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Teachers' Opinions towards Educational Robotics for Special Needs Students: An Exploratory Italian Study

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Abstract: Research reveals that robotics can be a valuable tool for school students with special needs (SNs). However, to our knowledge, empirical studies on teachers' attitudes towards educational robotics for SNs students have been very limited and, in general, do not account for the great variability in the existent difficulties of school-aged children. Our aim is to fill this research gap. This post-test empirical study assessed Italian pre-service and in-service learning support teachers' attitudes towards the application of Educational Robotics—ER with their students with SNs at the end of a 12-h training course. The results generally showed that most teachers perceived ER as a powerful tool for children with numerous SNs, particularly for Attention Deficit Hyperactivity Disorder—ADHD, Autism Spectrum Disorder—ASD, and Dyspraxia. Looking at the differences depending on the school level, kindergarten teachers perceived that ER is mostly helpful for ASD, ADHD, Down Syndrome—DS as well as with psychological or emotional distress or the needs of foreign students. For primary school teachers, ER was mostly helpful with ADHD, Dyspraxia and ASD. For both junior secondary school teachers and high school teachers, ER was mostly helpful with ASD, Dyspraxia, and ADHD.

Keywords: educational robotics; special needs students; educational contexts; learning support teachers; attention deficit hyperactivity disorder—ADHD; autism spectrum disorder—ASD; dyspraxia; Down syndrome—DS

1. Introduction

There is common agreement that robots and robotics activities can be a valuable tool in teaching and learning. The scientific literature features several studies that report the benefits and efficiency of Educational Robotics (ER) in the learning process of average students e.g., [1,2]. In this paper, the term Educational Robotics (ER) is used to indicate learning activities that use simple robots, interfaced with simple electronic systems, as tools to foster interest and motivation in children and teenagers in acquiring new skills and knowledge in school subjects (particularly, but not limited to, the STEAM disciplines, namely Science, Technology, Engineering, Art and Mathematics. In ER activities robots and robotics are neither the focus nor the goal of the learning activity, but rather are utilized as 'learning tools' to help teachers and students in the learning process [3]. As an example, during a science class, the students can learn about the subject of physics by programming a robot fitted with sensors and actuators [2]. With respect to other Information and Communication Technology (ICT) tools designed to support the learning process (e.g., touchscreens, computers, interactive whiteboards (IWB)) ER offers

a strong emotional engagement thanks to the physical embodiment of the robot and the possibility of fostering teamwork and communication skills because the students often experience the need to cooperate with others to solve the robotics activities assigned to the team [2].

A recent review of 22 papers showed multiple learning gains for students through ER, helping students to benefit in terms of: (1) understanding of concepts (e.g., programming, sensors, mechanics); (2) attitude changes (e.g., motivation toward science and technology, self-efficacy, leadership); and (3) skills development (e.g., problem-solving, computational thinking, team working) [4]. Nevertheless, this is not always the case, as there are indeed situations in which ER did not bring about significant improvements in student learning. Chambers et al. [5] reported that, though robotic sessions helped develop students' understanding of gear motion and function, the majority of students still failed to provide an accurate explanation of the concept of mechanical advantage. However, those results encouraged the researchers to reflect on the role of metacognition and the importance of taking it into account for the evaluation of problem-solving [6]. The use of ER in class may be particularly well-suited to creating the conditions for an inclusive learning environment answering the unique needs of all students.

"Special needs" (SNs) is an umbrella term for a wide range of disabilities and many other conditions characterized by learning difficulties. Herein, we focus on the special needs in education, rather than on the disabilities and their special needs. Students are said to have "special educational needs" if they have greater learning difficulties than the majority of children of their age group, which call for special educational provision [7]. Italy is characterized by an advanced inclusion model for SNs students. Since 1971, numerous guidelines and legislative measures have been adopted to achieve the complete integration of SNs children into general education classes in schools of every type and at each level [8]. For instance, in 2009 Italy signed the Convention on the Rights of Persons with Disabilities (CRPD) that explicitly acknowledged rights related to respect, dignity, and equal opportunity for individuals with disabilities. A key element of the CRPD pertains to respecting disabled students' right to be included in the general education system and receive appropriate educational support. Other types of "special educational needs" that do not originate from disabilities (e.g., immigrant students without previous knowledge of Italian language, social or economic difficulties of the families) are also supported. Learning support teachers represent a fundamental element for the success of the SNs students' inclusion, and the use of technology can help make teaching and learning more meaningful and fun [9]. At first sight, ER could be perceived as a contradictory approach as far as SNs are concerned: it seems to require advanced abilities (such as building complex mechanical structures, making complicated computer programs, understanding complex interactions with the environment). Fortunately, the current ER robots and tools available in the market are very simple with a low technological access threshold. They do not require advanced technical skills or computer science knowledge. In particular, they do not require a specific knowledge of robotics. This is true for the students, but also for the teachers. Our experience in teacher training in ER proves that a brief introduction of two hours on the concepts of what a robot is and what a computer program is can suffice. After a comprehensible initial discomfort due to the novelty of the tool, teachers very soon feel comfortable with educational robots (designed specifically for educational purposes) and they can imagine situations where to exploit ER for their didactical goals with the specific class they are teaching without any extra help. Given the plethora of the current commercial supply of educational robots, the learning support teachers (LST) can easily recognize which robot is most suited to each student and his/her disability. The LST's experience and her/his understanding of the SNs of the students are crucial in assigning to the SNC a suitable and rewarding interaction with the robot and possibly the teammates (e.g., a student with severe muscle mobility problems might be perfectly comfortable in designing strategies and in programming).

In the Italian context, previous studies e.g., [6] have found that most teachers agreed in considering ER as a powerful tool for promoting several skills for SNs students. For instance, by answering open-ended questions, Italian kindergarten teachers recognized that robotics could be used to improve

the learning of straightforward didactic units on maths for students with autism spectrum disorders (ASD). As for some primary school teachers, they also mentioned geography, geometry, and science as subjects where robotics could be used with students with ASD, attention deficit hyperactivity disorder (ADHD) and learning disabilities. However, empirical studies on attitudes towards ER for SNs students did not systematically explore and compare teachers' opinions taking into account their education level (e.g., kindergarten teachers vs. primary school teachers vs. secondary school teachers) and the type of student disabilities. The present study aims to expand the line of research into the application of ER with SNs students by investigating Italian pre-service and in-service learning support teachers' attitudes towards the application of ER to different types of student needs.

1.1. Robotics in a Classroom with Special Needs Students

In a recent review of the literature on ER for students with neurodevelopmental disorders, the authors [10] reported that from most studies it emerged that students (from 3 to 19 years of age) showed improvements in school performance or in class involvement, or in communication/interaction with peers. For instance, in the work of González-González and colleagues [11] aimed at assessing the cognitive, social and emotional development of students with Down syndrome (DS) in primary and secondary education, a positive impact of KIBO robots on students' engagement was reported. Testing cognitive and social improvements of students with autism spectrum disorder (ASD), from two classes of lower secondary education, Hinchliffe et al. [12] found that ER activities with Lego Mindstorms favored students' social capabilities and decreased the severity of some cognitive impairment in one of the two classes. In semi-structured interviews, teachers of these students reported that they perceived benefits from ER in students' content knowledge and teacher-student relationships. According to the teachers' attitudes toward ER activities with SNs students, Encarnação and colleagues [13] found that regular and special education teachers considered ER to be a useful resource, having a positive impact on students with disabilities by increasing their participation, motivation and autonomy. In pre-primary and primary education level, Cook and colleagues [14] described that teachers perceived that their students with cerebral palsy (CP) enjoyed using Lego robots, increased their task attention and increased vocalization and verbalization with other students. In the Italian school context, Agatolio and colleagues [6] found that pre-service and in-service learning support teachers expressed a positive attitude towards robotics, agreed on the belief that robotics can enhance students' motivation to learn and named ASD, ADHD, learning disabilities and mild mental retardation as aspects that can be addressed effectively by ER.

Overall, the research shows that ER could be useful in improving learning in students with SNs e.g., [10,13,14]. For instance, González-González and colleagues [11] showed that Down syndrome students aged between 7–19, but with a cognitive age from 3–6, satisfactorily gain basic programming and computational thinking skills as well as increase their motivation and the emotional state using a KIBO robot. The basic idea behind ER with SNs students is that children will be more motivated to engage in class including robotics activities than in an ordinary class. Moreover, drawing upon a constructivist framework, during an ER experience, teachers talk about and demonstrate new curricular content, but also give students the opportunity to experiment and draw their own inferences, discoveries and conclusions [13].

1.2. Description of Laboratories for Learning Support Teachers

The Italian legislation assigns a fundamental role to the learning support teachers (LST) in guaranteeing the inclusion of SNs students facilitating, at the same time, the integration of all students in the group class. LSTs acquire a post-degree specialization qualification at the end of an annual course which includes interdisciplinary training, workshops and internship. All the teachers involved in this study were enrolled in this 1-year course to gain the Italian certification of learning support teachers (LST). The course had many modules on different didactic, pedagogical, and psychological subjects. Since 2015, one of the last mandatory courses is an ER laboratory. ER well fits with multidisciplinary

and inclusiveness aspects that characterize the LST specialization [15–17]. The activity took place, in parallel with other modules, in a period from early January and late February 2020; as the trainees were divided into 16 groups, two for kindergarten, six for primary and junior secondary and two for senior secondary schools, four tutors were engaged to work with groups of homogeneous level for a total of 4 h with plenary meetings and 8 laboratory hours per group.

In planning the training intervention, we kept in mind that an LST is at the same time educator and observer of the multidisciplinary skills that his/her students bring into play in the ER laboratorial activities. Rather than focusing solely on certified objective difficulties, teachers are encouraged to accept different learning styles and different potentials, affording due importance to the student's motivation and confidence in their own abilities: this is an alternative approach to the exclusively 'clinical' one that the school often applies.

In the following, some details regarding the plenary meetings and the specific interventions for each group will be explained in brief: both the variety of proposals in relation to the level considered and some aspects common to the general adoption of robots in education will be highlighted [6].

1.2.1. Plenary Meetings

An introductory meeting provided the pedagogical motivations for an inclusive teaching practice with robots. Starting from the constructivist/constructionist theories [18,19] it was shown that robots can become a powerful didactic tool. The robot was presented as a mediator of concepts and a natural motivator that can promote STEAM development and foster computational thinking, problem-solving, critical thinking, teamwork. Moreover, educational activities with robots are based on the experiential approach and on team working. These invite each student of the team to assume personal responsibility according to his/her capabilities (which is a factor of inclusiveness, especially for SNs students). ER also develops social qualities, because it promotes the learning of the whole group in the class, but at the same time enhances the role assigned to each student. This fosters a long list of soft skills such as: the balance between autonomy and collaboration, adaptability, action planning, clarity in objectives, personal initiative, creativity, effective communication [20,21].

The most suitable types of educational robots available on the market were presented, specifying which level of education they target. At the same time, the importance of adopting "unplugged methodologies" was also underlined. The terms "unplugged robotics" or "unplugged computer science" refer to activities related to robots, robotics, and computer science that do not require the use of robots or computers. This drops the barrier of the technological interface (e.g., small keys, difficult programming interface, tiny screens) creating a further factor of inclusiveness, especially for younger students.

The distinction between robots used for therapeutic purposes (e.g., robots explicitly developed and programmed for the interaction with young autistics) and those utilized for general educational purposes has been presented with several examples.

Great attention was devoted to highlighting the specificity of ER when used with SNs students: being a particular application of ER, it maintains its positive characteristics but at the same time requires more careful planning depending on the disability involved.

1.2.2. Kindergarten and Primary School

It is important to explain to teachers in kindergarten and primary school how teaching-learning strategies and robotics should be brought together in an effective and inclusive methodology so as to also reach the students on the periphery of the class group. These students, due to actual disability, learning disorders or special educational needs, often escape the teacher's primary didactic action and its benefits. These school levels require a very soft approach: for this reason, unplugged activities in the classroom or in uncovered areas should precede the activity with the physical robot, making this latter phase more participative (the relevant literature uses terms such as 'embodied cognition', which means problem-solving by using your own body, physically and/or mentally, and 'body syntonic' to qualify

artifacts recalling these corporeal activities). In addition, robots that do not necessarily require the use of computers are preferable: this category includes so-called 'floor turtles' that are programmed with keys on the robot's back and are reminiscent of the actions of the Logo language turtle. During the lab, the LST students worked with robots of this type (Bee- and BlueBot by TTS-Group, DOC and Mind Designer by Clementoni) but also with preparatory activities with paper, pens, pencils and other material, and with Logo-like robotic simulation environments like Code.org and Scratch. Other robotic kits were also presented such as 'Little bits' and the rather special case of Ozobot: this small robot has the characteristic of being able to be programmed with color codes placed on sheets of paper or reproduced from a tablet screen, with a particular emphasis on the role of coding.

Another aspect worth highlighting, actually common to the other education levels, has been well summarized by Mitchel Resnick with his five Ps: Projects, Passion, Peers, Play and Purposes [22]. For this reason, the LST students, like the students in the class, were divided into cooperative teams, and they were invited to discover the robot and its operation experientially under the observation and stimulation/integration of the tutor. The importance of contextualizing the activity with the robot in wider multidisciplinary scenarios was also stressed through adding story-telling and artistic activities such as drawing, painting and theatre. For example, it has been shown that Ozobot can be used as a "mobile descriptor" of special paths (e.g., digestive system, space travel, travel to learn about countries) or conceptual paths (e.g., language, literature, mathematics and its history). Computational thinking can be fostered through a sort of textual coding of the 'turtle' commands that can be introduced for students who have already acquired the rudiments of writing. For older students, the introduction of a computer as a programming interface can be suitable: to this purpose, block-based languages are increasingly successful as a good combination of the immediacy of geometrical shape with the meaningfulness of the inscribed textual part: the examples presented were Lego WeDo, MakeBlock, Edison's mBot and Mind Designer itself (alternatively programmed on tablets). Given the inclusive connotation of the course, the teacher students were continually stimulated to reflect on the case history regarding physical or learning disability or special educational needs and on how to ensure that each child truly participates in the proposed activity and thus feels motivated and happy.

1.2.3. Junior Secondary School

Being a segment of the transition to high school, abstractions of a certain complexity are introduced for the first time, both mathematical (algebra) and geometric (polygons, circumferences and solids), but also descriptive, as motor languages and the perception of reality are greatly enriched. This allowed us to adopt more sophisticated robots: the experimentation was carried out with the Lego EV3 robot which constitutes a good compromise between robustness, flexibility and precision, and effectiveness with its 'native' block programming environment. In particular, the student teachers were faced with the relevance of the role of the sensors for a robot as indicators of the state of the surrounding environment, a fact that allows them to start reflecting on related topics such as the observation of natural parameters, pollution problems and conservation, control of flora and fauna, to name just a few. During the laboratory a case study was examined, robotic parking, which includes all the above-mentioned potentialities.

1.2.4. Senior Secondary School

The age and educational objectives of this level further justify the use of LEGO EV3 exploiting its most advanced features: indeed, the logical-mathematical, geometric-mechanical and programming-control aspects become even more challenging. Thus, it is possible to easily introduce reflections on kinematics, control of physical quantities, advanced sensory functions, and advanced aspects of programming such as state diagrams and small algorithms, together with other abstract concepts of significant educational value. In this age range, students are often attracted by challenges in teams, so an involvement in an ER competition is a motivating possibility that does not exclude anyone in advance.

1.2.5. Development of a Project Unit

In the end of the ER course, the LST students were divided into groups according to the level of school and each group was invited to create a robot-based project unit together with: a contextualization theme, and an integrating background in a context as interdisciplinary as possible. The LST students were asked to place the different phases of the project they were asked to design in a grid that highlights the nature of each phase in the project and other relevant aspects. The layout of the grid is reported in Figure 1. This is an empty grid to be printed and filled by the teachers that are designing the robotics activity. The LST students were also asked to include appropriate assessment tools within the phases and, above all, to imagine the presence of a disabled student whose role and specific teaching objectives should be specified. Finally, one speaker for each group briefly illustrated the PU developed by eliciting a discussion involving the whole class.

Level	Type (*)	Involved Knowledges	Tools	Teacher's Actions	Students' Actions	Expected Results

Figure 1. Layout to be reproduced and printed with the grid to be used to brainstorm and fix the ideas in the design phase of the robot-based didactic units. *Note*: (*) (E) Engagement, (X) Exploration, (I) Investigation, (R) Creation/Realization, (V) Evaluation.

2. The Empirical Study: Teachers' Attitudes toward ER for Special Needs Students

What did Italian LST think about the inclusion of the educational robotic approach in their classes with disadvantaged students? After the ER course, a questionnaire was distributed to the LST students. They had already received a fair number of hours of specialized teaching for SNs students.

Therefore, the post-test study assessed pre-service and in-service LSTs' attitudes towards the application of ER with their students with SNs. To our knowledge, no previous study has investigated the opinions of a large sample of teachers about the feasibility of ER with SNs students. Regarding the effectiveness of ER for different SNs, there are a few (inconclusive) studies in which robots are used with youngsters affected by one or more difficulties, but the data is scarce and fragmented [10]. Thus, it is very important to collect opinions of teachers trained both in ER and in the use of ER for SNs students. This investigation is intended as a preliminary study on teachers' opinions and attitudes towards the use or ER for SNs students. Some teachers might be critical about the application of ER in general and about ER with SNs students, as it is considered too complex for these students. We consider the course attended by learning support teachers as a starting point to show them the feasibility and potentiality of ER in general and ER with SNs students, in particular. In this sense, the participants were informed about the possible applications of ER.

3. Method and Materials

3.1. Participants

A total of 337 questionnaires were administered online. One participant did not give his/her consent to the participation and so was entirely excluded from the data collection. Nine participants were excluded from the analyses because they did not indicate their school level. Four participants declared they were not teachers, so they were excluded from the analyses. The final sample consisted of 323 pre-service and in-service LST, 289 females and 27 males (females = 89.5%; missing for gender = 7) aged from 25 to 58 years ($M = 37.26$ years, $SD = 7.89$). Twenty-seven participants (8.4%) teach at kindergarten, 144 (44.6%) in a primary school, 105 (32.5%) at a junior secondary school, and 47 (14.6%) at a senior secondary school. The teacher group was composed of professionals with different specializations (e.g., a math teacher, an art teacher). One-hundred and sixty-one of them were only LSTs

(49.8%), 9 (2.8%) of them were both LSTs and teachers with other specializations, and the remaining were teachers with other specializations (missing = 59). According to their teaching experience, 54.8% of them had been teaching for at least 4 years (ranging from 0 up to 28 years; $M = 5.64$; $Mdn = 4$; $SD = 5.11$; missing = 20). Ten participants are pre-service teachers (3.1%) and the remaining ones are in-service teachers (20 participants did not fill in the answer for years of experience, 6.2%). The short on-line anonymous questionnaire was administered to the participants at the end of the classes. It is worth remarking that all teachers in the 1-year certification program for LST have to take the ER laboratory. Thus, the participation in the ER laboratory is not motivated by a positive attitude toward robotics or technology. The research was compliant with the Code of Ethics of the Italian Psychology Association [23]. As no Institutional Review Board for Psychology research is currently available from the affiliations of the social-psychology researchers involved in the study (i.e., University of Chieti-Pescara, Chieti, Italy and University of Bergamo, Bergamo, Italy), no request for approval was submitted.

3.2. Measures

Attitudes towards ER for special needs students. Participants gave their opinion on how ER is helpful for a series of SNs. Participants first read: "Below is a list of the major disabilities or difficulties you may encounter among your students. Think about the application of Educational Robotics in these specific cases and respond to the following statements. The Educational Robotics is helpful for . . . ." They then rated the following 15 SNs: Attention Deficit Hyperactivity Disorder—ADHD, Dyslexia, Dysgraphia, Down Syndrome—DS, Cerebral Palsy—CP, Dyscalculia, Dysorthography, Intellectual Disability—ID, Dyspraxia or motor disability, Autism Spectrum Disorder—ASD, Visual impairment, Hearing impairment, Economic or social difficulties, Psychological/emotional distress, the needs of a foreign student. Each item was assessed on a 5-point scale (1 = completely unhelpful; 5 = completely helpful). Higher scores indicated that participants felt the ER was helpful for the specific difficulty. These SNs were put together in an ad-hoc way for this study and extracted by a preliminary inspection of the literature on the use of the ER with SNs students e.g., [10,13]. The selection of disabilities was based on the classification of neurodevelopmental disorder (ND) of the major currently used diagnostic classification systems for mental and behavioral disorders, as in the Diagnostic and Statistical Manual of Mental Disorders [24] published by the American Psychiatric Association. It was also compared with the terms used in the ICD-10 Classification of Mental and Behavioural Disorders [25] published by the World Health Organization, considering some alternative terms indicating the same or similar disorders of DMS-5. Moreover, we included the needs of foreign students as we found many studies reporting on the effects of robotics-assisted language learning (RALL) on the vocabulary learning and retention of foreign languages [26]. Finally, we included economic and social difficulties as we found many studies describing experiences with disadvantaged students [27].

Intentions to use ER with special needs students. Participants then indicated their intentions to use ER with SNs students ("If I had the opportunity, I would use Educational Robotics with special need students") on a 5-point scale (1 = absolutely not; 5 = absolutely yes). This item was put together in an ad-hoc way for this study.

Demographic questions. We also measured the self-report participants' gender (1 = *male*; 2 = *female*), age, education level at which participants are teaching (corresponding to the Italian education stage system: 1 = *kindergarten*, 2 = *primary school*, 3 = *junior secondary school*, and 4 = *senior secondary school*), teaching role, and years of teaching.

4. Results

4.1. Attitudes towards ER for Special Needs Students

Table 1 shows the descriptive statistics relating to the teachers' attitudes towards ER utility for SNs students. One sample t-test revealed that ER is considered quite helpful for each of the proposed

special need. Indeed, all means are significantly greater than the mean point of the response scale (=2.5; see Table 1).

Table 1. Descriptive statistics.

	n	*M*	*SD*	*t*	*df*	*Sig.*
ADHD	323	4.01	0.98	27.79	322	<0.001
ASD	319	3.94	0.94	27.23	318	<0.001
Dyspraxia or motor disability	322	3.93	0.96	26.74	321	<0.001
ID	319	3.84	0.97	24.69	318	<0.001
DS	320	3.77	0.97	23.53	319	<0.001
Foreign student	319	3.69	1.12	18.95	318	<0.001
Economic or social Difficulties	321	3.68	1.03	14.12	320	<0.001
Hearing impairment	320	3.59	1.05	18.64	319	<0.001
CP	323	3.54	1.11	16.89	322	<0.001
Dyscalculia	321	3.50	1.07	16.68	320	<0.001
Psychological/emotional distress	321	3.45	1.21	20.57	320	<0.001
Dyslexia	322	3.42	1.08	15.27	321	<0.001
Dysorthography	321	3.24	1.13	11.63	320	<0.001
Dysgraphia	322	3.22	1.13	11.43	321	<0.001
Visual impairment	319	3.19	1.16	10.6	318	<0.001

Note: Response scale: 1 = *completely unhelpful*; 5 = *completely helpful*. For one-sample *t*-test: 95% confidence intervals, two-tailed.

Furthermore, analysis of variance with repeated measures reveals that all teachers believe that ADHD, ASD and Dyspraxia or motor disability are the SNs in which ER plays the most helpful role compared the other ones (*Wilks's* $\Lambda = 0.45$; $F\ (14, 277) = 24.\ 29$; $p < 0.001$; $\eta^2{}_p = 0.55$). In other words, participants perceived that ER could be fruitfully used with students with the following disabilities: ADHD, ASD and motor disability, as compared with other listed disabilities.

When considering the distribution of answers (in percentages) for each educational level, analysis revealed that kindergarten teachers perceived that ER is mostly helpful with the needs of foreign students and with DS, ASD, ADHD and psychological or emotional distress. They also perceived that ER is least helpful with students with economic or social difficulties or visual impairments (see Figure 2).

For primary school teachers, ER is mostly helpful with ADHD, dyspraxia or motor disability and ASD, while ER is perceived to be least helpful with visual impairment and CP (see Figure 3). For both junior secondary school teachers and senior secondary school teachers (see Figures 4 and 5), ER is mostly helpful with ASD, dyspraxia or motor disability, and ADHD, while the four SNs in which ER appears least helpful are dyslexia, dyscalculia, dysorthography, dysgraphia.

To analyze effects of teachers' education levels (kindergarten, primary school, junior secondary school, and senior secondary school) on their favourability concerning ER for each of the 15 SNs, a Multivariate Analysis of Covariance (MANCOVA), with years of experience and teaching role as covariates, was performed.

Individual experiences with SNs students (e.g., length of time in teaching) could substantially affect the teachers' attitudes about the utility of ER with different typologies of SNs. To filter the potential effects of such features, the two covariates were entered in the analysis, however their effects were not significant (years of experience: *Wilks's* $\Lambda = 0.90$; $F\ (15, 221) = 1.64$; $p = 0.07$; teaching role: *Wilks's* $\Lambda = 0.94$; $F\ (15, 221) = 0.87$; $p = 0.61$).
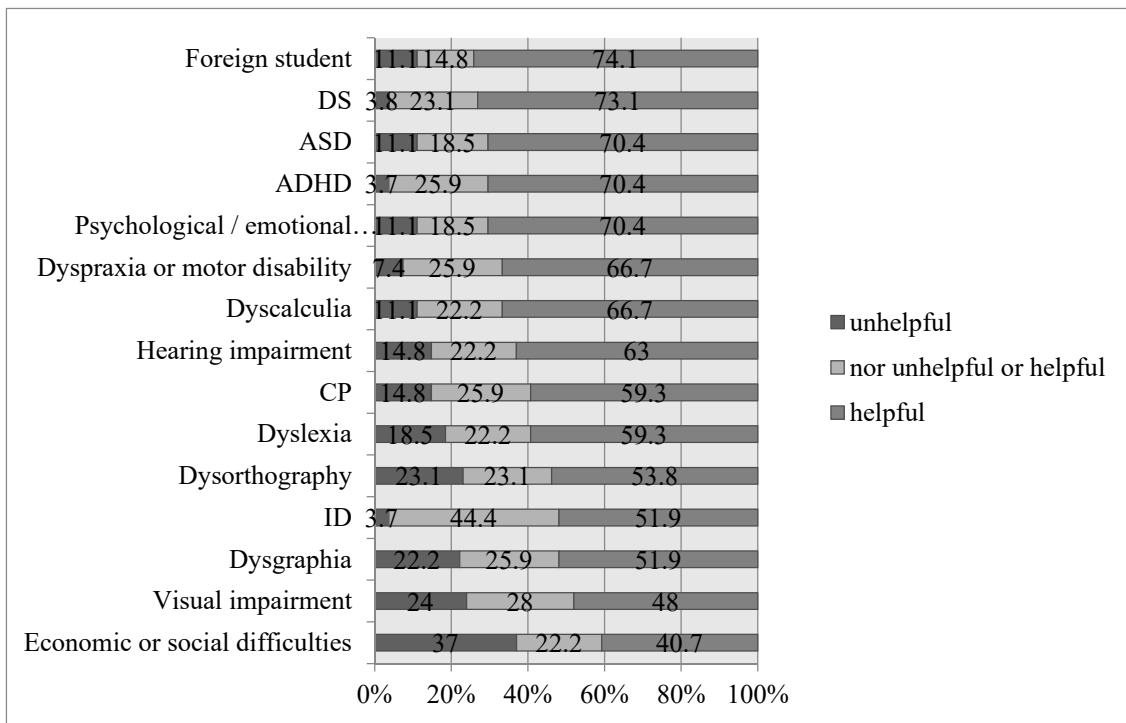
Figure 2. Percentages of responses of kindergarten teachers for each special need.
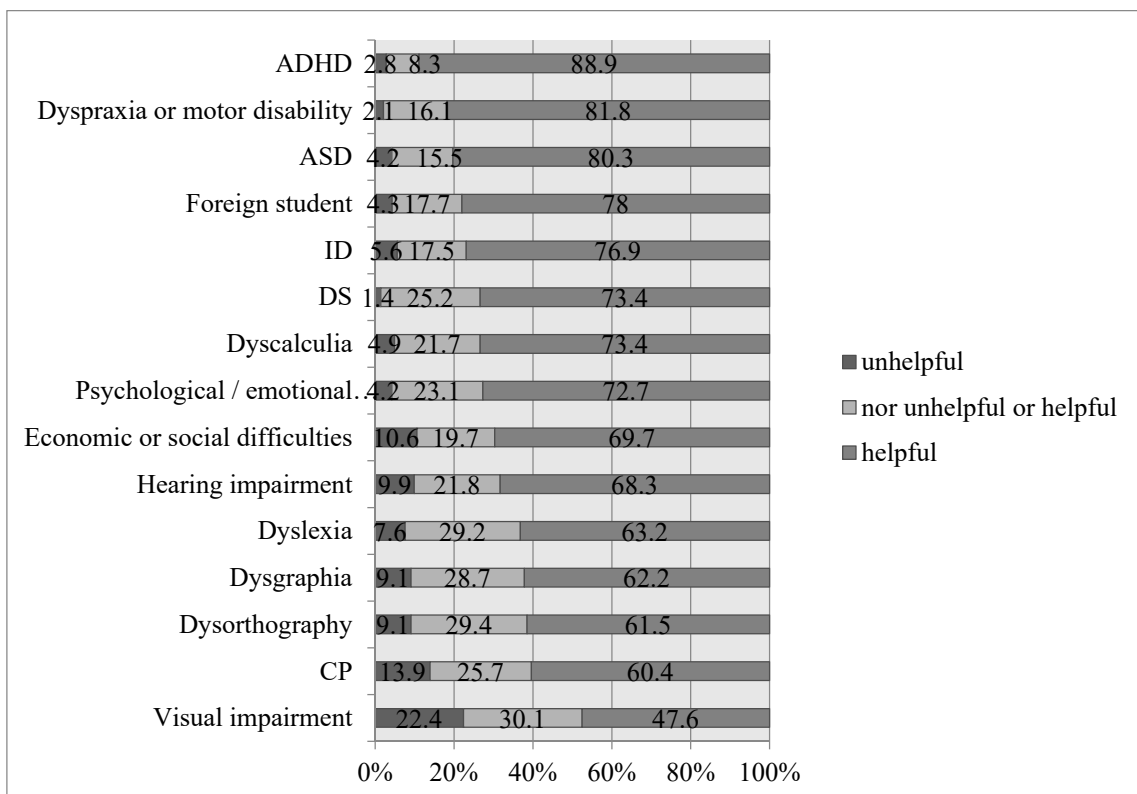

Figure 3. Percentages of responses of primary school teachers for each special need.
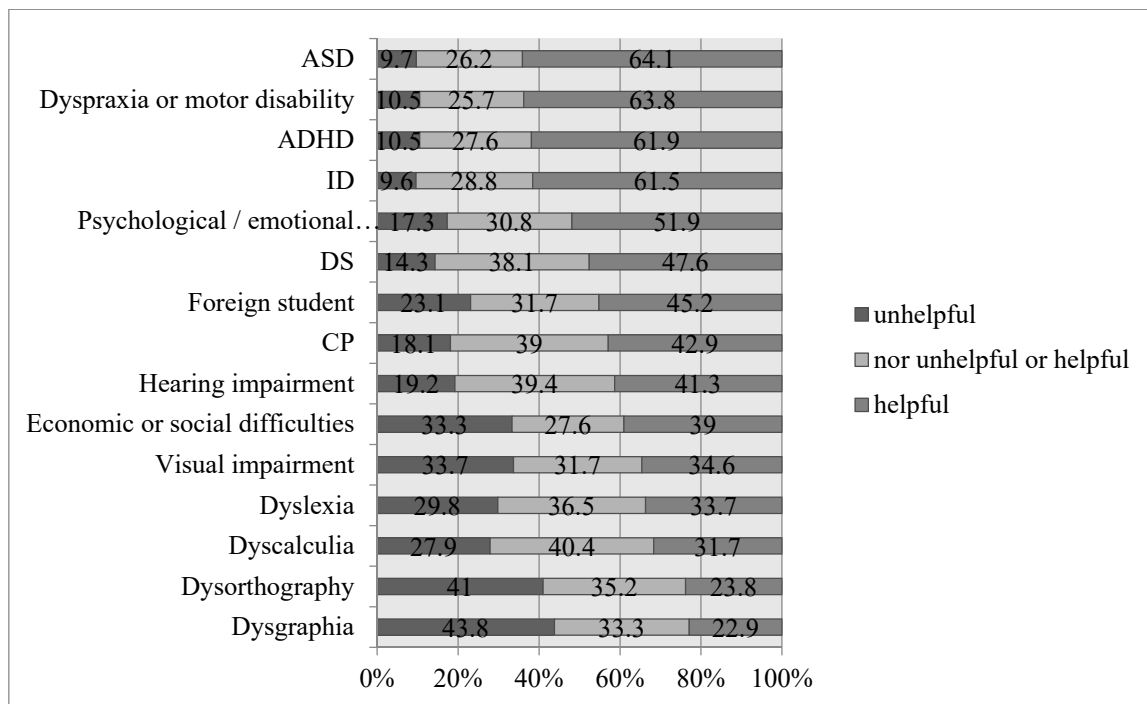
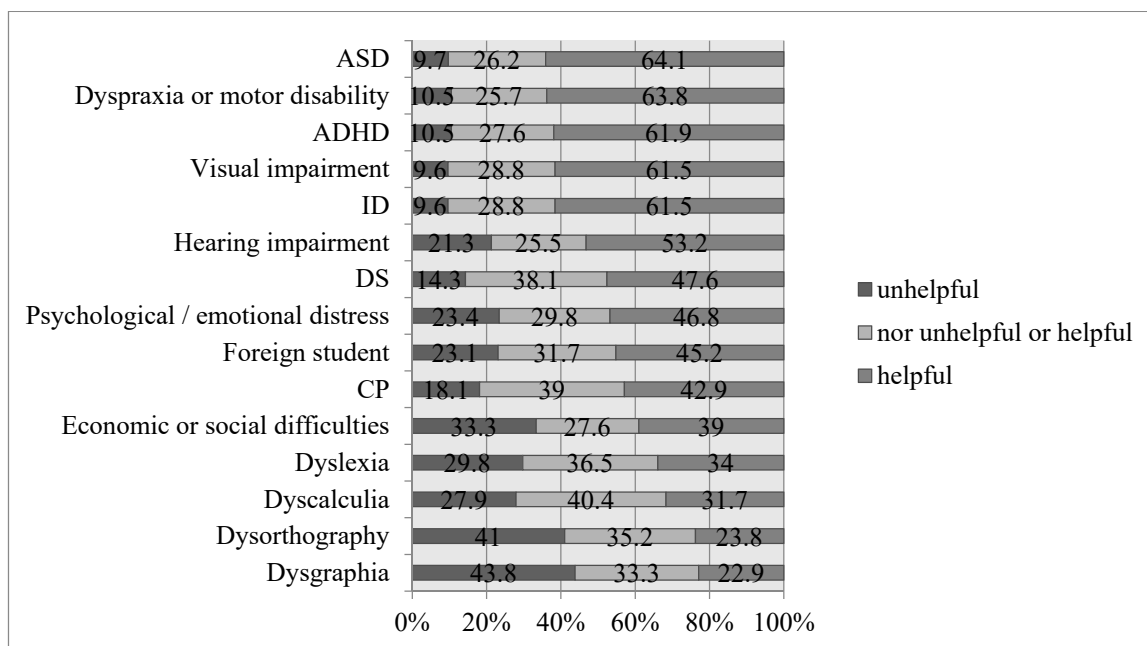**Figure 4.** Percentages of responses of junior secondary school teachers for each special need.

Figure 5. Percentages of responses of senior secondary school teachers for each special need.

The multivariate effect of teachers' education level was significant (*Wilks's* Λ = 0.67; F (45, 675) = 2.12; $p < 0.001$; η^2_p = 0.12). The univariate analyses showed significant differences in the four groups. Specifically, ER was perceived as being more helpful by primary school teachers compared with junior secondary school teachers and senior secondary school teachers for ADHD (F (3, 241) = 11.40; $p < 0.001$; η^2_p = 0.13), dyslexia (F (3, 241) = 8.22; $p < 0.001$; η^2_p = 0.09), dysgraphia (F (3, 241) = 22.69; $p < 0.001$; η^2_p = 0.22), DS (F (3, 241) = 6.44; $p < 0.001$; η^2_p = 0.08), dyscalculia (F (3, 241) = 12.43; $p < 0.001$; η^2_p = 0.14), dysorthography (F (3, 241) = 17.07; $p < 0.001$; η^2_p = 0.18), ID (F (3, 241) = 4.73; $p = 0.003$; η^2_p = 0.06), dyspraxia or motor disability (F (3, 241) = 5.56; $p < 0.001$; η^2_p = 0.07), hearing impairment (F (3, 241) = 5.06; $p = 0.002$; η^2_p = 0.06), psychological/emotional

distress (F (3, 241) = 8.69; $p < 0.001$; $\eta^2_p = 0.10$), economic or social difficulties (F (3, 241) = 11.95; $p < 0.001$; $\eta^2_p = 0.13$), and in the case of foreign students (F (3, 241) = 13.29; $p < 0.001$; $\eta^2_p = 0.14$). ER is perceived as being statistically more helpful by primary school teachers compared with senior secondary school teachers for ASD (F (3, 241) = 3.76; $p = 0.01$; $\eta^2_p = 0.05$). No significant differences were found for CP ($p = 0.15$) and visual impairment ($p = 0.11$; see Table 2 for descriptive statistics). Overall, primary school teachers had a more positive view of ER with SNs students and perceived ER to be more helpful with several SNs (with the exception of CP and visual impairment) as compared with junior secondary school teachers and senior secondary school teachers. The kindergarten teachers do not significantly differ from the other groups of teachers.

Table 2. Descriptive statistics of responses to the SNs comparing the four educational levels. Each item was assessed on a 5-point scale (from 1 = *completely unhelpful*; to 5 = *completely helpful*).

Special Needs	Educational Level	*M*	*SD*
ADHD	Kindergarten	4.13	0.73
	Primary school	4.43	0,70
	Junior secondary school	3.78	1.02
	Senior secondary school	3.55	1.24
Dyslexia	Kindergarten	3.62	0.85
	Primary school	3.75	0.96
	Junior secondary school	3.07	1.06
	Senior secondary school	3.03	1.30
Dysgraphia	Kindergarten	3.37	0.99
	Primary school	3.77	0.96
	Junior secondary school	2.63	1.08
	Senior secondary school	2.64	1.09
DS	Kindergarten	4.02	0.78
	Primary school	4.08	0.81
	Junior secondary school	3.51	0.98
	Senior secondary school	3.53	1.03
CP	Kindergarten	3.94	1.09
	Primary school	3.66	1.09
	Junior secondary school	3.36	1.04
	Senior secondary school	3.43	1.33
Dyscalculia	Kindergarten	3.69	1.01
	Primary school	3.91	0.90
	Junior secondary school	3.09	1.05
	Senior secondary school	3.01	1.25
Dysorthography	Kindergarten	3.45	1.14
	Primary school	3.72	0.97
	Junior secondary school	2.68	1.13
	Senior secondary school	2.73	1.11

Table 2. *Cont.*

Special Needs	Educational Level	M	SD
ID	Kindergarten	3.79	0.89
	Primary school	4.12	0.86
	Junior secondary school	3.72	0.93
	Senior secondary school	3.52	1.24
Dyspraxia or motor disability	Kindergarten	4.26	0.92
	Primary school	4.19	0.81
	Junior secondary school	3.70	1.02
	Senior secondary school	3.63	1.23
ASD	Kindergarten	4.20	0.87
	Primary school	4.16	0.82
	Junior secondary school	3.83	0.99
	Senior secondary school	3.63	1.19
Visual impairment	Kindergarten	3.34	1.02
	Primary school	3.29	1.07
	Junior secondary school	3.05	1.23
	Senior secondary school	2.79	1.21
Hearing impairment	Kindergarten	3.68	0.85
	Primary school	3.86	0.98
	Junior secondary school	3.33	1.01
	Senior secondary school	3.32	1.19
Psychological/emotional distress	Kindergarten	4.02	0.83
	Primary school	4.08	0.82
	Junior secondary school	3.48	1.06
	Senior secondary school	3.30	1.25
Economic or social Difficulties	Kindergarten	3.50	1.21
	Primary school	3.98	1.06
	Junior secondary school	3.08	1.15
	Senior secondary school	3.05	1.27
Foreign student	Kindergarten	3.98	0.88
	Primary school	4.18	0.79
	Junior secondary school	3.32	1.15
	Senior secondary school	3.23	1.37

4.2. Intentions to Use ER with Special Needs Students

Descriptive statistics showed that most teachers would use ER with their students with disabilities (responses 4 and 5; $n = 221$; 68.6%; $M = 3.97$; Mdn = 4; $SD = 1.12$). One sample t-test revealed that the mean for each special need is significantly greater than the mean point of the response scale ($t\ (321) = 23.67$; $p < 0.001$). Generally speaking, participants stated that they would use ER with their SNs students.

Comparing the four educational levels at which participants are teaching, one-way Analysis of Variance (ANOVA) showed significant differences between groups ($F\ (3, 321) = 23.89$, $p = 0.001$).

In particular, kindergarten teachers (M = 4.11; SD = 0.85) would use ER with their students with disabilities more than junior secondary school teachers (M = 3.51; SD = 1.06; p = 0.04) and senior secondary school teachers (M = 3.4; SD = 1.45; p = 0.025). Primary school teachers (M = 4.47; SD = 0.82) would use ER with their students with disabilities more than junior secondary school teachers (p < 0.001) and senior secondary school teachers (p < 0.001). In order to test the role of years of experience on teachers' intentions to use ER with SNs students, we conducted a regression analysis. The results were not significant (p = 0.51). In order to test the influence of teaching role on teachers' intentions, an Analysis of Variance (ANOVA) with teaching role as independent variable (LSTs vs. teachers with other specializations) was conducted. The results were not significant (p = 0.58).

5. Discussion

In this exploratory study, we found that pre-service and in-service learning support teachers expressed a positive attitude towards ER for SNs students, in line with previous Italian studies [6]. Furthermore, the study expands this line of research investigating teachers' opinions towards different types of disabilities and needs of students. The results showed that most teachers perceived ER to be a powerful tool for students with all the 15 proposed SNs, particularly for ADHD, ASD and Dyspraxia or motor disability. In the literature, it appears that school projects involving ER are effective for the social and communication skills of students with ASD or motor disabilities [28,29]. However, teachers could have a lack of ideas on the learning objectives that the robot could help achieve. We believe that the 12-h training course on ER was helpful to offer LST the opportunity to identify a wide range of teaching objectives which the robot could help with.

Comparing different educational levels, it was found that kindergarten teachers perceived that ER is mostly helpful with foreign students and for DS, ASD, ADHD and psychological or emotional distress. For primary school teachers, ER was mostly helpful with ADHD, Dyspraxia or motor disability and ASD. For both junior secondary school teachers and senior secondary school teachers, ER was mostly helpful with ASD, dyspraxia or motor disability, and ADHD. ADHD and ASD were named by teachers at each educational level. Considering that DS and CP are common disabilities in childhood [30,31], future studies could explore why these disorders are less cited by teachers.

Surprisingly, ER for special need students was perceived as being more helpful for most primary school teachers compared with junior secondary school teachers and senior secondary school teachers, with the exception of the application of ER with CP and visual impairment that was equally evaluated. This might be due to the secondary school teachers being aware of the increasing level of complexity of school subjects from primary care to secondary schools, leading the teachers to be more cautious about the possible application of ER with special need students in higher education.

Furthermore, according to their future intentions, most teachers, particularly from kindergarten and primary schools, would use ER with their students with disabilities. Kindergarten and primary school teachers were the most optimistic about the integration of ER in curricular activities involving special needs students. One possibility would be that those teachers could easily see how to integrate ER into their classes involving younger students with SNs, aiming to achieve one of their learning objectives through play. This way of learning is more common in Italian kindergarten and primary school than in the high school environment.

Years of teaching and teaching role did not particularly impact teachers' attitudes and intentions towards ER for special needs students. Teachers might differ in their knowledge of or experience with SNs students. However, younger teachers, despite having less teaching experience, may have built up more technological experience as compared with older teachers. Furthermore, significant reforms of the Italian educational system have been approved in recent years (e.g., law no. 107/2015). Such reforms redefined the entry requirements for the teaching profession and the elements of pre-service training with increasing attention paid to internship evaluation, pedagogical competencies, use of technology and the themes of inclusive education.

We believe that this study provides some insight into the implementation of ER with special needs students in Italy. As ER represents a learning opportunity for special needs students and in-service and preservice teachers are those who actually choose whether to implement an ER experimentation in their classes, we have investigated their opinions towards ER with special needs students, in order to draw a picture of their attitudes. In literature, attitudes are positively related to behaviors [32] and in this way, we hope that the teachers' positive attitudes we have collected will translate into actual implementation of ER sessions with special needs students.

In spite of the findings stemming from the study, limitations are evident. One study limitation was the discrepancy in sample concerning the educational levels at which participants are teaching and as regards the male and female participants. The prevalence of women reflects the usual predominance of female teachers in the Italian education system already observed in other studies exploring teachers' attitude toward ER e.g., [6]. This gender imbalance prevented us from exploring gender differences. Furthermore, only a few participants were pre-service teachers whereas the main part of the sample was composed of in-service teachers. Further studies should include larger and more balanced samples. Furthermore, the study focuses on teachers' expectations of ER after a relatively short introduction to it, rather than on their actual experience of implementing it. Although the results indicate a positive attitude of teachers to this idea, future studies should use a longitudinal research design for understanding the development of teachers' attitudes, behavior and knowledge over short or long periods of time. Furthermore, in future investigations, a comparison study among teachers who used ER with SNs students, teachers trained solely in ER and SNs students, and teachers with no knowledge of ER, but trained in SNs students would be appealing to demonstrate the effectiveness of ER with SNs students and the effectiveness of our training course. Teachers with previous experience could provide their specific points of view concerning the utility of ER with SNs students.

At the present, a small number of teachers have experience with ER and an even smaller group has experience with ER with SNs students, but we hope that the present work will stimulate other teachers to work in this direction. As no previous literature is available on teachers' opinions about the feasibility of ER with several typologies of SNs students, this investigation is meant to be a preliminary study on teachers' opinions and attitudes towards the use or ER for SNs students. Future studies could also explore teachers' opinions in regard to the use of ER for other students' outcomes, such as engagement given the importance of this topic in learning for students with intellectual disabilities [33–35]. Since in this study, ER has also been found to be a valuable tool for emotional and psychological distress, it may also be helpful to test ER efficacy in terms of students' psychological and relational needs [36].

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