - Who is available to help the remote student if any issue occurs? - Is the remote student integrated with other students during the break? - What does the remote student do during the breaks? - Anything else?	Yes ⬚ No ⬚ Yes ⬚ No ⬚ Yes ⬚ No ⬚ Yes ⬚ No ⬚ Yes ⬚ partly ⬚ No ⬚ Comments: _____
Telepresence robot	

- Does the robot run successfully during the whole session? - What technical issues occur? If so, how often? - Anything else?	Yes ☐ No ☐ Interrupted internet connection ☐ Not reconnecting after being disconnected ☐ Running out of battery ☐ shutting down ☐ Other _____
Teacher - How does the teacher address the remote student? - How does the teacher refer to the remote student when talking to the class in general? - Does the teacher engage the remote student in the lesson as much as other students? - Does the teacher encourage the remote student to be more active or engaged in the lesson? - Does the teacher encourage other students to take a particular action related to the remote student? - Anything else?	First name ☐ Last name ☐ Anything else _____ First name ☐ Last name ☐ Anything else _____ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐

Collocated students - How do collocated students address the remote student?	First name ⬚ Last name ⬚ Anything else _____
- Are collocated students willing to communicate with the remote student?	Yes ⬚ No ⬚
- Are collocated students willing to collaborate / work / play with the remote student?	Yes ⬚ No ⬚
- Are collocated students willing to assist the remote student?	
- Are collocated students respectful to the remote student?	Yes ⬚ No ⬚
- Do collocated students show empathy toward the remote student?	Yes ⬚ No ⬚
- Are collocated students distracted by the remote student?	Yes ⬚ No ⬚
- Do collocated students bully the remote student or harass the robot?	Yes ⬚ No ⬚
- How do the collocated students talk about the remote student?	Yes ⬚ No ⬚
- Anything else?	
Observer - Does the observer have a good view of the remote student, other students, and the teacher?	Yes ⬚ No ⬚

- Does the observer have to intervene anytime during observation? If so, why? - Anything else?	Yes ☐ No ☐ Reason _____
Final comment If you have any interesting or noteworthy observations that have not been mentioned above, please report here.	

Sociometric test

Affective section

(1) Write the names of those classmates that you would like as a seatmate on the bus during a school trip. You can write as many names as you like.

(2) Write the names of those classmates that you would not want as a seatmate on the bus during a school trip. You can write as many names as you like.

(3) Write the names and surnames of those classmates who, according to you, would like you as their seatmate on the bus during a school trip. You can write as many names as you like.

(4) Write the names of those classmates who, according to you, would not want you as their seatmate on the bus during a school trip. You can write as many names as you like.

Group organization section

(1) Write the names of those classmates who you would gladly make a working group with. You can write as many names as you like.

(2) Write the names of those classmates who you would not gladly make a working group with. You can write as many names as you like.

(3) Write the names of those classmates who, according to you, would gladly make a working group with you. You can write as many names as you like.

(4) Write the names of those classmates who, according to you, would not gladly make a working group with you. You can write as many names as you like.

Trustworthiness

(1) Do you think you can keep secrets?

(2) Do you think you are a truth teller?

(3) Do you think you are trustworthy?

(4) Do you think you can help others?

Big Five

(1) tends to find fault with others;

(2) is generally trusting;

(3) tends to be lazy;

(4) does a thorough job;

(5) is relaxed, handles stress very well;

(6) gets nervous easily;

(7) is reserved;

(8) is outgoing, sociable;

(9) has few artistic interests;

(10) has an active imagination.

Six items on neuroticism (the fellow student)

Is Tense

Is Irritable

Is Not contented

Is Shy

Is Moody

Is Not self-confident.

Item on JD Humanoid robot

Would you like to have a JD Humanoid robot at home?