SOCIAL ROBOTICS TO PROMOTE INCLUSIVE EDUCATIONAL PROCESSES: A STUDY ON FUTURE EDUCATORS' PERCEPTIONS

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ABSTRACT
This exploratory research aims to explore the role of social robotics in educational contexts, with the goal of preserving the socio-emotional and non-linear dimension of learning in the era of the Fourth Revolution. Conducted with Italian and Spanish university students, the study adopts a *mixed-methods* approach to analyze future educators' perceptions of the educational and relational potential of robotic technologies and their integration into learning environments, following an experience with the social robots *Unitree Go2* and *Pepper*. The results highlight a widespread openness to the use of social robotics as a tool to support interaction, participation and emotional engagement, especially in contexts involving individuals with Special Educational Needs (SEN). From this perspective, social robotics emerges as an inclusive educational device capable of enhancing, without replacing, the teacher's role in building authentic and meaningful educational relationships.

KEYWORDS
Social robotics; Inclusive learning; Socio- emotional education

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1. Introduction

Social robotics is playing an increasingly significant role in the debate on the transformation of educational environments (Neumann, 2023). Unlike other digital technologies, social robots introduce physical presence, movement, communicative responsiveness and multimodal interaction into spaces where learning is constructed through relationships (Gallese & Morelli, 2024; 2026), verbal and non-verbal languages and active participation. Woo et al. (2021) show that field studies on social robots in classrooms have addressed functions related to instructional support, student interaction and participation in specific educational activities. In a similar vein, Youssef et al. (2023) identify an expansion in the applications of social robotics in education, with uses linked to learning, communication, motivation, and support in educational activities.

However, this technological presence does not in itself equate to educational improvement. The central issue is not the novelty of the device, but the type of pedagogical experience it enables, the role it plays in activity and the way teachers interpret its possibilities and limitations, as emphasized by Mullick (2025). Similarly, Tekerek et al. (2026) highlight that human-robot interaction in educational contexts has become a broad field of research, still characterized by methodological, technical and pedagogical challenges. Mullick (2025) also stresses that social robotics can transform certain educational practices, although its integration raises challenges related to training, acceptance, costs and contextual adaptation.

Examining the scientific evidence, it should be noted that social robots can foster attention, motivation and participation when integrated into activities with a clear educational purpose. Accordingly, Ackermann et al. (2025) analyze how robot-mediated adaptive teaching can influence cognitive, emotional and self-regulated learning, making it possible to situate these technologies within

complex educational processes. However, their findings call for a cautious evaluation of what kind of support the robot provides and which conditions make a meaningful learning experience possible (Di Tore, Todino & Sibilio, 2019). Maggi et al. (2021) further demonstrate that the robot's interaction style affects cognitive performance, acceptance and user behavior. Therefore, it is not enough to introduce a robot into the classroom, what matters is how it communicates, what kind of feedback it provides and what role it plays in the activity. Acceptance of social robotics is another key aspect. Tutul et al. (2026) study technology acceptance in university learning activities supported by the Pepper robot and compare verbal and multimodal feedback modalities.

This type of research is particularly relevant for initial teacher education, since the intention to use a technology depends on perceived usefulness, trust, ease of use and real implementation conditions (Carlomagno, Vadalà & Ricciardi, 2026). Li et al. (2025), in the field of robot-assisted language learning, show that teachers perceive both opportunities and difficulties related to teacher preparation, available resources and pedagogical management of the technology. The robot's embodied dimension also influences its perception. Human-robot interaction is not limited to an exchange of information, as it includes presence, distance, movement, appearance, voice, gesture and the attribution of intentions. Vidovićová and Menšíková (2023) emphasize the importance of materiality, embodiment and relationality in understanding how people construct their experience of interacting with robots. Miraglia et al. (2023), on the other hand, show that shared knowledge in human-robot interaction can be based on the robot's communicative cues, although it also depends on the characteristics of the human interacting with it.

Duncan et al. (2024) reinforce this idea through a review of multimodal perception methods, identifying visual, auditory, bodily and contextual signals as fundamental elements for interaction in social contexts.

2. Theoretical Framework

According to this scenario, it is necessary to analyze some studies conducted in fields other than formal education. In this way, we can outline a comprehensive view of the possibilities offered by this emerging technology.

Social robots in eldercare contexts, for example, provide useful elements for interpreting social robotics from a relational and inclusive perspective. Beuscher et al. (2017) analyze older adults' perceptions of social care robots and emphasize the importance of understanding users' pre-existing attitudes before proposing continuous use. Blindheim et al. (2023) study the use of Pepper in long-term care facilities and highlight its potential to promote activity and interaction. Shao et al. (2023) examine robot-assisted physical exercise for older adults in both group and individual sessions, focusing on the adaptation of robot behavior and the monitoring of progress. Preston et al. (2024) propose robotic activities aimed at fostering physical, cognitive and social engagement in residential care settings. Nault et al. (2024) add that sensory feedback can enhance older adults' engagement in cognitive activities mediated by socially assistive robots. Although these studies come from contexts different from schooling, they help to understand that the value of social robotics depends on the concrete activity, the participants' needs and the quality of mediation (Damiano, 2013). This idea is particularly important when social robotics is connected to inclusive education. Vitale and Dello Iacono (2024) analyze the use of social robots as an inclusive educational technology for learning mathematics through storytelling. Their proposal makes it possible to embed the robot within a specific teaching activity, where technology functions as a support for participation and access to learning. Inclusion, therefore, does not derive from the mere presence of the robot. It requires accessibility, planning, adaptation to students' needs, teacher supervision and attention to the

possible barriers that the technology itself may introduce (Kouroupa et al., 2022). In this context, the role of teachers is crucial. Social robotics can support communicative, playful, motor or cognitive activities, but it does not replace professional judgment, pedagogical sensitivity or the teacher's ethical responsibility, as emphasized by Maijala & Mutta (2024). This issue directly concerns initial teacher education, since future educators must develop a critical perspective on emerging technologies (Ceha et al., 2022; Carlomagno, Vadalà & Ricciardi, 2026). The aim is not to accept or reject social robotics a priori, but to learn how to assess when it can contribute to educational activity, what limitations it presents and what conditions must be met for its use to be meaningful. The type of robot used also influences educational expectations. Pepper, as a humanoid robot, is usually associated with verbal communication, gestures, bodily orientation, social interaction and relational support.

Pandey and Gelin (2018) describe it as a socially engaging mass-produced humanoid robot designed to interact with people through voice, movement, environmental perception and expressive behaviors. This configuration explains why Pepper has been used in different contexts where interaction, proximity and communication are relevant. Al Barakeh et al. (2019) present it as a service robot with interaction potential in user-assistance contexts.

In educational and training settings, we have used this robot in music education (Martinez-Roig et al., 2023). From an applied perspective, we have also analyzed older adults' perceptions of the *Pepper* robot in music and movement activities, which reinforces the interest in this robot in experiences where the bodily, relational and socio-educational dimension plays a significant role (Martinez-Roig, 2024). Roštšinskaja et al. (2025) evaluate children's interaction with *Pepper*, defining this robot as a device capable of eliciting attention, communication and engagement in children's activities. Quadruped robots present a different profile. Lakatos et al. (2025) analyze the attribution of

intentions and emotions to dog-like robots, including *Unitree Go1*, and show that certain bodily and expressive traits can modify users' interpretations of the robot. Shin et al. (2024) study non-verbal interaction with a quadruped robot through bodily and manual gestures, which is relevant for understanding forms of communication beyond verbal conversation. Liu et al. (2024) illustrate technical advances in locomotion and manipulation with *Unitree Go2*, allowing its potential to be contextualized as a robot oriented toward movement, exploration and physical interaction with the environment. Hafezi et al. (2024), from another application domain, propose uses of dog-like robots associated with autonomous surveillance and facial recognition, which highlights the need to pay attention to ethical implications and to the concrete purpose of each technological deployment. From this perspective, the comparison between Pepper and *Unitree Go2* should not be understood as a choice between a better and a worse robot. Each one elicits different expectations. Pepper may be perceived as closer to communication, trust and relational mediation. *Unitree Go2* may be associated with exploration, attention, movement and technological experimentation. This difference is useful for studying how future educators interpret the educational potential of two very different robotic forms and which conditions they consider necessary for their use in inclusive contexts. Despite the growth of research on social robotics, it is still necessary to deepen understanding of how future educators construct their perceptions based on concrete experiences with robots of different morphology.

Much of the existing research has focused on general educational applications of social robotics (Youssef et al., 2023), broad reviews of human-robot interaction in educational contexts (Tekerek et al., 2026), technology acceptance following concrete experiences with humanoid robots such as *Pepper* (Tutul et al., 2026), or the assistive and relational uses of this same robot in care contexts (Blindheim et al., 2023). Other recent studies have addressed

quadruped robots from the perspective of attribution of intentions and emotions in zoomorphic models such as *Unitree Go1* (Lakatos et al., 2025), non-verbal interaction through bodily and manual gestures (Shin et al., 2024) or the technical development of locomotion and manipulation in *Unitree Go2* (Liu et al., 2024). However, it is less common to integrate initial attitudes, perceived inclusive potential, the role attributed to teachers and the comparison between humanoid and quadruped robots in initial teacher education. This gap is significant because future decisions about the educational use of social robotics will largely depend on how future teachers interpret these devices.

In this sense, studies on users' perceptions of social care robots (Beuscher et al., 2017), differences in robot perception between children and adults (Burdett et al., 2022), and teachers' perceptions of robot-assisted language learning (Li et al., 2025) reinforce the need to investigate future teachers' attitudes and expectations before broader implementation processes are initiated.

Taking all this into account, the present study aims to describe future educators' perceptions of social robotics in educational and inclusive contexts following an exploratory experience with the *Pepper* and *Unitree Go2* robots. In particular, it analyzes initial attitudes toward social robotics, the role attributed to teachers, intention to use, perceived inclusive potential and the differentiated educational meanings attributed to both robots. The study does not aim to measure the actual impact of robots on learning or to demonstrate effects on educational inclusion. Its purpose is to examine how future educators interpret their possibilities, limitations and conditions of use.

Therefore, this study is structured around the following research questions:

RQ1. What are future educators' initial perceptions of social robotics as a pedagogical resource in educational contexts?

RQ2. How do future educators perceive the potential of social robots in supporting inclusive educational processes?

RQ3. What role do future educators attribute to teachers in the pedagogical use of social robots?

RQ4. How do future educators differentiate the educational potential of *Pepper* and *Unitree Go2*?

3. Methodology

This exploratory study adopts a *mixed-methods* research design (Creswell & Clark, 2011), integrating quantitative and qualitative data in order to conduct an in-depth analysis of university students' perceptions, who are also future educators, regarding the use of social robotics in educational contexts.

The integration of the two approaches makes it possible to investigate both the measurable dimensions of attitudes and intentions to use, as well as participants' subjective representations, reflections and interpretations.

3.1 Sample

The initial sample comprised 381 students on the Bachelor's degree programme in Primary Education, enrolled in the early stages of their university studies. The participants came from two European universities: 94 students from the University of Alicante (Spain) and 287 from the Università degli Studi Suor Orsola Benincasa in Naples (Italy). The specific academic year of each participant was not recorded as an individual sociodemographic variable, as in university education students are organised not so much by academic year but by the modules they enrol in each year, which are often from different academic years. In any case, the research was conducted in modules corresponding to the first years of study.

In the Italian subsample, the mean age was 21.77 years (SD = 2.74; range = 19–44; n = 286 with a valid age), whilst in the Spanish subsample it was 19.20 years (SD = 2.19; range = 17–31; n = 94). One age record from the Italian subsample did not contain a valid value and was treated as missing data.

The sample consisted predominantly of women. Across the entire sample, 353 (92.7%) identified as women and 17 (4.5%) as men; 7 participants (1.8%) selected the 'Prefer not to say' option and 4 (1.0%) provided a multiple response by selecting both 'Female' and 'Prefer not to say'. In the Italian subsample, 276 participants (96.2 per cent) identified as women, 2 (0.7 per cent) as men, 6 (2.1 per cent) preferred not to answer, and 3 (1.0 per cent) provided a multiple response. In the Spanish subsample, 77 participants (81.9 per cent) identified as women, 15 (16.0 per cent) as men, 1 (1.1 per cent) preferred not to answer and 1 (1.1 per cent) provided a multiple response.

Participation in the study was voluntary. The questionnaires were collected without requesting any direct personal identifiers. To facilitate potential linking between the different data collection time points, each participant generated a personal pseudonymous code by following the same instructions across successive questionnaires. As some duplicate or incomplete codes were observed, the analyses presented in this study were primarily conducted by data collection time point and by subsample, and differences between phases were not interpreted as intra-individual changes.

The research was carried out as part of modules included in the respective curricula of both universities, although participation in completing the questionnaires for research purposes was voluntary. Prior to data collection, participants were provided with information regarding the study's objectives, data processing and their right to withdraw at any time. Informed consent was obtained prior to the

administration of the instruments by the Ethics Committee of the University of Alicante.

3.2 Research Design and instruments

This exploratory study was structured in three sequential phases, corresponding to three rounds of data collection. The questionnaires used were derived from a broader instrument developed to analyse perceptions of and acceptance towards robots in educational contexts. Their development drew on the Technology Acceptance Model (TAM) by Davis (1989) and Davis et al. (1989), particularly for items relating to perceived usefulness, ease of use and intention to use. The items relating to trust and the roles attributed to the robot and the teacher were formulated and adapted from previous literature on acceptance and human–robot interaction (Arocena et al., 2022). The adaptations mainly involved contextualising the wording to the educational setting, to future teaching practice and, in subsequent questionnaires, to the robot presented in each session, whilst maintaining the conceptual content of the reference items.

The initial questionnaire comprised 18 perception items, answered using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). The items were organised into three thematic blocks: attitudes towards social robots (6 items), the teacher's role and relationship with technology (9 items) and initial intention to use (3 items). Four demographic questions were added: previous use of artificial intelligence tools and previous contact with social robots, both with dichotomous responses (yes/no); and self-assessment of teachers' digital competence and interest in educational innovation, both using five-point scales (1 = very low; 5 = very high).

The second questionnaire, administered following the presentation of Unitree Go2, included 20 closed-ended items using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree), organised into seven thematic blocks: perceived usefulness (3 items), perceived ease of use (3), intention to use (3), trust in the robot (3), the role of the teacher and the robot (4), social influence and conditions of use (2) and overall assessment of the experience (2). The questionnaire concluded with an open-ended question designed to gather participants' perceptions regarding potential educational uses, in relation to teaching practice, characteristics of the interaction, advantages, limitations and concerns associated with the robot.

The third questionnaire, administered after the presentation of Pepper, retained the same structure of 20 items and the same response scale, adapting the reference to the robot observed. It also included a specific open-ended question on Pepper's educational potential. It then included a comparative section between Unitree Go2 and Pepper, comprising five items relating to the closeness of the interaction, suitability for a real classroom situation, ability to capture pupils' attention, confidence in its educational use, and suitability as a support for teaching. These items were answered using a five-point scale: 1 = clearly Unitree; 2 = somewhat Unitree; 3 = both equally; 4 = somewhat Pepper; and 5 = clearly Pepper. Finally, a question was included asking participants to choose which robot they would prefer to use in the classroom, along with an open-ended question asking them to provide a comparative justification for the perceived differences between the two robots.

The blocks served a purely organisational purpose and were not treated as psychometric scales intended to yield overall scores per construct. The items

were analysed individually using descriptive statistics; for this reason, no composite scores or measures of internal consistency were calculated for the blocks. To facilitate the potential linking of responses obtained at different data collection points without requesting direct personal identifiers, each participant generated a personal pseudonymous code following the same instructions in all three questionnaires. The code was constructed using the first letter of the mother's name, the day of birth, the first letter of the town, and the month of birth. As the code was self-generated, some duplicate or incomplete records were observed . For this reason, the analyses presented in this study were carried out primarily by data collection time point and by subsample, and differences between phases were not interpreted as intra-individual changes.

The phases carried out are detailed below:

Phase 1. Initial questionnaire on social robotics.

Prior to exposure to social robots, participants were given a structured questionnaire designed to ascertain their initial perceptions of social robotics in educational contexts. The instrument comprised 18 perception items organised into three thematic blocks: six items on attitudes towards social robots, nine on the role of the teacher and technology, and three on initial intention to use. The 18 items were answered using a five-point Likert scale, ranging from 1 = 'Strongly disagree' to 5 = 'Strongly agree'.

A fourth section on general information, comprising four questions, was added. Two of these were dichotomous — previous use of artificial intelligence tools and previous contact with social robots — whilst two were answered using a five-point scale: perceived level of teachers' digital competence and general interest in educational innovation.

The blocks served solely an organisational purpose, and all items were analysed individually. A total of 381 students took part in this first phase: 94 from the

University of Alicante and 287 from the Suor Orsola Benincasa University in Naples. In this initial questionnaire, each participant generated a personal pseudonymous code which they were required to reproduce in subsequent questionnaires to enable their responses to be linked across the different data collection points.

Phase 2. Experience with Unitree Go2 EDU.

In a second session, the Unitree Go2 EDU quadruped robot was presented. The presentation procedure differed between the two universities. At the University of Alicante, the students took part in a face-to-face demonstration supported by specialist staff from the Higher Polytechnic School. During the session, the robot's main features and functions were explained, and the students were allowed to interact directly with it. The demonstration included locomotion, actions such as sitting down, lying down and standing up, following commands, dynamic movements, recognition and tracking functions, and voice interaction. At the Suor Orsola Benincasa University in Naples, the students were introduced to the robot through demonstration videos and guided explanations of its features, functions and potential uses.

Following the activity, a second questionnaire was administered, completed by 366 participants: 89 in Spain and 277 in Italy. The questionnaire comprised 20 closed-ended items, answered using a five-point Likert scale ranging from 1 = 'Strongly disagree' to 5 = 'Strongly agree'. The items were organised into seven thematic blocks: perceived usefulness of the social robot (3 items), perceived ease of use (3 items), intention to use (3 items), trust in the robot (3 items), the teacher's role and the robot (4 items), social influence and conditions of use (2 items) and overall assessment of the experience (2 items). The blocks served an organisational purpose, and the items were analysed individually.

The questionnaire also included a specific open-ended question about Unitree Go2 EDU, in which participants were invited to reflect on its potential educational uses, its integration into the classroom, its relationship with the teacher's work and pupils' learning, as well as on the robot's characteristics that might influence its acceptance, its advantages, limitations and potential concerns.

Phase 3. Experience with Pepper and comparison between the two robots. The third phase focused on the humanoid robot Pepper. At the University of Alicante, students took part in a face-to-face demonstration and interacted directly with the robot, whilst at the Università degli Studi Suor Orsola Benincasa in Naples, the experience took place via demonstration videos and guided explanations of its features and functions. A total of 318 students took part in this phase: 82 from Spain and 236 from Italy.

Following the experience, the third and final questionnaire was administered, structured in the same way as the post-Unitree Go2 EDU questionnaire. It included the same 20 closed-ended items, adapted to refer specifically to Pepper, distributed across the same seven thematic blocks and answered using the same five-point Likert scale. A specific open-ended question on Pepper was also added, designed to gather students' perceptions regarding its potential educational applications, its integration into the classroom, its relationship with teaching and learning, as well as the advantages, limitations and concerns associated with its use.

This same questionnaire included, in a final section, a comparison between Unitree Go2 EDU and Pepper. Participants answered five comparative items relating to the perceived closeness of interaction, suitability for a real classroom situation, ability to capture pupils' attention, confidence in using it in an educational activity, and its suitability as a support for teaching. These

items were rated on a five-point comparative scale: 1 = ‘Clearly Unitree’; 2 = ‘Somewhat Unitree’; 3 = ‘Both equally’; 4 = ‘Somewhat Pepper’; and 5 = ‘Clearly Pepper’.

Finally, a question was included asking which robot they would choose to use in the classroom, along with an open-ended question asking them to explain the perceived differences between the two robots and which they considered more suitable for an educational context. Although the choice question was worded in terms of selecting a single robot, the form’s configuration allowed for the selection of more than one option. This circumstance was subsequently taken into account in the descriptive analysis of the responses.

Consequently, the comparison between Unitree Go2 EDU and Pepper did not constitute a separate fourth phase nor did it involve the administration of a fourth questionnaire; rather, it formed part of the final section of the third questionnaire, completed by the 318 participants in this phase.

The order of presentation was the same for all participants: Unitree Go2 EDU was presented first, followed by Pepper. This fixed order was taken into account as a possible source of order effect in the interpretation of the results.

To facilitate the potential linking of responses obtained at the three data collection points, each participant was assigned a personal pseudonymous code which they were required to reproduce on subsequent questionnaires. The code was constructed using the first letter of the mother’s name, the day of birth, the first letter of the town or city, and the month of birth. As this was a self-generated code, some duplicate, incomplete or inconsistent records were observed; consequently, an unambiguous individual match could not be guaranteed for the entire sample. As a result, the analyses presented were carried out primarily by data collection time point and by subsample, and the

differences observed between the phases were not interpreted as intra-individual changes in the same participants.

3.3 Data analysis

The study adopted an exploratory, multi-phase mixed-methods design, combining quantitative and qualitative data across the different data collection time points. Quantitative data were analysed using descriptive statistics, and questionnaire items were examined individually. To facilitate the presentation and interpretation of certain trends, scores of 1–2 and 4–5 on the Likert scales were grouped together as the lower and upper extremes respectively, whilst score 3 was retained as the intermediate category. The original responses across all five categories were retained in the database.

Responses to open-ended questions were analysed using an inductive thematic analysis. Two researchers with experience in qualitative analysis jointly reviewed and coded the responses. Categories were not pre-defined but were constructed through repeated reading of the data, the identification of recurring patterns and the progressive grouping of conceptually related content. This process yielded five main themes: (1) the robot as a support rather than a substitute for the teacher; (2) motivation, curiosity and participation; (3) perceived inclusive potential and support for pupils with special educational needs; (4) morphological and communicative characteristics of the robots; and (5) limitations and concerns associated with their educational use.

The quotations included in the results were selected for their ability to represent the main patterns identified and, where relevant, the different positions expressed by the participants. Each quotation was assigned an anonymous analytical identifier that allows the source of the response to be distinguished without revealing the

participant's identity. Online machine translation tools were used to facilitate the joint analysis of the responses collected in Spanish and Italian.

The integration of the quantitative and qualitative components took place primarily during the interpretation phase. The results of the open-ended questions were used to contextualise, nuance and expand upon the trends observed in the quantitative data, particularly in relation to the role attributed to robots, their possible educational uses, their perceived potential for inclusion, and the reservations expressed regarding their introduction into the classroom.

4. Results

In Section A, 'Attitudes towards social robots', in response to the statement 'I would feel comfortable interacting with a robot in an educational context', 37.6 per cent of students disagreed, 36.2 per cent were neutral and 26.2 per cent agreed. Regarding the statement 'The presence of robots in educational settings makes me feel somewhat uncomfortable', 30.2 per cent strongly disagreed , 39.4 per cent were neutral and 30.4 per cent agreed. Regarding the statement 'I believe that robots can play a useful role in education', 27.2 per cent of students disagreed, 40.4 per cent were neutral and 32.4 per cent agreed. In response to 'I would find it difficult to trust a robot during an educational activity', 22.2 per cent disagreed, 38.7 per cent remained neutral and 39.2 per cent agreed. As for 'I am interested in learning about the potential of robots in teaching', 15.7 per cent disagreed, 35.4 per cent remained neutral and 48.9 per cent agreed. Finally, in response to the statement 'I find the idea of working with robots in education unappealing', 29.9 per cent disagreed, 34.9 per cent remained neutral and 35.1 per cent agreed.

Overall, Block A reflects an initial cautious and conditional openness towards social robotics, characterised by a significant number of intermediate responses, although

accompanied by an interest in learning about and exploring its potential educational use.

In Section B, 'The role of the teacher and technology', regarding the statement 'I retain control over the pedagogical decisions I make', 3.7 per cent of students disagreed, 26.9 per cent were neutral and 69.3 per cent agreed. As for the statement 'My professional judgement (even whilst I am still in training) should guide the use of any technological resource in the classroom', 8.7 per cent disagreed, 38.2 per cent were neutral and 53.2 per cent agreed. Regarding 'I feel capable of deciding independently when to use technology and when not to', 4.9 per cent disagreed, 19.5 per cent were neutral and 75.6 per cent agreed. Regarding 'Ultimate responsibility for educational decisions must lie with the teacher' ( ), 5.4 per cent disagreed, 23.7 per cent were neutral and 70.8 per cent agreed. As for 'Technology can support teaching, but the teacher's professional judgement must remain central', 5.9 per cent disagreed, 17.7 per cent were neutral and 76.3 per cent agreed.

In response to 'Some smart technologies could reduce the teacher's role in the classroom', 29.4 per cent disagreed, 32.2 per cent were neutral and 38.4 per cent agreed. Regarding the statement "In the future, new technologies could take on tasks currently performed by teachers", 43.6 per cent disagreed, 27.7 per cent were neutral and 28.7 per cent agreed. As for 'Advances in social robotics in education may create uncertainty about the professional role of teachers', 19.9 per cent disagreed, 34.2 per cent were neutral and 45.9 per cent agreed. Finally, regarding the statement 'It is likely that a social robot will eventually replace key teaching functions', 45.1 per cent disagreed, 29.9 per cent remained neutral and 25 per cent agreed.

Overall, Section B highlights the great importance attached to professional judgement and teachers' responsibility, alongside a degree of uncertainty regarding the changes that the introduction of smart technologies might bring about in certain professional roles.

In Section C, 'Initial intention to use', regarding the statement 'I would consider using a social robot in my future teaching practice', 37.9 per cent of students disagreed, 41.6 per cent remained neutral and 20.4 per cent agreed. As for the statement 'If I had a suitable social robot, I would consider integrating it into the classroom', 29 per cent disagreed, 42.1 per cent remained neutral and 28.9 per cent agreed. Regarding 'I can see social robots being used as an educational resource in my future career', 34.1 per cent disagreed, 39.7 per cent remained neutral and 26.2 per cent agreed. Overall, initial intentions regarding use were not yet clearly defined, with a predominance of neutral or intermediate positions regarding the future integration of social robots into teaching practice.

In Section D, 'General Information', in response to the question 'Have you previously used artificial intelligence tools such as ChatGPT or similar?', 96.5 per cent answered in the affirmative and only 3.5 per cent in the negative. To the question 'Have you had previous contact with social robots in educational or training contexts?', 18.2 per cent answered 'yes' and 81.8 per cent indicated they had not had previous contact. As for 'How would you rate your level of digital competence as a teacher?', 6.7 per cent rated themselves as having a low level (scores 1–2), 59.4 per cent as having a medium level (score 3) and 33.9 per cent as having a high level (scores 4–5). Finally, regarding general interest in educational innovation, 6.2 per cent reported low levels, 35.9 per cent reported medium levels and 57.8 per cent reported high levels.

The descriptive analysis broken down by university revealed some differences in initial perceptions. At the University of Alicante, 43.6 per cent of participants agreed that they felt comfortable interacting with a robot in an educational context, compared with 18.8 per cent of the Italian sub-sample. Similarly, 53.2 per cent of Spanish participants considered that robots could play a useful role in education, compared with 23.7 per cent of the Italians, and interest in exploring their educational potential stood at 76.6 per cent in the Spanish sub-sample and 36.6 per cent in the Italian one. By contrast, both subsamples agreed on assigning a central role to teachers: 75.5 per cent of Spanish participants and 68.3 per cent of Italian s agreed that ultimate responsibility for educational decisions should rest with the teacher. Consequently, the initial differences centred mainly on the degree of openness towards social robotics, whilst the centrality of teachers' professional responsibility was shared by both groups.

The qualitative data obtained through open-ended questions following the demonstrations of Unitree Go2 and Pepper were examined using thematic analysis. This analysis identified five main themes: (1) the robot as a support, rather than a substitute for the teacher; (2) motivation, curiosity and participation; (3) perceived inclusive potential and support for pupils with special educational needs; (4) the importance of the robot's morphological and communicative characteristics; and (5) limitations and concerns regarding the educational use of social robotics. In detail:

The robot as a support rather than a replacement for the teacher

One of the recurring themes concerns the complementary role attributed to social robots. Participants described both Unitree Go2 and Pepper as potential support tools, but maintained that lesson planning, classroom management, interpreting pupils' needs and the educational relationship remained the responsibility of teachers. The robots were conceived as assistants or resources capable of supporting certain tasks and activities, without replacing the teacher's professional functions (Table 1).

Thematic category	Representative quotation
The robot as a support rather than a replacement for the teacher	*'The teacher would use it as a support for explaining and motivating, but it does not replace their work' (ES-GO2-028).* *'Pepper could be integrated into the classroom as a complementary teaching aid […] it does not replace the teacher, but rather accompanies them, whilst the teacher retains the central role of guiding, planning and facilitating learning' (IT-PEP-194).*

(Tab.1)

Motivation, curiosity and engagement

A second theme concerns the perceived ability of robots to stimulate interest, curiosity and participation. In the case of Unitree Go2, this perception was mainly associated with its movements, its quadrupedal form and the novelty of the technology. In the case of Pepper, participants particularly highlighted its communicative potential and its ability to engage in interactive activities. These characteristics were linked to a possible increase in pupil engagement, although it was also noted that the novelty effect could become a source of distraction (Table 2).

Thematic category	Representative quotation
Motivation, curiosity and engagement	*'The Unitree robot motivates and supports hands-on learning. It is approachable, but it can be distracting and is expensive' (ES-GO2-038).* *'It could help teachers make lessons more engaging and encourage student participation […] Among the advantages are increased curiosity and participation' (IT-PEP-205).*

(Tab.2)

Perceived inclusive potential and support for pupils with special educational needs

A third theme concerns the perceived inclusive potential of social robotics. Some participants envisaged possible uses relating to pupils with special educational needs, communication difficulties, attention issues or mobility challenges. These responses reflect the expectations and perceptions of trainee teachers and do not allow us to infer the actual effectiveness of robots in inclusive processes, as the study did not directly assess learning outcomes nor did it include pupils with special educational needs (Table 3).

Thematic category	Representative quotation
Inclusion and support for students with SEN	*'Unitree could serve as a support for pupils with special needs, particularly those with mobility issues, by acting as a guide dog or carrying objects' (ES-GO2-068).* *'This robot can be particularly useful on an emotional and practical level in the classroom, with children with special educational needs or with various types of behavioural and learning difficulties' (IT-PEP-199)*

(Tab.3)

The importance of morphological and communicative features

The physical and communicative characteristics of the robots constituted another key focus. With regard to Unitree Go2, participants made particular reference to its quadrupedal form, its movements and its resemblance to an animal. With Pepper, they highlighted its humanoid form, voice, gestures and ability to respond and interact. These characteristics were associated with different forms of perceived closeness and acceptance (Table 4).

Thematic category	Representative quotation
The importance of morphological and communicative features	*'Its human form and the way it speaks make the interaction much more intimate and easier to understand' (ES-PEP-023).* *"The human appearance has a huge influence on our perception of the robot [...] its humanoid form could encourage its acceptance" (IT-PEP-207).*

(Tab.4)

Limitations and concerns

In addition to the perceived opportunities, the responses reflected various reservations. These included the cost of purchase and maintenance, potential technical faults, the need for teacher training, the risk of distraction and the possibility of excessive reliance on technology. The impossibility of replacing the empathy, active listening and adaptability inherent in human educational relationships was also repeatedly highlighted. In the Spanish subsample, concerns also arose regarding the strength and movements of the Unitree Go2 when its use with younger pupils was envisaged (Table 5).

Thematic category	**Representative quotation**
Limitations and concerns	*'I think it could be entertaining and fun for children. Although I do think it's a bit dangerous, as [...] it's very powerful. [...] If I were to use it, I'd restrict it to a designated area' (ES-GO2-085).* *'I think that teaching should remain primarily a human activity [...] Other potential limitations include cost, maintenance and the risk of becoming too dependent on technology' (IT-PEP-026).*

(Tab.5)

Furthermore, the order in which the robots were presented was not randomised: Unitree Go2 EDU was always presented before Pepper. Therefore, a possible order effect, familiarisation effect or contrast effect in the subsequent evaluations cannot be ruled out, particularly in the direct comparison between the two robots.

Quantitative results following the demonstrations

To complement the open-ended responses, the main closed-ended items following each robot presentation were examined descriptively, keeping the Spanish and Italian subsamples separate due to the different presentation conditions. In Spain, both robots were presented in person, whilst in Italy the presentation was carried out via videos accompanied by a guided explanation; for this reason, the

differences presented below should be interpreted descriptively and not as effects attributable to the mode of presentation.

Table 6 shows the percentage of participants in the highest response categories (4–5) for some of the main indicators. Following the Unitree Go2 demonstration, the differences between the two groups were particularly evident in the perception of the robot as a tool rather than a substitute for the teacher, in the responsibility attributed to teachers, and in the evaluation of the demonstration. Following Pepper, favourable ratings increased in both subsamples, although more markedly in the Spanish one.

Indicator	Go2 Spain	Go2 Italy	Pepper Spain	Pepper Italy
Useful in educational contexts	27.0	26.2	64.2	38.8
Would improve certain learning activities	42.7	28.4	56.8	38.4
I would consider using it in my future teaching practice	25.8	19.6	43.2	25.3
I would have confidence in how it works during an educational activity	10.1	16.7	30.9	27.0
It could support teaching work	30.3	22.5	69.1	31.6
The final decision should be the teacher's responsibility	80.9	52.0	88.9	53.6
It seems more like a tool than a substitute for the teacher	68.5	32.7	71.6	42.6
The demonstration helped me understand its educational potential	61.8	32.0	79.0	40.1

Table 6. Key post-evaluation ratings for Unitree Go2 and Pepper by subsample (% of responses 4–5)

Consequently, the results do not simply indicate acceptance or rejection of the robots. *Unitree Go2* received more qualified ratings, particularly regarding trust and intention to use, whilst *Pepper* was more frequently associated with potential for

integration into education. In both cases, however, the potential use of the robots was clearly placed under the responsibility and supervision of the teacher.

Final comparison between Unitree Go2 and Pepper

The direct comparison between the two robots was included as the final section of the third questionnaire, administered after the presentation of Pepper, and did not constitute a separate fourth phase of data collection. The five comparative items used a five-point scale: 1 = Clearly Unitree; 2 = Somewhat Unitree; 3 = Both equally; 4 = Somewhat Pepper; and 5 = Clearly Pepper. To summarise the descriptive trends, responses 1–2 were grouped as a preference for Unitree Go2, a score of 3 was retained as an equivalent rating, and responses 4–5 were grouped as a preference for Pepper. The original responses across the five categories were retained in the database.

Across the participant sample, 7.2 per cent favoured Unitree Go2 in terms of interactional closeness, 32.7 per cent considered both robots equivalent, and 60.1 per cent favoured Pepper. With regard to suitability for a real classroom situation, 5.7 per cent favoured Unitree Go2, 32.7 per cent considered both to be equivalent, and 61.6 per cent favoured Pepper. As for the ability to capture pupils' attention, the distribution was more balanced: 19.5 per cent favoured Unitree Go2, 43.1 per cent considered both to be equivalent, and 37.4 per cent favoured Pepper. With regard to confidence in using the robot in an educational activity, 6.6 per cent favoured Unitree Go2, 33.0 per cent considered both to be equivalent, and 60.4 per cent favoured Pepper. Finally, regarding suitability as a support for teaching, the percentages were 6.0 per cent, 32.1 per cent and 61.9 per cent, respectively.

Given that the conditions under which participants interacted with the robots were not equivalent at the two universities, these results were also analysed separately.

The preference for Pepper was more pronounced in the Spanish sub-sample, whilst a higher proportion of intermediate positions was observed amongst the Italian participants. The ability to capture attention was the dimension in which the ratings of both robots were closest.

Indicator	Spain Unitree	Spain (both)	Spain Pepper	Italy Unitree	Italy both	Italy Pepper
Closeness in interaction	4.9	7.4	**87.7**	8.0	41.4	**50.6**
Suitability for a real classroom situation	1.2	8.6	**90.1**	7.2	40.9	**51.9**
Ability to capture attention	16.0	40.7	**43.2**	20.7	**43.9**	35.4
Confidence in an educational activity	2.5	11.1	**86.4**	8.0	40.5	**51.5**
Suitability as a support for teachers	2.5	11.1	**86.4**	7.2	39.2	**53.6**

Table 7. Comparison between Unitree Go2 and Pepper by subsample (%)

The final question asked participants to choose which robot would be used in the classroom. Upon reviewing the database, it was found that, although the wording suggested a single choice, the form's configuration allowed for more than one option to be selected, which explains why the percentages initially presented totalled more than 100 per cent. To avoid this distortion, the responses were reclassified according to the pattern actually recorded. Of the 318 records, 34.3 per cent selected only Pepper, 3.5 per cent selected only Unitree Go2, 34.6 per cent indicated that both could be useful depending on the activity, 19.5 per cent stated that they would not use either, and 8.2 per cent made a multiple selection.

Here too, descriptive differences were observed between the subsamples. In Spain, selecting Pepper exclusively was the most frequent response (48.1 per cent), followed by the view that both could be used depending on the activity (28.4 per

cent). In Italy, the most frequent response was the view that both could be useful depending on the activity (36.7 per cent), followed by the exclusive choice of Pepper (29.5 per cent). The option of not using either was more common in the Italian sub-sample (24.1 per cent) than in the Spanish one (6.2 per cent).

A qualitative analysis of the final comparative question allows for a more nuanced understanding of these results. Participants mainly associated Pepper with greater communicative rapport, its humanoid form, verbal and gestural communication, and its potential use as a support in routine classroom activities. Unitree Go2, on the other hand, was more closely linked to movement, technological novelty, curiosity, and practical activities or those related to robotics and STEM subjects.

These differences do not imply that participants viewed the two robots as necessarily mutually exclusive. A significant proportion of the responses highlighted their potential complementarity and noted that the choice would depend on educational objectives, the pupils' age and the characteristics of the proposed activity. Similarly, references to inclusion should be interpreted as perceptions of inclusive potential, rather than as evidence that the robots bring about actual improvements for pupils with special educational needs.

Overall, the quantitative and qualitative results show a descriptive trend towards a more favourable assessment of Pepper in terms of interaction, trust, suitability for the classroom and perceived support for teaching, whilst Unitree Go2 retains a distinct profile associated mainly with movement, curiosity and technological experimentation. In both cases, the educational use of social robotics was conceived primarily as complementary to teachers' work and dependent on a clear pedagogical purpose.

5. Discussion

The results emerging from the different sections of the questionnaire and from the qualitative analysis allow for an articulated and coherent picture of students' perceptions regarding the use of social robotics in educational contexts. First, *Block A* highlights a predominantly neutral attitude toward social robots, accompanied by moderate openness, especially in terms of interest and curiosity about the educational potential of the technology.

This result is consistent with studies on the acceptance of social robotics, which show that interest in robots does not necessarily imply an immediate willingness to use them in education, but rather requires trust, clarity of use and appropriate pedagogical conditions (Tutul et al., 2026). This neutrality appears to reflect a phase of cognitive and value-based exploration, in which students recognize both opportunities and elements of uncertainty related to the integration of robots into educational settings. This interpretation is also supported by research on users' perceptions, which highlights how attitudes toward robots depend on prior experiences, expectations and the meaning attributed to the presence of the device (Beuscher et al., 2017; Burdett et al., 2022). Second, *Block B* shows a clear centrality attributed to the teacher, who is perceived as an essential actor in the educational process and as the primary guarantor of pedagogical decisions. This finding confirms what emerges from studies on the teacher's role in robot-assisted learning, where technology is interpreted as a support for teaching rather than a replacement for teacher mediation (Maijala & Mutta, 2024). At the same time, a widespread awareness emerges regarding the possible transformative impact of technologies, including social robotics, which is generally not interpreted as substitutive, but rather as potentially complementary to the teacher's role. Ceha et al. (2022) also emphasize that the use of social robots in classroom activities must be

understood in relation to the functions teachers attribute to these devices and the instructional conditions in which they are embedded. This coexistence between the affirmation of teachers' professional authority and the recognition of technological innovation suggests a balanced yet still consolidating view regarding the redefinition of educational roles.

Block C confirms this perspective, showing an intention to use that is still not fully structured. Responses are mainly concentrated in neutral or intermediate positions, indicating that the possible integration of social robots into future teaching practice is perceived as feasible but not yet clearly defined. This result can be read in continuity with Li et al. (2025), who highlight that teachers' perceptions of robot-assisted learning include both opportunities and challenges related to training, resources and pedagogical management of the technology. This hesitation can be interpreted as the result of still-limited direct experience with robots, but also as an expression of critical reflection on technological innovation in education. In this sense, the results do not indicate resistance to social robotics, but rather a form of professional caution that appears consistent with the methodological and pedagogical challenges identified in the literature on human-robot interaction in education (Tekerek et al., 2026). Finally, *Block D* depicts a context characterized by a high general exposure to digital technologies, particularly artificial intelligence, alongside still limited experience with social robots in educational settings. However, the high level of interest in innovation and the medium-to-high perceived digital competence suggest the presence of favorable conditions for future openness toward teaching practices based on social robotics. This finding is in line with recent reviews describing social robotics as an expanding field in education, still dependent on concrete experiences, implementation conditions and clear educational purposes (Woo et al., 2021; Youssef et al., 2023). Overall, the quantitative results find significant support in the qualitative evidence, which

enriches and deepens their interpretation. The thematic analysis of open-ended responses indeed highlights a representation of the robot primarily as a support for the teacher rather than a replacement, emphasizing the centrality of the human educational relationship. This representation aligns with a pedagogical view of social robotics as a complementary resource whose value depends on human mediation and activity design (Mullick, 2025). At the same time, the motivational and inclusive potential of social robotics emerges, as well as the importance of robots' morphological and communicative features in determining levels of engagement and acceptance in educational contexts. This aspect is consistent with Maggi et al. (2021), who show that the robot's interaction style can influence acceptance, cognitive performance and user behavior. Alongside these opportunities, however, significant limitations also emerge, mainly related to the risk of reducing the relational dimension, costs, the need for training and concerns about excessive technologization of the educational process. These concerns reflect issues already reported in the literature, where the integration of social robotics is associated with questions of training, accessibility, sustainability and contextual adequacy (Mullick, 2025; Tekerek et al., 2026). Finally, the comparison between the two analyzed robots highlights an overall preference for the humanoid robot *Pepper*, perceived as more suitable for the school context due to its communicative and interactive capabilities, while still recognizing the quadruped robot *Unitree* as valuable in terms of motivation, curiosity and use in laboratory activities. The preference for *Pepper* can be interpreted in light of its characteristics as a socially engaging humanoid robot, designed to interact through voice, movement, environmental perception and expressive behaviors (Pandey & Gelin, 2018). Moreover, studies on *Pepper* in educational, training, and care contexts have highlighted its potential to promote attention, communication, engagement and social interaction (Blindheim et al., 2023; Roštšinskaja et al., 2025).

The value attributed to *Unitree*, instead, is consistent with studies on quadruped robots, which show how zoomorphic morphology, movement and forms of non-verbal interaction can foster attributions of intention, curiosity and engagement (Shin et al., 2024). This intermediate position represents one of the most relevant outcomes of the study, as it shows that future educators do not adopt a purely techno-enthusiastic view, but rather interpret social robotics as a resource to be evaluated in relation to educational objectives, students' needs and the quality of the educational relationship.

This interpretation is consistent with reviews emphasizing the dependence of social robotics on context, pedagogical mediation and implementation conditions (Woo et al., 2021; Tekerek et al., 2026). In this sense, the results contribute to filling the gap identified in the literature by offering an integrated analysis of future educators' perceptions regarding two socially assistive robots with different morphological characteristics (Lakatos et al., 2025).

5. Conclusion

This exploratory study highlights how future educators adopt an open yet cautious attitude toward the use of social robotics in educational contexts. Initial perceptions do not reflect either full acceptance or clear rejection, but rather an intermediate position characterized by interest, curiosity and the need to further explore the real potential of such devices in teaching practice. This finding addresses the research question concerning the perception of social robotics as a pedagogical resource, as robots elicit attention and positive expectations, but are not yet fully integrated into future educators' professional imagination.

In this scenario, social robotics is seen as a resource capable of supporting students' attention, motivation, communication and participation, especially in contexts involving students with special educational needs, since its

educational value emerges through the ways educators and teachers understand, integrate and adapt this technology within instructional design. From this perspective, social robotics is configured as a pedagogical mediation tool whose use requires professional competence and responsible implementation. Social robots are therefore conceived as complementary resources, capable of supporting specific activities, enriching learning experiences and fostering new forms of interaction, without being considered substitutes for the educational relationship. Indeed, future educators attribute to teachers the responsibility of deciding when, how and for what purposes such technologies should be used. The pedagogical use of social robotics is thus understood as a practice mediated by professional judgment, educational sensitivity and the ability to interpret students' needs. The integration of social robotics into educational contexts therefore requires training pathways capable of combining openness to innovation with pedagogical reflection (Carlomagno, Vadalà & Ricciardi, 2026), as it is essential that these technologies are always guided by teachers' professional responsibility.

6. Limitations and Future Perspectives

Among the main limitations of the study, it is important to highlight the heterogeneity of the sample across the different data collection phases. This issue concerns both the modalities of participant involvement across the two university contexts and the continuity of participation throughout the research phases, which was not consistent. In particular, students from the University of Alicante (Spain) had the opportunity to directly observe and interact with the social robots in person, experiencing hands-on engagement and experimentation, whereas students from the Suor Orsola Benincasa University of Naples (Italy) were exposed to the same robots exclusively through demonstration videos and instructor-led explanations. This methodological

difference represents a significant limitation, as the different quality of experience - *direct* for Spanish students and *mediated* for Italian students - may have influenced perceptions, levels of engagement and the evaluations expressed. A further limitation concerns the voluntary and non-probabilistic nature of the sampling, which, while ensuring compliance with ethical research principles, reduces the possibility of generalizing the findings to the broader population of future educators. Moreover, the fact that participants are initial teacher education students may have influenced their responses, orienting them more toward perceptions and expectations rather than consolidated professional experience. Regarding future perspectives, it would be desirable to replicate the study using research designs that ensure greater sample homogeneity across the different phases and data collection conditions, in order to reduce potential differences that may significantly affect the analysis of results. Further developments could investigate the impact of different modes of exposure on the formation of perceptions and attitudes toward social robotics, with particular attention to how such perceptions may change over time through continuous and structured use of robots in educational contexts, while also examining how the integration of robotics may evolve while preserving the centrality of the human dimension of the educational experience.

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