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Before and after the lockdown: an analysis of the impressions of students and teachers involved in an Educational Robotics project[1]

Prima e dopo il lockdown: la percezione di studenti e docenti coinvolti in un progetto di Robotica Educativa

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Abstract. The first Covid-19 lockdown period in the spring of 2020 had a very significant impact on the lives of Italian students. Distance learning suddenly became the only way to attend school. Students did not have the appropriate technological and emotional background to deal with instruments like computers and e-learning platforms, or sufficient knowledge and skills to handle the new teaching format, especially as it was the only option available. This paper looks at the PON "Coding and Robotics" project, which took place in the 2019-2020 school year and ended in the middle of the lockdown. Starting from the large amount of information gathered before, during and after the project from student and teacher questionnaires, and teachers' reports and focus groups, we analyse the results of the survey administered to students and teachers to investigate how their behaviours and impressions about their education changed during the period of distance learning. It emerged from the analysis of 214 pre- and post-project responses that the students who had participated in the project felt their relationship with science and maths had improved and that some teachers found the project had provided a motivational boost for overcoming lockdown difficulties.

Keywords: COVID-19, lockdown, educational robotics, distance learning, coding.

Riassunto. Il primo periodo lockdown nella primavera del 2020 ha avuto un impatto molto significativo sulla vita degli studenti italiani. L'apprendimento a distanza è diventato improvvisamente l'unico modo per frequentare la scuola, nonostante gli studenti non avessero un background tecnologico ed emotivo adeguato per gestire strumenti come computer e piattaforme di e-learning, né conoscenze e competenze sufficienti per gestire il nuovo format di insegnamento. Il presente lavoro analizza il progetto PON "Coding e Robotica", svoltosi nell'anno scolastico 2019- 2020 e conclusosi per la maggior parte dei gruppi durante il lockdown. Partendo dalla grande quantità di informazioni raccolte prima, durante e dopo il progetto da questionari per studenti e inse-

[1] Although this article is a shared effort, sections 3 and 4 are attributed to Daniela Bagattini, while sections 1,2,5 are attributed to Beatrice Miotti.

gnanti, e da interviste e focus group con i docenti, in questo contributo andremo ad analizzare come sono cambiati comportamenti e impressioni di docenti e studenti durante il periodo di formazione a distanza. Dall'analisi di 214 risposte pre e post progetto è emerso che gli studenti che hanno partecipato al progetto hanno visto un miglioramento nel loro rapporto con la scienza e la matematica, in linea con l'opinione di una parte di insegnanti che hanno trovato nel progetto una spinta motivazionale per superare le difficoltà del lockdown.

Parole chiave: COVID 19, lockdown, robotica educativa, formazione a distanza, coding.

1. INTRODUCTION

In this paper we discuss the results of the "Coding and Robotics" project on Educational Robotics funded by the National Operational Programme for Schools (PON) and the European Social Fund (10.2.7.A2-FSE-PON-INDIRE-2017 -1). The literature contains a significant amount of research on the effects of coding and educational robotics as teaching methods that are part of curricular lessons and this way of looking at computational thinking and robotics has become increasingly widespread (Merlo, 2017; Marcianò, 2017). This is in contrast with robotics and computer studies seen as curricular subjects.

During the pandemic some authors looked at hands-on activities and teaching strategies, and proved that laboratory-based methodologies were possible even via distance learning (Tuomi, Multisilta, Saarikoski, 2018; Picarella, Moro, 2021; Bizzarri, Donati, 2021; Controlli, Martelli, Masi, 2021; Cesareo, Monti, 2021). However, these can be seen as virtuous experiences since, according to INDIRE (2020a; 2020b), most teachers adopted a transmission teaching approach during the lockdown period.

In this paper we consider the impact of lockdown on the Coding and Robotics project and the extent to which the project was able, in some circumstances, to help motivate the students involved.

In the first section we will first describe generally how coding and educational robotics are used as learning tools before looking at their use in INDIRE's Coding and Robotics project. We will then discuss the data on the impact of lockdown on the project, by analysing the questionnaires administered to students and teachers and an in-depth study carried out with focus groups.

2. CODING AND ROBOTICS AS METHODOLOGIES AND THE RESEARCH

2.1 Coding and robotics

The last few years has seen a good deal of research on the effects of coding and educational robotics, starting with the first studies conducted by Papert (1980), who proposed the use of the Logo language to code a robotic artefact as a way to improve logical and mathematical skills. Papert introduced constructionism, which relates to experiential learning and builds on Jean Piaget's epistemological theory of constructivism (Papert, 1986). It is achieved by increasing hands-on learning activities, where students can physically handle instruments and concrete objects. To be effective, coding and educational robotics need a suitable methodological context. Specifically, the evidence is positive for collaborative, problem-based and cooperative learning-approaches in interdisciplinary contexts (Bruner, 1961; Dewey 1938).

Around the world, great emphasis is placed on idea that students should be prepared for changes in society, in anticipation of digital transformations and new job profiles requiring a thorough knowledge of computer use and programming (Academy of Science of South Africa, 2021). To deal with this, computer science and robotics are already compulsory subjects from primary school upwards in 18 European Union countries (European Schoolnet 2015). The expectation is that there will be a widespread need in the future for programming and problem-solving skills in the workplace. According to Lahati et al. (2016) "By doing this the respective nations wish to develop an improvement in computational and logical thinking, interest in technology and programming and improve students ICT competences in general" (p.5). The influence large international companies have to promote the interests of learners of programming and computer science has also been highlighted by Moreno-Leon et al. (2018), who describe how activities such as "The Hour of Code" and "All you need is Code" promoted by the European Commission are also financially supported by major IT companies, including Microsoft and Facebook.

This point of view is shared by Martinez and Stager (2013), authors of *Invent to Learn*, the book that is mandatory reading for anyone approaching tinkering for the first time, who state that "Learning to program a computer is an act of intellectual mastery that empowers children and teaches them that they have control of a piece of powerful technology. Students quickly learn that they are the most important part of the computer program" (p. 204).

In Italy computer science is not a compulsory subject in primary and lower secondary schools and is only compulsory on certain course programmes in secondary schools (i.e. technical institutes and schools with technology and science tracks) (Eurydice, 2022). In lower secondary schools it is often incorporated into other subjects, such as Technology or Maths (MIUR, 2012). Computer science is not taught at primary school level. On the other hand, in the Italian educational system, headteachers have the autonomy to adapt and improve the services and educational resources they provide. Indeed, there are several experiences where coding and educational robotics have been included as curricular subjects at primary school level. The aim here is to get children involved in programming from an early age because of a growing awareness that demand for information technology professionals will continue to increase and a fear that it may not be met (Scardozzi et al., 2015, Valzano et.al 2021).

However, coding and educational robotics do not have to be a school discipline to be effective for learning (Nulli et. al, 2022, Bagattini et al, 2022); on the contrary, in a context established with the bricoleur and STEAM philosophy (Blikstein, 2021) (Screpanti et. al, 2021), they can be seen as methodologies that can be applied across curricular subjects.

Italy's "National Plan for Digital Education" (Law 107/2015) and the subsequent "National Guidelines and New Scenarios" (2018) define computational thinking as a competence to be acquired across all disciplines, describing it as "a mental process that allows one to solve problems of various kinds by applying specific methods and tools and planning a strategy" (p. 13). Moreover, it is developed through educational robotics activities without the use of technological devices: "Any situation that requires a procedure to be built, a problem to be solved through a sequence of operations, a network of connections to be established (e.g. a hypertext), fall into this category, provided that the procedures and the algorithms are well-thought out and are accompanied by metacognitive reconstruction, and openness about and justification of the choices made" (*ibid*.). According to Merlo (2017), a retired primary school and leader of the Mathematics Division of Movimento di Cooperazione Educativa[22], inspired by Freinet's principles, it is not difficult to find connections between the curricular subjects and robotics. In her work she describes several teaching units and interdisciplinary educational robotics experiences conducted in her classes over the years stating that "one of the first aspects teachers should focus on is contextualising the experience. In other words, the robot should be built for a purpose" (Merlo, 2017, ch. The robotics laboratory: a look at the working methodology). Giovanni Marcianò (2017) highlights the importance of the educational robotics lab as a practice that is yet to be consolidated within curricular teaching, stating further that the practice of teaching computer science as a discipline in non-specialist schools has led to the contradiction of computer science "the tool" being confused with "computer science" as a science in its own right. Several examples of coding and educational robotics activities incorporated into the curriculum can be found in the literature: Parola et. al. (2021) describe the results of their research on the use of robots as a mediation instrument for normal learning and for transversal competencies in the school setting. Nulli et al. (2022) describes the activities carried out by teachers during the Coding and Robotics PON project and highlight the use of digital artefacts to encourage problem- solving and learning-by-doing and to develop computational thinking and a constructive approach to errors.

2.2 The Coding and Robotics project

The PON Coding and Robotics project was a favourable setting for observing the impact of educational robotics and computational thinking on students of different ages and from different socio-cultural backgrounds. The experimental research was planned for the entire school year (from mid-September 2019 to mid-June 2020), but, owing to Covid-19 restrictions and containment measures, including school closures and the introduction of distance learning, the project ended in December 2020.

The aim of the experimental research was to prove that coding and educational robotics were suitable methodologies for encouraging an interdisciplinary and vertical approach (Nulli, Miotti, 2021).

The project involved three actions. Two actions were in educational robotics, with two groups of teachers with expert and non-expert technological skill levels (22 and 44 teachers respectively). The third action was in coding with primary and nursery school teachers (50 teachers). Some information about their background are reported in the next tables.

In table 1 the distribution of teachers according to sex is shown: the number of female teachers is higher in the action related to coding as it involves primary school where typically women are the majority.

[2] http://www.mce-fimem.it/

Table 1. Distribution of teachers involved according to sex and action.

Action	Female	Male	Total
CODING	47	3	50
ROBOTICS–Expert teachers	15	7	22
ROBOTICS–Non-expert teachers	32	12	44
Total	94	22	116

Table 2. Distribution of teachers according to the region in which they taught.

	Number of Teachers
Less developed Regions[1]	48
Regions in Transitions	8
More developed Regions	60

[1] Less developed regions: Basilicata, Campania, Puglia, Sicilia, Calabria; Regions in transitions: Abruzzo, Sardegna; More developed regions: Lombardia, Lazio, Toscana, Marche, Veneto, Piemonte,Trentino,Emilia-Romagna, according to PON guideline.

Table 3. Distribution of lower secondary school teachers according to sex and curricular subjects.

Curricular subject	Female	Male	Total
Art	1	2	3
Physical Education		2	2
Italian literature	8		8
L2	5		5
Maths and Science	16	3	19
Music	1	2	3
Religious Education	1	1	2
Science	1		1
Special need teachers	1		1
Technology	13	9	22
Total	47	19	66

In table 2 the distribution of teachers according to the Italian region classifications of PON guideline, is shown. The number of teachers involved was equally distributed between less and more developed regions, while few teachers belonging to region in transitions applied the project.

A very interesting aspect of the project involved the disciplines taught by the teachers (table 3). Despite being a technology-based project, about 20% of the teachers involved were from the humanities. Although the latter is a low value, it is still certainly an important result because it signals that even teachers of, for example, literature were ready to get involved in learning new methodologies even though they were far from their background.

The first two actions involved a total of 600 students aged 11 to 13 from 33 classes in lower secondary school. Teachers of different subjects working in the same class were asked to create a collaborative, interdisciplinary teaching plan to be implemented in a cooperative laboratory setting. Each class was provided with an Arduino CTC101 kit. Teachers with no experience in educational robotics were given 25 hours of training in electronics and programming.

Students had to create robotic artefacts from scratch using Arduino and were asked to employ a problem-based approach and the Think Make Improve design method (Martinez and Stager, 2013). Students were involved in the design, programming and debugging phases. Here, the purpose of the experiment was to explore how educational robotics can be used to implement an interdisciplinary curriculum.

Younger students from primary and nursery schools worked with Cubetto Playset, an Arduino-based wooden robot which children can program by fitting directional tiles into the control board. Teachers were asked to plan an activity suitable for children of different ages to work on together. The research question for this action was "how can coding be used to implement a vertical curriculum?"

2.3 The Project during Lockdown

The first lockdown period in spring 2020 had a very significant impact on the lives of Italian students (De Marchi, 2020; Leonini, 2020; Clemens et al., 2020; Capperucci, 2020; Pavolini et al., 2021; Fondazione Agnelli, 2021). When distance learning suddenly became the only way to attend school, a high percentage of students were without the right technological and emotional skills and experience to deal with e-learning platforms or this new teaching format, which was the only option available. Added to this is the scarcity of technological devices, both within schools and available to families. According to ISTAT (2020, p.159), 45.4% of students aged 6 to 17 (about 3.1 million children) have had difficulties with distance learning linked to a shortage of IT tools in the family. ISTAT also notes the importance of suitable living spaces. In 2018, 41.9% of minors in Italy lived in overcrowded homes (*ibid.*). As De Marchi states "School, an area that ought to temper inequalities, has suddenly turned into the litmus test for the country's structural and infrastructural backwardness and its poverty" (2020, p. 252).

Table 4. Percentage participation in the project according to actions.

	Did not complete project	Percentage participation in the project according to actions, ending 30 June 2021	Percentage participation in the project according to actions, ending 31 December 2021
CODING	10.0%	70.0%	20.0%
ROBOTICS–Expert teachers	9.1%	81.8%	9.1%
ROBOTICS–Non-expert teachers	31.8%	36.4%	31.8%
Total	18.1%	59.5%	22.4%

For distance learning to work effectively, teachers need the right digital teaching devices and skills. It is also important to stress that teachers should be willing to adapt their teaching methods to the new context.

Distance learning also had an impact on the Coding and Robotics project.

The outbreak of the Covid-19 pandemic and the consequent school closures from the end of February meant that teachers were unable to complete the in-person portion of the robotics and coding activities.

About 18% of teachers withdrew from the project; 41% chose to extend it until the end of December 2020. Only some teachers (22 out of 82 for whom we have information)[3] suggested new ways of doing educational robotics and coding in distance learning mode and tried to engage students with simulator software, or by providing hardware to share between one home and another.

Returning to our project, most of the teachers were able to finish in distance learning mode by the end of June 2020. Of these, the largest portion was in the expert group (table 4). This suggests that it is important to have confident knowledge of topics when it comes to handling difficult situations.

3. ANALYSIS OF THE DATA FROM QUESTIONNAIRES AND FOCUS GROUPS

3.1 Methodology

The project's methodological framework was initially very broad: we planned both pre-project and post-project questionnaires for teachers and lower secondary school students. The purpose of the teachers' questionnaire was to investigate their approach to teaching and the methodologies used, in order to better assess the impact of the project. An analysis of the results of this questionnaires is presented in a recent publication (Nulli, Miotti, Di Stasio, 2022).

The aim of the students' questionnaire was to investigate their impressions, learning styles, relationships with the school and impressions of self-efficacy.

The questionnaires were administered via an online platform and were not compulsory. The numbers of responses by questionnaire type are given below:

- pre-project questionnaire – robotics teachers (January 2020): 52 out of 66 answers;
- post-project questionnaire – robotics teachers (June/December 2020): 51 out of 66 answers;
- pre-project questionnaire – nursery school coding teachers (January 2020): 21 out of 25 answers;
- pre-project questionnaire – primary school coding teachers (January 2020): 18 out of 25 answers;
- post-coding questionnaire – nursery school teachers (June/December 2020): 22 out of 25 answers;
- post-coding questionnaire – primary school teachers (January 2020): 22 out of 25 answers;
- pre-project questionnaire – students: 450 answers out of approx. 700 students;
- post-project questionnaire – students (only students on projects ending before 30 June 2020): 214 answers out of approx. 350 students.

In addition to the questionnaires, the teachers were asked to complete three textual reports, with trace questions whose function was to guide them in "the planning of activities, their observations through documentation and guided analysis, and replanning" (Nulli, Miotti, Di Stasio, 2022, p. 108). A total of 93 out of 116 teachers completed all three reports (numbers of those who completed the experiment: 93, 45 for coding, 48 for robotics – 20 experts, 28 non-experts).

The questionnaires were intended to be accompanied by case studies, however, Covid-19 containment measures made this impossible. Interviews and focus groups were held instead with teachers selected according to certain criteria based on four main themes emerging from a cross- analysis of questionnaires and reports: the technical aspects of design; interdisciplinarity; aspects linked to inclusion; the gender issue. The members of the focus group were selected because they had provided more details about subjects of interest in their

[3] This information was not in the reports. To obtain it, we started a topic on the project forum and received responses from 82 out of 116 teachers.

third report[4]. The aim of this section of the report was to investigate how those who had seen the transformative potential of robotics and coding had interpreted it, and then to understand the conditions in which it had occurred.

Although the instruments used were designed to highlight different aspects, they also made it possible to gather information on the topics discussed here, particularly on how the project was experienced during the period of school closure.

We focus on two main questions: 1) how did the students' perception of themselves in certain subjects change? 2) how did lockdown affect the project?

3.2 The students' point of view

A questionnaire was given to students before the start of the project and the intention was to repeat some of the questions at the end of the experience. School closures and distance learning radically changed our research questions and the pandemic's arrival was a very powerful variable.

Figure 1 presents the results of the question "How good do you think you are in these subjects?".

If we look at those who chose a rating of 4 and 5, there was little difference for Italian between the start and the end of the project, corresponding more or less to before and after lockdown, and there was a slight decrease in mathematics, but there was an increase by 3% for technology and by 7% for science, one of the subjects that was more involved in the project[5].

If we look at the distribution of individual scores (figures 3 and 4), we see that something curious happens with technology. Although the number of those scoring 4 increases, the number of those who feel they are very good decreases. Could this mean that their actual use of technology during the months of distance learning had had a slightly negative impact on their perception of themselves?

The trend for mathematics (figure 3) was similar, with maximum scores tending to decrease (scores in the middle of the ranged were higher after lockdown than

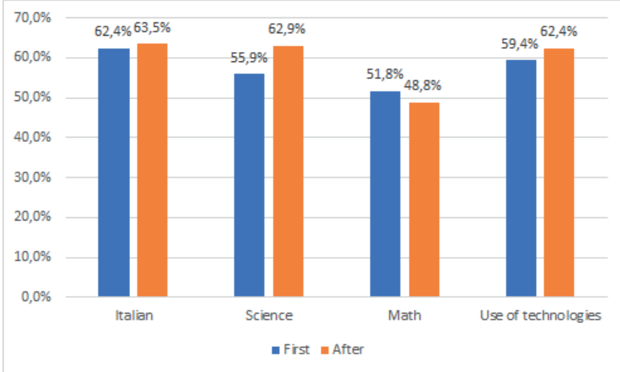

Figure 1. Comparison of percentage of students scoring 4 or 5 for the question "How good do you think you are at…?" asked at the start and at the end of the project.

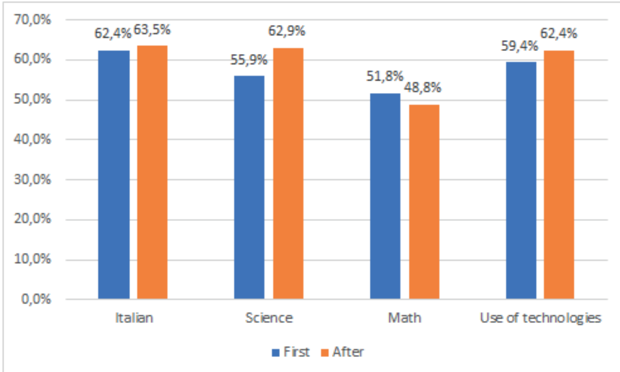

Figure 2. Comparison of students' answers to the question "How good do you think you are at using technology?" at the start and end of the project.

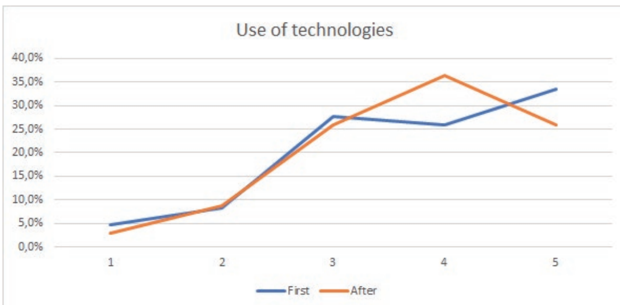

Figure 3. Comparison of students' answers to the question "How good do you think you are at maths?" at the start and end of the project.

they were before it), whereas the trend for Italian (figure 5) remained more or less stable. For science (figure 4) there was an increase especially in students who saw themselves as being good (score 4).

[4] Specifically, the answers to the following question in the third report were analysed: "On the issue of student inclusion: how did the class as a whole work during the project? Were there any changes in motivation and involvement, especially in students with special educational needs (non-Italian students, those with specific learning disorders, with a special needs teacher, with typical bullying attitudes…), compared with during activities using traditional teaching methods? If yes, can you describe the type of needs of these students had and what the changes were?

[5] In 12 of the 18 robotics classes that completed the project in June science was one of the subjects involved in the interdisciplinary project.

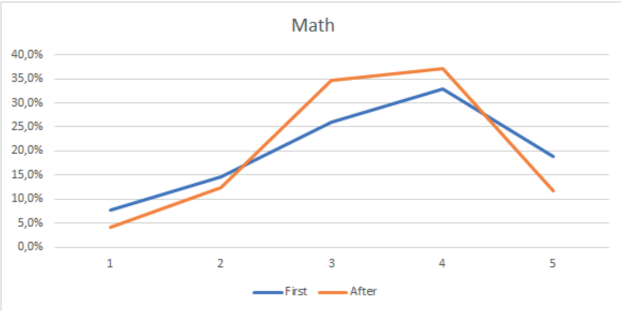

Figure 4. Comparison of students' answers to the question "How good do you think you are at science?" at the start and end of the project.

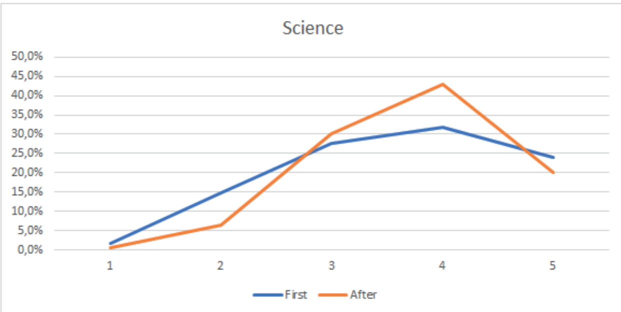

Figure 5. Comparison of students' answers to the question "How good do you think you are at Italian?" at the start and end of the project.

Therefore, the students' perception was that they had not got worse in these subjects during the lockdown period and this trend was in the opposite direction to the one that emerged nationally (Fondazione Agnelli, 2021).

3.3 The teachers' point of view

Moving on to the teachers, in this section we analyse the teachers' impressions regarding the impact of lockdown on the project. We will analyse the following questions:

- What impact did the lockdown have on the project? (Frequency of scores from 1 to 5 for each action).
- Were you able to conclude the project as you expected? (yes/no)
- In terms of the project's goals, what disadvantages did the lockdown and distance learning bring to the project? (multiple choice)
- In terms of the project's goals, did lockdown help students develop their knowledge, skills and aptitudes? (multiple choice)

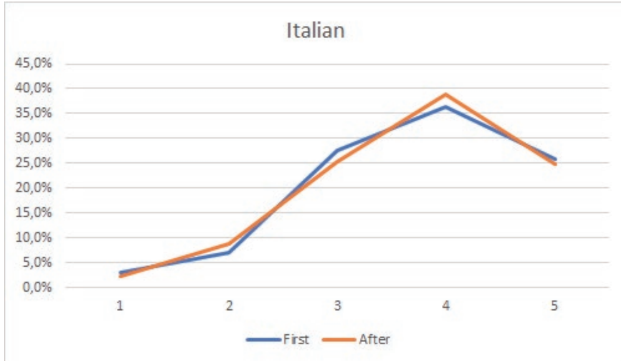

Figure 6. Comparison of the teachers' answers to the question "What impact did the lockdown have on the project?". Frequency of scores from 1 to 5 for each action.

Table 5. Comparison of the teachers' answers to the question "Were you able to conclude the project as you expected?" (Percentage per action).

Project	YES
CODING	54.5%
ROBOTICS Expert teachers	71.4%
ROBOTICS Non-expert teachers	36.7%

As we can see in figure 6, the teachers saw the impact of lockdown as being fairly significant.

Continuing with the impact of lockdown on the project, in table 5 we present the teachers' answers to the question "Were you able to conclude the project as you expected?" Most teachers, especially those with expertise in coding and robotics, were able to finish the project as they had expected.

One of the aspects to focus on is the points identified by the teachers as the most critical for continuing the project during lockdown. As shown in table 6, the extent of the problems depended on the project action. Thus, most of the expert teachers felt that the lack of collaborative work was crucial. This is to be expected as the expert teachers experimented more with distance learning activities than the non-experts. Also, collaboration via the e-learning platform did not meet expectations. The same problem was highlighted by primary and nursery school teachers, when students needed to work together, for example on unplugged coding activities.

It was also not surprising that the main problem with non-expert teachers was the lack of hands-on activities. They probably did not have the skills to consider a virtual environment as a solution to the lack of devices.

The last question we analyse (table 7) is "In terms of

Table 6. Comparison of the teachers' answer to the question "What disadvantages did the lockdown and distance learning bring to the project? Percentage value for the project" (Highlighted in bold are the most important and in italic are the ones that had the smallest impact). (Percentage calculated on the number of respondents)

	Coding	ROBOTICS	
		Expert teachers	Non-expert teachers
Lack of teamwork	70.5%	85.7%	50.0%
Lack of practical work with kits	65.9%	52.4%	60.0%
Problems following the progress of the project	9.1%	4.8%	10.0%
Communication and motivation problems	4.5%	0.0%	20.0%
Problems solving difficult aspects	13.6%	19.0%	23.3%

Table 7. Comparison of the teachers' answer to the question "In terms of the project's goals, did lockdown help students develop their knowledge, skills and aptitudes?" (Percentage calculated on the number of respondents).

	Coding	ROBOTICS	
		Expert teachers	Non-expert teachers
Autonomy in the management of activities and/or learning	50.0%	47.6%	56.7%
Acquisition of technical skills	56.8%	47.6%	36.7%
Acquisition of group relational skills	N/A	14.3%	26.7%
Development of specific interests (through independent insights)	9.1%	52.4%	20.0%
None	15.9%	4.8%	10.0%

the project's goals, did lockdown help students develop their knowledge, skills and aptitudes?".

Although it is true that students were prevented by circumstances from reaching certain important goals, some goals were reached. For example, older students with non-expert teachers learnt to manage their learning materials autonomously. This was perhaps because non-expert teachers did not have sufficient technological skills and this led students to study by themselves. Also, the project was so engaging for students with expert teachers that they continued working on it even after school.

3.4 The teachers' point of view: focus group

To get a better understanding of the responses and the findings we have described, we held a focus group on the robotics action and another on coding.

We begin with the data from the coding focus group, the area of the project where most difficulties emerged and which, for the teachers, saw the greatest impact from lockdown (graph X). Primary and nursery school teachers reported having the greatest difficulties. Indeed, when very young children are involved, another important variable to consider, other than teachers and the children themselves, is their parents. During lockdown, parents played a very important role in the learning process of their children. The difficulties some families experienced while trying to manage the situation also meant that some children got lost along the way. Also, young students found it more difficult than their older counterparts to work remotely, precisely because of the nature of the project, which included unplugged activities to be carried out in groups.

When distance learning was introduced, we never received any feedback from the parents of the foreign children, except for one girl. The suspension of in-person activities interrupted the process and therefore the possibility of further work on these objectives.[6]

The project had a workshop approach, which enabled the inclusion of children with various problems. They participated actively in the in-person activities and more passively in distance learning activities.[7]

Some lower secondary school teachers also reported positive aspects. Although the project was taking place online, it was also seen as a meeting between teachers and classmates and an opportunity to form a group.

Some teachers also told us that, in order to ensure the work with Arduino could be completed, there had been new forms of collaboration among the adults at different stages in the project, which included taking the hardware to other students' homes, disinfecting it, etc.

They met up and even the children who were having more difficulty participated fully, because they were being helped. They also enjoyed meeting each other, because these were the first periods of distance learning so, seeing each other also on the screen, the students helped each other; they were not alone, they were together and so this greatly favoured inclusion. In other words, the students were all connected, they got involved

[6] Original version: "Con l'attivazione della DaD, non abbiamo mai ricevuto riscontri dai genitori dei bambini stranieri, tranne una bambina. La sospensione delle attività in presenza ha interrotto il percorso e quindi la possibilità di lavorare ulteriormente su questi obiettivi".

[7] Original version: "Il progetto ha evidenziato caratteristiche laboratoriali, permettendo l'inclusione dei bambini con problematiche varie. Hanno partecipato attivamente alle proposte in presenza, più passivamente a quelle in DAD".

and they supported each other, and this led to significant improvements.[8]

The fact that it was partly done remotely led to more enthusiasm from the kids, because many of them called each other… they even exchanged things in their letterboxes. So these things really stood out for us, not only in the kids' activities, but also the teachers'. So it was the fact that they collaborated together… they held their own meetings on Meet by themselves so they could continue the project and show what they had done.[9]

The teachers with more training in robotics were the ones who saw the positive aspects and were able to add to the project during the lockdown. Their ability to find new solutions helped improve the lockdown experience. So, in these cases, the project was helpful. These experiences are interesting because they show that it can be done. At the same time, the data tell us that few actually do it, because only a few are trained in these subjects. Also, perhaps only a few are motivated, although this cannot be concluded from the data.

4. DISCUSSION

The literature contains a good amount of research on the relationship between teachers, students and technology during the lockdown (Indire, 2020a; 2020b). This period brought to light some of the critical issues that were already present in the school system and widened pre-existing gaps, such as those between the north and south of the country and between students from different socio-cultural backgrounds. Pavolini et al. (2020) applied the saying "It takes two to tango" to distance learning: for it to work, students need access to a computer with an internet connection and teachers need to be capable of using at least one device. As we said in our opening, these conditions were not met. Not only was there a shortage of individual instruments, but students also lacked space in which to work. This led to some complicated family dynamics, which became a source of stress for students, potentially accompanied by a drop in motivation (Leonini, 2020; Farina, 2020; Mori, Bagattini, 2021).

Although the pandemic and the lockdown were unplanned aspects of the PON Coding and Robotics project, two interesting aspects emerged that will certainly be explored in more detail in later research on these topics:

1) despite the lockdown, students taking part in the project felt their relationship with science and maths had improved. While it is true that their impressions were subjective, it is interesting to note that they applied to science subjects, which had more overlap with the robotics project.

   This may certainly also have been influenced by factors external to the project, such as the general increase in the use of technology during the lockdown. Therefore, it would be interesting to investigate this result through further study;

2) despite the difficulties experienced during the project caused by the unforeseen circumstance of the pandemic, some teachers were able to recalibrate and this gave students a motivational boost to get through a difficult period. Finally, what emerged from the research as the real boost was the motivation of teachers and also their ability to make the project interesting.

The methodological framework of the Coding and Robotics project included other topics under investigation. However, the instruments used drew attention to potential subjects for future investigation. The first would be students' motivation, especially when the teachers managed to engage them during lockdown. Also, it would be interesting to investigate the influence of teacher motivation on the success of coding and robotics activities.

5. CONCLUSION

In this paper we investigate the relationship between distance learning and the wellbeing of students through the case study of a hands-on educational robotics project, which was completed via distance learning, with a focus on the role of innovative teaching methods. We particularly looked at the usefulness of these methodologies, even at critical times, such as during a lockdown.

During the last editions of FabLearn Italy[10] and the

[8] Original version: "Si sono incontrati e c'è stata proprio una partecipazione totale anche da parte di quei ragazzi? che avevano più difficoltà, perché in questo modo venivano aiutati, un po' era anche il fatto del piacere di incontrarsi, perché erano i primi periodi di DaD e quindi i ragazzi vedendosi anche a schermo si aiutavano, non erano soli, stavano insieme e quindi questo ha favorito tantissimo l'inclusione. Cioè i ragazzi si sono tutti collegati, hanno partecipato, e si sono sorretti vicendevolmente e questo ha portato a dei notevoli miglioramenti".

[9] Original version: "Il fatto di averlo fatto in parte a distanza ha portato un entusiasmo maggiore da parte dei ragazzi perché molti si sono chiamati… addirittura si scambiati pezzi dentro le cassette delle poste. Quindi sono cose che rimangono veramente impresse nell'attività, non solo nell'attività dei ragazzi ma anche nell'attività dei docenti, quindi il fatto di collaborare insieme… facevano delle riunioni su Meet da soli, in autonomia, per portare avanti il progetto e farlo vedere".

[10] FabLearn Italy 2021 is an international conference that connects researchers, teachers, educators and professionals working with the aim of innovating education by applying the principles of Making, Coding

IBR Conference,[11] several authors addressed the possibility of experimenting with robotics and coding via distance learning with motivated, expert teachers (Miotti et al., 2020). We are aware that these are only a few virtuous experiences because recent research by INDIRE found that most teachers adopted the transmission approach during lockdown, mainly using video lessons, assignments and evaluation. Only 12% of the primary school teachers and 19% of the secondary school teachers who took part in the survey adopted "laboratory-style" strategies (Indire, 2020b, pp. 12-16). Irrespective of this, our sample of teachers demonstrated a willingness to train and overcome the fear of new technologies and adopting them as effective tools for an increasingly interdisciplinary approach to teaching.

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