# Teachers’ attitudes towards educational robotics in compulsory school

# *Gli atteggiamenti degli insegnanti della scuola dell’obbligo nei confronti della robotica educativa*

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**ABSTRACT** Despite the proven potential of educational robotics as a learning tool to promote disciplinary and transversal skills needed in 21st-century society, robots are still underused in schools. Teachers’ attitudes towards educational robotics play an important role in whether or not robotics is implemented in schools. This study analyses the attitudes of 174 teachers towards educational robotics, differentiating by region, gender, age, school level and disciplines taught. The results show that teachers are interested in educational robotics and that they perceive potential in the use of robots for the development of transversal skills. Some factors that limit the implementation of robotics are the costs, the time needed to prepare the activities and the fact that technologies are massively present in our everyday life and therefore some teachers do not want to bring them into school as well.

**KEYWORDS** Educational Robotics; Teachers’ Attitudes; Compulsory School; Teacher Training; Transversal Skills.

**SOMMARIO** Nonostante il dimostrato potenziale della robotica educativa come strumento didattico per promuovere le competenze disciplinari e trasversali necessarie per la società del XXI secolo, i robot sono ancora sottoutilizzati nelle scuole. Gli atteggiamenti dei docenti nei confronti della robotica educativa giocano un ruolo importante nel far sì che la robotica sia implementata o meno a scuola. Questa ricerca analizza gli atteggiamenti di 174 insegnanti nei confronti della robotica educativa differenziando per regione, sesso, età, ordine scolastico e discipline insegnate. I risultati mostrano che gli insegnanti sono interessati alla robotica educativa e che percepiscono un potenziale nell’uso dei robot per lo sviluppo di competenze trasversali. Alcuni fattori che limitano l’implementazione della robotica a scuola sono i costi, il tempo necessario per preparare le attività e il fatto che le tecnologie sono massicciamente presenti nella nostra vita quotidiana e quindi alcuni insegnanti non vogliono portarle a scuola.

**PAROLE CHIAVE** Robotica Educativa; Atteggiamenti dei Docenti; Scuola dell’Obbligo; Formazione Docenti; Competenze Trasversali.

# 1. INTRODUCTION AND LITERATURE REVIEW

Over the last few years, interest in educational robotics has increased due to the digitalisation of our society and the new skills that the working world requires, such as computational thinking (CT) and digital literacy in general (World Economic Forum, 2016). Several attempts have been made worldwide to introduce robotics in school education as well as in after school courses and activities (e.g., robotic tournaments like the FIRST LEGO League). Educational robotics has mainly been introduced with the aim to promote science, technology, engineering and mathematics (STEM) disciplines. In fact, the labour and research market in industrialised countries is facing an acute shortage of specialists, especially women, in these fields as well as in computer sciences (Holmquist, 2014). The use of robots in education is known to increase students' interest in STEM (Chalmers, 2017; Park & Han, 2016) and to foster technical and scientific skills (Chioccariello, 2009). The field in which educational robotics has developed most is mathematics, as demonstrated by a meta-analysis by Benitti (2012). In fact, 80% of educational robotics experiences take place in the field of mathematics or physics. However, educational robotics can also involve other disciplines seemingly further away from robotics, such as languages or arts. There are different experiences of using robots, such as learning words in a foreign language (Chang, Lee, Chao, Wang, & Chen, 2010) or putting on a theatre show (Negrini, 2018). Educational robots can therefore be used for almost any discipline.

Educational robotics also enables the development of different transversal skills that are fundamental for modern society (Alimisis, 2013; Chioccariello, Manca, & Sarti, 2002). First of all, it develops CT skills and skills in the field of coding and programming (Atmatzidou & Demetriadis, 2016; Keane, Chalmers, Williams, & Boden, 2016). According to Wing (2008), "*computational thinking involves solving problems, designing systems, and understanding human behaviour, by drawing on the concepts fundamental to computer science*" (p. 33). The fundamental concepts of computer science include the ability to: formulate problems; logically organise and analyse data; represent data through abstractions, models and simulations; automate problem resolution through algorithmic thinking; and test and improve the possible solutions (Keane et al., 2016). Furthermore, educational robotics promotes problem-solving skills, collaborative work and communication strategies (Nelson, 2012). In fact, robotics activities often take place in small groups with an educational approach to projects where collaboration between group members is required to achieve the final result (Ardito, Mosley, & Scollins, 2014). Another transversal competence that can be fostered with robotics is creativity, such as in the construction of robots or in the conception of a solution (Park & Hahn 2016).

However, it should be mentioned that robots should not be seen as a panacea. There are also studies reporting no significant impact of robots on learning or the development of skills (Benitti, 2012).

In sum, educational robotics can represent a great opportunity for learning. However, although robotics is becoming more popular and more studies report its benefits, it is still not well integrated in compulsory school (Chevalier, Riedo, & Mondada 2016; Eguchi, 2014). Some reasons for this weak presence include a lack of learning materials (Mubin, Stevens, Shahid, Mahmud, & Dong, 2013), the cost of the robots (Kradolfer, Dubois, Riedo, Mondada, & Fassa, 2014), limited knowledge of the educational benefits of robotics (Alimisis, 2013), fear of lacking computer science skills, a lack of time in which to initiate robotics activities (Chevalier et al., 2016), and the fear that robots might replace interpersonal relationships (Reich-Stiebert & Eyssel, 2016). As experiences with other technologies introduced in the classroom (e.g., computers and interactive whiteboards) have shown, to promote their use, it is necessary to reflect not so much on the tool itself but rather on the teachers who will use the tool. Before teachers implement educational robotics in their classes, appropriate teaching methods need to be formulated and incorporated in the school curricula (Alimisis, 2009), teachers need to be trained and, more importantly, teachers have to build a positive attitude towards robotics (Ertmer, 2005). In fact, teachers' beliefs about new technologies can represent an important limiting factor for their successful implementation in school (Hew & Brush, 2006; Lawson & Comber, 1999).

Although teachers are crucial for the effective introduction and use of robots in school, only a few studies have analysed their attitudes towards educational robots (Alimisis, 2009; Chevalier et al., 2016).
Among the few studies that have explored teachers' attitudes towards robotics, in a Korean study of 367 primary and middle school teachers, Lee E., Lee Y., Kye, and Ko (2008) demonstrated that teachers have more negative attitudes towards the use of robots in school than parents and students. The highest negative values were reported when robots were used as teachers. However, in this study the authors did not differentiate by gender and age of teachers or by discipline taught. Another more recent study of 140 primary school teachers (Kim & Lee, 2015) showed that primary school teachers in Korea have a negative attitude towards robots. This study also analysed whether attitudes are different according to age and gender but did not find any statistically significant differences. In another study of 116 primary, middle and high school teachers, Kim, Choi and Baek (2014) reported that teachers see the use of robots as appropriate from the fifth grade onwards and as applicable to almost every discipline. This study did not differentiate according to age, gender or disciplines taught. Another study by Fridin and Belokopytov (2014) investigated the perception of the human-like robot NAO as an educational robot among 18 preschool and primary school teachers. The study reported that teachers have a positive attitude towards the robot and are pleased to use it. Their desire to use robots was mainly linked to the perceived utility of robots as interactive teaching tools. A limit of this study was the small sample size. In a German study of 59 teachers, Reich-Stiebert and Eyssel (2016) investigated teachers' willingness to use robots in diverse learning settings. Their results showed a rather negative attitude of teachers towards educational robots. In this study, the authors focused on the robot NAO as an assistant to teachers. The study differentiated according to age, gender and subject taught. Age and gender did not have a significant impact on attitudes. However, the subject taught had a significant impact: teachers preferred to use robots in domains related to STEM. The study by Chevalier et al. (2016) focused on the use of the robot Thymio II and analysed the utility, usability and acceptability of the robot by 43 primary and middle school teachers in Switzerland. The analysis showed that the main motivation for teachers to use robots was intrinsic: they want to learn something new, want to be more professionally efficient and were interested in the device itself. According to the teachers, using Thymio allows pupils to develop transversal skills like collaboration, communication, learning strategies and creative thinking (Chevalier et al., 2016).

## 2. RESEARCH QUESTIONS

Based on the above-presented literature review and given the lack of studies that analyse teachers' attitudes towards educational robotics according to teachers' age, gender, region, school level and discipline taught, the present study examines the following specific questions:

1) Are teachers interested in the implementation of educational robotics in compulsory school and do they perceive an educational potential for robots?
2) Are there differences in teachers' attitudes towards educational robotics according to their age, gender, region and discipline taught?

## 3. METHOD

### 3.1. *Participants*

One hundred seventy-four teachers from the Italian speaking part of Switzerland participated in the survey (123 female, 38 male and 13 without indication; see Table 1). The teachers work in different schools: 57 teach in Lugano, a city in Canton Ticino; 45 in Castione, a suburban town of the Canton Ticino; and 72 in one of the four Italian speaking valleys of Canton Grigioni (Grigioni Italiano (G.I.)), a mountain region. In Lugano and Castione, teachers were reached during an institution plenary meeting. The sample therefore represents the whole population of the two institutions. Teachers from the G.I. were reached during mandatory refresher training. The teachers teach in different school orders: 15 in pre-primary school (children aged 3 to 5 years in Ticino, and 4 to 6 in Canton Grigioni), 98 in primary school (ages 6 to 10 years in Ticino and 7 to 12 years in Canton Grigioni), 51 in lower secondary school (ages 11 to 14 years in Ticino and 13 to 15 years in Canton Grigioni) and 10 in special education schools. Sixty-one of the teachers are between 18 and 35 years old, 43 between 36 and 45, 45 between 46 and 55 and 23 between 56 and 65. Two teachers did not indicate their age. Teachers at the pre-primary, primary and special education schools are generalist teachers, i.e., they teach all subjects in their grade. In contrast, teachers from the lower secondary schools teach a specific subject or two: 14 teach languages, 14 sciences and mathematics, 12 humanities and seven arts. One hundred and five teachers already knew what educational robotics is, while for the other 66 this was the first time they had heard of it.

| | | REGION | | | | | | | | DO YOU KNOW WHAT EDUCATIONAL ROBOTICS IS? | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CASTIONE | | G.I. | | LUGANO | | TOTAL | | YES | | NO | |
| | | N | % | N | % | N | % | N | % | N | % | N | % |
| GENDER | FEMALE | 29 | 69.0 | 51 | 75.0 | 43 | 84.3 | 123 | 71.0 | 73 | 59.8 | 49 | 40.2 |
| | MALE | 13 | 31.0 | 17 | 25.0 | 8 | 15.7 | 38 | 22.0 | 25 | 65.8 | 13 | 34.2 |
| AGE | 18–35 | 13 | 29.5 | 28 | 39.4 | 20 | 35.1 | 61 | 35.0 | 35 | 59.3 | 24 | 40.7 |
| | 36–45 | 17 | 38.6 | 11 | 15.5 | 15 | 26.3 | 43 | 25.0 | 27 | 62.8 | 16 | 37.2 |
| | 46–55 | 8 | 18.2 | 21 | 29.6 | 16 | 28.1 | 45 | 26.0 | 26 | 57.8 | 19 | 42.2 |
| | 56–65 | 6 | 13.6 | 11 | 15.5 | 6 | 10.5 | 23 | 13.0 | 16 | 72.7 | 6 | 27.3 |
| SCHOOL LEVEL | PRE-PRIMARY | 0 | 0.0 | 0 | 0.0 | 15 | 26.3 | 15 | 9.0 | 6 | 40.0 | 9 | 60.0 |
| | PRIMARY | 0 | 0.0 | 56 | 77.8 | 42 | 73.7 | 98 | 56.0 | 54 | 56.3 | 42 | 43.8 |
| | LOWER SECONDARY | 45 | 100.0 | 6 | 8.3 | 0 | 0.0 | 51 | 29.0 | 40 | 80.0 | 10 | 20.0 |
| | SPECIAL EDUCATION | 0 | 0.0 | 10 | 13.9 | 0 | 0.0 | 10 | 6.0 | 5 | 50.0 | 5 | 50.0 |

**Table 1.** Sample characteristics.

### 3.2. *Instruments*

Data were collected using a questionnaire developed in-house. The questionnaire included questions about teachers' interest in educational robotics (e.g., "Il tema della robotica educativa ti incuriosisce?")[1], about their perception of the potential of educational robotics for their disciplines (e.g., "Intravedi delle potenzialità nell'utilizzo della robotica per l'insegnamento di almeno una delle discipline di cui ti occupi?")[2] and for the development of transversal skills (e.g., "Intravedi delle potenzialità nell'utilizzo della robotica per lo sviluppo di competenze trasversali degli allievi?")[3]. The questionnaire included open question items as well as dummy items (e.g., "yes", "no").

### 3.3. *Procedure*

During the initial plenary meeting, teachers were introduced to educational robotics through a 45-minute presentation. The presentation included some information about the skills that can be developed through robotics activities, different examples of learning activities carried out in other schools and some information about the different robots that can be used (e.g., Bluebot, Thymio II, Lego Wedo 2.0, Lego Mindstorms EV3). After the presentation, teachers had an opportunity to ask questions and see the robots. The questionnaire was distributed at the end of the meeting and filled out immediately. We decided to distribute the questionnaire after the presentation knowing that the contents of the presentation may have affected the results. However, since the aim of this study was to analyse teachers' interest in the implementation of educational robotics in school and their perception of the potential of educational robotics, it was considered important to first briefly introduce what is meant by educational robotics and leave the questionnaire to be filled in afterwards.

### 3.4. *Data analyses*

First, contingency tables of the quantitative data were generated. To explore whether the obtained interactions between the variables were significant, an $\chi 2$-Test was carried out. If in these tests more than 20% of the cells had an expected frequency of less than five or at least one cell had an expected frequency of zero, Fisher's exact test was used instead of the $\chi 2$-Test (Abu-Bader, 2011). An alpha level of .05 was used for all statistical tests. The $\chi 2$-Test assesses whether there is a significant relation between the analysed variables. When a $\chi 2$-Test result is associated with more than one degree of freedom, the source of a statistically significant result is unclear and a post-hoc test is needed (Sharpe, 2015). For this purpose, bivariate comparisons with an adjustment of $\alpha$ to reduce the probability of Type I errors were performed. Second, the open questions were analysed as follows: the data were first prepared and organised and then read several times to get a deep understanding; further categories were defined, and finally the data were interpreted (Ruona, 2005).

## 4. RESULTS

Table 2 presents teachers' interest in educational robotics differentiated by region, gender and age. The results show that the majority of teachers (82.4%) are interested in educational robotics. A $\chi 2$-Test of independence was calculated comparing the interest in the different regions. A significant effect was found:

[1] "Does the topic of educational robotics make you curious?"

[2] "Do you perceive any potential in the use of robotics for teaching at least one of the disciplines you teach?"

[3] "Do you perceive any potential in the use of robotics for the development of students' transversal competences?"

$\chi2(2) = 14.498$, $p < .001$. Going into more detail with a post-hoc test using Bonferroni adjusted alpha levels of .0166 per test (.05/3), a significant difference was found between the G.I. and Lugano ($p < .001$). There is a higher interest in educational robotics in the G. I. than in Lugano. However, there are no significant differences between the other regions. It has to be mentioned that in Canton Grigioni, compared to Canton Ticino, informatics became part of the curriculum as of the 2018–2019 school year, and teachers have to do activities in this field. However, gender seems to have no significant impact on interest in educational robotics ($\chi2(1) = .304$, $p = 0.581$). Male and female teachers are interested in educational robotics in almost the same proportion. Additionally, there was no significant relationship between the age of the teachers and interest in educational robotics: $\chi2(3) = 2.238$, $p = 0.524$.

| | | ARE YOU INTERESTED IN EDUCATIONAL ROBOTICS? | | | |
|---|---|---|---|---|---|
| | | YES | | NO | |
| | | N | % | N | % |
| REGION | CASTIONE | 35 | 81.4 | 8 | 18.6 |
| | G.I. | 66 | 94.3 | 4 | 5.7 |
| | LUGANO | 39 | 68.4 | 18 | 31.6 |
| GENDER | FEMALE | 100 | 82.6 | 21 | 17.4 |
| | MALE | 32 | 86.5 | 5 | 13.5 |
| AGE | 18–35 | 46 | 78.0 | 13 | 22.0 |
| | 36–45 | 36 | 85.7 | 6 | 14.3 |
| | 46–55 | 37 | 82.2 | 8 | 17.8 |
| | 56–65 | 20 | 90.9 | 2 | 9.1 |
| | TOTAL | 140 | 82.4 | 30 | 17.6 |

**Table 2.** Interest in educational robotics by region, gender and age.

Table 3 reports the results of the analysis of the interest in educational robotics according to school level and disciplines taught. Since in both cases there are more than 20% of cells with an expected frequency of less than five, Fisher's exact test was used. The school level where teachers teach has no significant relationship with interest in educational robotics (p= .766, Fisher's exact test). There are also no significant differences in the interest in educational robotics based on the disciplines taught (p = .121, Fisher's exact test).

| | | ARE YOU INTERESTED IN EDUCATIONAL ROBOTICS? | | | |
|---|---|---|---|---|---|
| | | YES | | NO | |
| | | N | % | N | % |
| SCHOOL LEVEL | PRE-PRIMARY | 11 | 73.3 | 4 | 26.7 |
| | PRIMARY | 80 | 83.3 | 16 | 16.7 |
| | LOWER SECONDARY | 40 | 81.6 | 9 | 18.4 |
| | SPECIAL EDUCATION SCHOOLS | 9 | 90.0 | 1 | 10.0 |
| DISCIPLINE | LANGUAGES | 9 | 64.3 | 5 | 35.7 |
| | SCIENCES AND MATHEMATICS | 13 | 100.0 | 0 | 0.0 |
| | HUMANITIES | 8 | 72.7 | 3 | 27.3 |
| | ARTS | 7 | 100.0 | 0 | 0.0 |
| | SPECIAL EDUCATION | 16 | 88.9 | 2 | 11.1 |
| | GENERAL | 87 | 81.3 | 20 | 18.7 |

**Table 3.** Interest in educational robotics by school level and discipline.

Table 4 shows that 67.5% of the participating teachers perceive potential in educational robotics activities for their disciplines and 88.4% for the development of transversal skills. If we analyse the differences according to the regions, there are significant results in perceiving the potential of educational robotics for the disciplines ($\chi2$ (2) = 17.720, p < .001). A post-hoc test with an adjusted alpha of 0.0166 reports that teachers from the G.I. see more potential in educational robotics activities for their disciplines in comparison to Lugano ($p < .001$) and Castione ($p < .001$). In contrast, there are no significant differences among regions in the perceived potential of educational robotics for the development of transversal skills: $\chi2\ (2) = 1.002$, $p = .606$. Based on teachers' gender, there are no significant differences in the perceived potential of educational robotics for their disciplines ($\chi2\ (1) = 2.726$, $p = .099$) or the development of transversal skills ($\chi2\ (1) = .487$, $p = .485$). Additionally, the age of the teachers does not seem to have a significant impact on the perceived potential of the use of robotics in classes: $\chi2\ (3) = 6.940$, $p = .074$.

| | | **Do you see potential for your discipline?** | | | | **Do you see potential for transversal skills?** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Yes** | | **No** | | **Yes** | | **No** | |
| | | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Region** | **Castione** | 23 | 54.8 | 19 | 45.2 | 38 | 88.4 | 5 | 11.6 |
| | **G.I.** | 59 | 85.5 | 10 | 14.5 | 61 | 91.0 | 6 | 9.0 |
| | **Lugano** | 28 | 53.8 | 24 | 46.2 | 46 | 85.2 | 8 | 14.8 |
| **Gender** | **Female** | 77 | 65.3 | 41 | 34.7 | 105 | 90.5 | 11 | 9.5 |
| | **Male** | 28 | 80.0 | 7 | 20.0 | 32 | 86.5 | 5 | 13.5 |
| **Age** | **18–35** | 38 | 65.5 | 20 | 34. | 48 | 84.2 | 9 | 15.8 |
| | **36–45** | 35 | 83.3 | 7 | 16.7 | 38 | 92.7 | 3 | 7.3 |
| | **46–55** | 25 | 59.5 | 17 | 40.5 | 37 | 84.1 | 7 | 15.9 |
| | **56–65** | 11 | 57.9 | 8 | 42.1 | 20 | 100.0 | 0 | 0.0 |
| | **Total** | 110 | 67.5 | 53 | 32.5 | 145 | 88.4 | 19 | 11.6 |

**Table 4.** Potential seen in educational robotics by region, gender and age.

Differentiating by school level (Table 5), it appears that there are no significant differences in the perception of the potential of educational robotics for teachers' disciplines ($\chi2\ (3) = 6.375$, $p = .095$) or for the perception of the potential of educational robotics for the development of transversal skills ($\chi2\ (3) = 4.015$, $p = .260$).
In contrast, the disciplines taught by teachers seem to have a significant impact on the perceived potential

of educational robotics for their disciplines ($p < .001$ Fisher's exact test). A post hoc test with an adjusted alpha of 0.0033 unsurprisingly shows that language teachers see less potential for their classes than teachers of sciences ($p < .001$, Fisher's exact test) and arts ($p < .001$, Fisher's exact test) and generalist teachers ($p < .001$, Fisher's exact test). At the same time, there are no significant results when evaluating the potential of robotics for the development of transversal skills according to disciplines taught ($\chi2$ (5) = 1.653, $p = .895$).

| | | DO YOU SEE POTENTIAL FOR YOUR DISCIPLINE? | | | | DO YOU SEE POTENTIAL FOR TRANSVERSAL SKILLS? | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | YES | | NO | | YES | | NO | |
| | | N | % | N | % | N | % | N | % |
| SCHOOL LEVEL | PRE-PRIMARY | 9 | 60.0 | 6 | 40.0 | 11 | 73.3 | 4 | 26.7 |
| | PRIMARY | 65 | 72.2 | 25 | 27.8 | 82 | 91.1 | 8 | 8.9 |
| | LOWER SECONDARY | 27 | 56.3 | 21 | 43.8 | 43 | 87.8 | 6 | 12.2 |
| | SPECIAL EDUCATION SCHOOLS | 9 | 90.0 | 1 | 10.0 | 9 | 90.0 | 1 | 10.0 |
| DISCIPLINE | LANGUAGES | 3 | 21.4 | 11 | 78.6 | 13 | 92.9 | 1 | 7.1 |
| | SCIENCES AND MATHEMATICS | 11 | 91.7 | 1 | 8.3 | 12 | 92.3 | 1 | 7.7 |
| | HUMANITIES | 4 | 36.4 | 7 | 63.6 | 9 | 81.8 | 2 | 18.2 |
| | ARTS | 7 | 100.0 | 0 | 0.0 | 6 | 85.7 | 1 | 14.3 |
| | SPECIAL EDUCATION | 13 | 72.2 | 5 | 27.8 | 16 | 94.1 | 1 | 5.9 |
| | GENERAL | 72 | 71.3 | 29 | 28.7 | 89 | 87.3 | 13 | 12.7 |

**Table 5.** Potential seen in educational robotics by school level and discipline.

Besides the quantitative data, some qualitative data have been collected to analyse the reasons why teachers are willing or are unwilling to implement educational robotics activities in their classes. Eighty-eight teachers answered the qualitative questions. Among the reasons for implementing robotics, 32 teachers mentioned their interest in and curiosity about this innovative topic: "*curiosità, interesse a lavorare con un mezzo attuale"*[4]*; "mi interessano le attività con l'informatica e penso che sarà il futuro per i nostri allievi*"[5]. Twenty-three teachers see robots as an innovative learning tool that allows the implementation of new learning methodologies and breaking of routine: "[…] *voglia di uscire dai soliti schemi pedagogici*"[6]. Additionally, 15 teachers are interested in educational robotics as professional development: *"[...] opportunità di approfondire delle competenze ancora poco conosciute*"[7]. Robots are also perceived as useful for introducing differentiated learning activities to reach all pupils according to their competences, as reported by five teachers: "*offrire una chance agli allievi di un apprendimento differenziato e che va a promuovere interessi e talenti di allievi forti*"[8]. One teacher also cited the different role that errors assume when working with robots: programming errors are not seen as something to avoid but are part of the process and motivate the children to try a new solution: "[…] *perché favorisce la cultura dello sbaglio come opportunità*"[9]. Reflecting on the benefits that robotics could have for pupils, eight teachers listed the stronger motivation that pupils can demonstrate when working with robots: "*per gli scolari campo molto motivante e interessante*"[10], and seven teachers cited the opportunity to develop technical skills – "*capire come funziona e si costruisce un robot*"[11] – or transversal skills needed in digital society – "*nuovo argomento che vedo ben inserito per lo sviluppo di competenze trasversali*"[12] – or the possibility to use technology actively, rather than passively, and in an intelligent way: "*aiutare i bambini a farne un uso sempre più appropriato ed evitare un comportamento passivo*"[13].
The use of educational robotics is also seen as a way to get closer to the world of students: as one teacher reported, "*desiderio di avvicinarmi al mondo degli allievi*"[14]. In contrast, the reason 38 teachers give for unwillingness to use robots in their classes is the time needed for training and the development of robotics activities: "*grande investimento di tempo per apprendere qualcosa che evolverà molto velocemente*"[15]. Ten teachers are afraid of not having the competences to use robotics in their classes – "*non sono mai stata brava in questo ambito (tecnologie)*"[16] – three teachers cited the characteristics of their classes (children too young or too many children in the class) or the costs of the robots, 13 teachers perceived little potential for their disciplines and would like to have more concrete examples of learning activities – "*faccio molta*

[4] "Curiosity, interest in working with a current medium".

[5] "I'm interested in informatics activities and I think it's the future for our students".

[6] "[...] the desire to break away from the usual pedagogical schemes".

[7] "[...] opportunities to deepen skills that are still little known".

[8] "to provide a chance for learners to learn differently and to promote the interests and talents of strong learners".

[9] "[...] because it fosters the general attitude of error as an opportunity".

[10] "for schoolchildren very motivating and interesting field".

[11] "understand how it works and how you build a robot".

[12] "new topic that I see well inserted for the development of transversal skills".

[13] "helping children to make increasingly appropriate use of it and avoiding passive behavior".

[14] "desire to approach the world of students".

[15] "large investment of time to learn something that will evolve very quickly".

[16] "I have never been good in this area (technologies)".

*fatica a capire quali potenzialità potrebbe avere la robotica per l'insegnamento dell'italiano*"[17] – and five teachers are just not interested: "*attualmente do la priorità ad altro*"[18]. Seven teachers also mentioned that they do not want to bring technologies into school since children are already overwhelmed by technologies outside, so in school they prefer to work on other skills: "*preferisco situazioni dove i bambini mettono in atto relazioni sociali*"[19], "*mi spaventa aprire questa porta già ai piccoli che hanno bisogno [di] altro per crescere*"[20] and "*ci sono già troppi bambini attaccati al tablet giorno e notte. Il nostro lavoro dovrebbe andare in senso inverso*"[21].

## 5. DISCUSSION AND CONCLUSION

The aim of this paper was to analyse whether teachers are interested in the implementation of educational robotics in compulsory school and if they perceive potential in the use of robots.

The results show that teachers are generally interested in educational robotics, although there are some differences according to the region where teachers teach. Teachers in the G.I. are more interested than those in Canton Ticino. It has to be mentioned that, beginning in the 2018–2019 school year, the new curriculum for Canton Grigioni includes some hours of informatics and media in compulsory schools. Therefore, teachers need to be trained and have to prepare activities in these fields. In Ticino, however, educational robotics has only a tiny space in the compulsory school curriculum. Activities in this field are classified as general training, meaning skills are not part of one or more specific disciplines but involve all disciplines and are therefore mostly done on a voluntary basis in the form of school projects. The presence of educational robotics in school curricula is therefore crucial for promoting teachers' interest in robotics, as already reported by Alimisis (2009). At the same time, gender and age seem to have no significant impact on this interest. This result confirms the results obtained by Kim and Lee (2015) and Reich-Stiebert and Eyssel (2016). Furthermore, the analyses also indicate that school level and disciplines taught do not have a significant impact on interest in educational robotics.

When comparing the present research with previous studies, both positive and negative attitudes towards educational robotics can be found. When robots are seen as educational tools used to foster disciplinary or transversal skills, as in this study or in that by Chevalier et al. (2016), teachers have rather positive attitudes towards robotics. However, when they are perceived as teachers' assistants, attitudes are rather negative, as in the studies by Reich-Stiebert and Eyssel (2016) and Lee et al. (2008).

The qualitative data show that teachers value educational robotics since robots allow them to implement new learning methodologies, foster their professional skills, reach all students by differentiating their activities, and motivate students. Robots are also seen as useful tools to develop different technical and transversal skills and to get closer to the world of students.

Among the reasons for not implementing robotics, teachers mentioned the costs, the time needed for training and the development of robotics activities, the technical complexity they associate with robots and programming languages, the fear of not having the competences to master it, the characteristics of their classes (children too young or too many children in the class), and little perceived potential for their classes.

[17] "I find it very difficult to understand what potential robotics could have for teaching Italian".

[18] "I am currently giving priority to other things".

[19] "I prefer situations where children have social relations".

[20] "I'm afraid of opening this door already to the little ones, who need other things to grow up".

[21] "[...] there are already too many children attached to their tablet day and night. Our work should go in the opposite direction".

These results confirm the literature in this field (e.g., Kradolfer et al., 2014; Alimisis, 2013; Chevalier et al., 2016). One of the major causes preventing the implementation of robotics in school seems to be the time needed to prepare the activities. Several examples of activities exist, especially for sciences and mathematics or even arts, since robots support creative activities. For teachers of languages and humanities there are fewer examples available, though there are still some examples of use in these fields (Negrini, 2019). These results are also linked to the question about the type of potential that teachers perceive in the use of educational robots. Teachers perceive more potential for the development of transversal skills than the development of subject-linked topics. Only 67% see potential in the use of robots for their disciplines, while 88% see potential for the development of transversal skills. Not surprisingly, teachers who teach sciences, mathematics or arts and generalist teachers see more potential for their classes than language teachers do. Another factor that is not present in previous studies and that is worth investigating is the fact that several teachers affirmed they do not want to bring technologies into school since children are already inundated by technologies outside. Teachers seem concerned about the growing presence of technologies in our everyday life and want to find intelligent ways to use them.

In sum, teachers are interested in educational robotics and see potential in their use to develop transversal skills. However, teachers are also concerned that children already use too much technology. To foster the implementation of educational robotics in school, it would therefore be important to show more examples of activities where social skills are used and where technologies are used in an intelligent, active way. Robotics should not be focused on the technological aspects but rather on the development of transversal skills. Training courses should also allow teachers to see already existing activities so they do not waste time preparing activities themselves.

Based on these last points, we have begun a project in Switzerland with the aim of building a peer community of teachers interested in robotics in which they can contact one another and exchange activities and materials through the online platform Roteco[22].

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