Logged Out: How COVID-19 School Closures Deepened Educational Poverty in Italy

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December 14, 2025

Abstract

This paper examines how the digital divide intensified educational inequalities in Italy after the unplanned transition to remote teaching during the COVID-19 pandemic. It distinguishes three phases: the pre-pandemic baseline of 2018–2019, the pandemic shock of 2020–2021, and post-pandemic evidence on educational outcomes. Combining micro- and macro-level data on socioeconomic status, territorial disparities, digital access, and student achievement, the study shows that remote teaching was not a neutral emergency response. Instead, it magnified pre-existing inequalities, especially along Italy's North–South divide. Students from disadvantaged households and Southern regions faced greater barriers to devices, connectivity, and adequate learning environments. The findings suggest that digital exclusion operated as a structural mechanism through which social and territorial inequalities were reproduced, translating unequal access to technology into unequal learning opportunities and, ultimately, into deeper forms of educational poverty.

Keywords: digital infrastructure; distance learning; students' achievement; educational poverty

JEL codes: I24, I18, I3.

1 Introduction

This paper investigates how digital infrastructure, access to digital devices, digital competences, domestic learning conditions, and school-level organization shaped educational opportunities in Italy during the COVID-19 pandemic. The pandemic produced an abrupt acceleration in the digitalization of teaching and learning activities, as schools were forced to reorganize educational provision in response to social distancing measures. Yet this acceleration did not take place in a neutral environment. It occurred within an education system already marked by persistent territorial, socio-economic, and performance gaps, and therefore provides a critical context in which to assess whether digitalization operated as an equalizing force or as a mechanism for reproducing pre-existing inequalities.

The shift was sudden. In March 2020, in-person educational activities were suspended nationwide, and schools and universities moved from traditional face-to-face instruction to remote teaching under emergency conditions. During the remainder of the 2019–2020 school year, remote teaching became the main channel through which educational continuity was maintained. In the 2020–2021 school year, online instruction continued to play a major role, although it was combined with periods of in-person attendance and with blended arrangements based on student rotation, subgrouping, school-building capacity, and local epidemiological conditions. While the first phase of school closures was imposed uniformly across the national territory, during the second wave decisions on partial or full suspension of in-person teaching became increasingly differentiated by region, school level, and local health conditions. Remote teaching was therefore far from homogeneous. Evidence from Bovini and De Philippis (2021), based on a Bank of Italy survey, shows that between March 2020 and February 2021 the organization of distance learning varied substantially across school levels and regions. In primary and lower-secondary schools, almost half of distance-learning hours were delivered asynchronously, meaning that teachers and students were not simultaneously connected to the same digital platform. In upper-secondary schools, by contrast, remote teaching was more frequently delivered synchronously. Moreover, the regions and school levels where in-person teaching was reduced the most tended to compensate by increasing the share of synchronous online lessons. This was particularly evident in Southern regions and, above all, in Campania, where regional ordinances suspended face-to-face teaching for longer than elsewhere.

In principle, digital education can offer important opportunities for learning. Digital pedagogies may support new forms of interaction, extend access to educational resources, strengthen communication between teachers and students, and enable the use of online platforms, videoconferencing tools, and digital learning environments. However, digital education does not operate in a social vacuum. Its effectiveness depends on a set of

preconditions that are unequally distributed across households, schools, and territories: reliable connectivity, appropriate devices, adequate digital skills, suitable domestic spaces, and family support where needed. The central question is therefore not whether digital technologies can improve education in abstract terms, but under what conditions they do so, and for whom.

This question is particularly relevant in the Italian case. Italy entered the pandemic with long-standing inequalities in educational performance, socio-economic background, school trajectories, and territorial development. The North–South divide, in particular, continues to structure both students' learning outcomes and their access to material and technological resources. In such a context, the transition to remote teaching exposed a crucial tension within the digitalization of education: the same technologies that may expand learning opportunities for some students may also amplify exclusion for those who lack the material, cognitive, and domestic conditions required to benefit from them.

A growing international literature has assessed the educational consequences of COVID-19 school closures and remote teaching. Existing evidence shows that school closures reduced instructional time, generated learning losses, and widened pre-existing educational inequalities, especially for students from disadvantaged socio-economic backgrounds. Engzell, Frey, and Verhagen (2021), using evidence from the Netherlands, show that learning losses were substantial even in a country characterized by a relatively short period of school closures and high levels of digital preparedness, with stronger effects among pupils from less-educated households. Global simulations by Azevedo et al. (2021) similarly suggest that the disruption reduced schooling and learning outcomes, increased dropout risks, and may have long-term consequences for future earnings and human capital accumulation. From the perspective of the economics of education, Hanushek and Woessmann (2020) also stress that even temporary learning losses can have persistent effects on individual lifetime income and aggregate economic performance.

A second strand of the literature has emphasized that the emergency shift to online instruction should not be confused with well-designed online learning. Hodges et al. (2020) define this crisis-driven response as "emergency remote teaching", a temporary solution adopted under conditions of urgency rather than as the result of deliberate pedagogical planning. This distinction is crucial for interpreting the Italian experience. Distance learning was introduced under severe time constraints, with heterogeneous levels of digital infrastructure, teacher preparedness, organizational capacity, and family support. Its effectiveness therefore depended not only on access to platforms and devices, but also on the extent to which technologies could be embedded in coherent pedagogical practices, redesigned learning environments, and adequate forms of teacher-student interaction.

Recent empirical research on the Italian case points to a similar ambivalence. The

emergency shift to remote education produced uneven effects across schools, students, and households, depending on infrastructure, teachers' digital and pedagogical competences, students' autonomy, household resources, and territorial conditions. Lo Presti and Dentale (2025) interpret the pandemic as a large-scale collective experiment in digital teaching, showing how schools were forced to reorganize access to education, curricular practices, assessment, social relations, and school-family relationships under unequal conditions. Contributions in the same volume specify these mechanisms from different perspectives: Martire, Palmieri, Mastrolia, and Seller (2025) emphasize technological endowments, broadband stability, platform availability, and teacher training; Lo Presti, Capozza, Salvi, and Cavallo (2025) show that digital tools did not automatically generate pedagogical innovation; Fasanella, Dentale, Capozza, and Rimoli (2025) point to mixed effects on competence-based learning; and Lo Presti, Faggiano, and Dentale (2025) highlight the relational and socio-emotional consequences of remote education. The present analysis moves in the same direction, interpreting these dimensions as part of a cumulative process through which digital exclusion contributed to educational inequality and educational poverty.

This article also builds on previous research (Sarno, 2022), which provided an initial assessment of the Italian experience with remote teaching during the emergency phase of the pandemic, focusing on the period up to 2021. The present paper extends that earlier analysis in both temporal and analytical terms. Temporally, it connects the immediate disruption caused by remote schooling to the pre-pandemic structural baseline of 2018–2019, and to post-pandemic evidence on educational outcomes and educational poverty. Analytically, it shifts the focus from the emergency management of remote teaching to the mechanisms through which digital exclusion translated social and territorial inequalities into unequal learning opportunities.

The paper therefore adopts a multi-layered research design structured around three analytical moments. First, it reconstructs the pre-pandemic baseline by examining digital infrastructure, device availability, housing constraints, and educational performance before the outbreak of COVID-19. Second, it analyzes the contextual shock of the 2020–2021 school closures, focusing on students' participation in remote teaching and on the unequal conditions under which distance learning took place. Third, it examines post-pandemic evidence on the longer-term consequences of the crisis, with particular attention to learning outcomes and educational poverty.

The argument developed in the paper is that remote teaching did not function as a neutral emergency substitute for in-person schooling. Rather, it interacted with pre-existing inequalities and, in some cases, intensified them. Connectivity, device availability, housing conditions, family support, and school-track stratification did not operate as isolated

variables; they combined cumulatively, producing a self-reinforcing mechanism of exclusion. In this sense, the Italian case can be read through the lens of cumulative causality, or a "Matthew Effect", whereby students and territories already endowed with stronger resources were better positioned to maintain educational continuity, while disadvantaged students faced a higher risk of disconnection, learning loss, disengagement, and educational deprivation.

The evidence points to a familiar but deeply consequential image of Italy: a country divided along territorial and socio-economic lines, where family background and place of residence continue to shape both educational performance and access to innovative technologies. In a context where remote teaching became an essential component of educational provision, the digital divide did not merely represent a temporary technical obstacle. It became a structural channel through which existing inequalities were reproduced and translated into unequal learning opportunities. From this perspective, digital exclusion contributed not only to lower achievement, but also to deeper forms of educational poverty, understood as the deprivation of the opportunities, resources, and capabilities needed to learn, participate, and fully develop one's potential.

The remainder of the paper is organized as follows. Section 2 examines the material preconditions of remote teaching by bringing together digital infrastructure, connectivity, device availability, housing conditions, study space, and family support. Section 3 shifts the focus to students, linking pre-pandemic achievement and digital skills to participation in remote teaching, perceived learning effectiveness, school-track differences, and post-pandemic indicators of achievement, dropout, and educational poverty. Section 4 concludes by drawing together the mechanisms examined in the two analytical sections and by reflecting on the relationship between digital divide, educational inequality, and educational poverty in post-pandemic Italy.

2 Digital and domestic conditions before and during the pandemic

This section reconstructs the material preconditions that shaped the feasibility of remote teaching in Italy. It first examines digital infrastructure and digital readiness before the pandemic, then considers how territorial and socio-economic inequalities affected connectivity and access to devices, and finally turns to the domestic learning environments in which remote schooling actually took place.

2.1 Digital infrastructure and digital readiness

To trace the structural origin of the educational poverty spiral, it is necessary to establish the pre-pandemic baseline of Italy's digital ecosystem. By evaluating the structural and human capital indicators immediately preceding the crisis, we can map the systemic vulnerabilities that later conditioned and restricted the deployment of emergency remote teaching.

Since 2014, the European Commission has monitored Member States' digital performance through the Digital Economy and Society Index (DESI). DESI[1] is a composite indicator based on several measures of digital competitiveness. It covers five main dimensions: i) *connectivity*, to summarize the deployment and quality of broadband infrastructure; ii) *human capital*, to capture internet use and basic and advanced digital skills; iii) *use of internet services*, to measure the range of online activities undertaken by citizens; iv) *integration of digital technology*, to measure business digitalization and e-commerce; v) *digital public services*, to capture the digitalization of public services and e-government.

DESI data for 2020 show Finland as the digital leader, with a score of 72.3, followed by Sweden and Denmark. Italy, with a score of 43.6, ranks 25th out of 28 EU Member States, ahead only of Romania, Greece and Bulgaria. For the two DESI dimensions most relevant to education, Italy presents a mixed picture. Its connectivity score is 50, only slightly below the EU average, placing the country 17th among EU Member States. Conversely, Italy demonstrates the weakest performance within Europe regarding human capital. Specifically, only 42% of individuals aged 16–74 possess at least basic digital skills, compared to the European Union average of 58%. Furthermore, a mere 22% exhibit above-basic digital proficiency, in stark contrast to the broader EU average of 33%. Crucially, this demographic bracket encompasses the core actors of the educational ecosystem, both students and educators, highlighting the significant risk that those tasked with navigating the crisis were inadequately prepared for the sudden transition to remote learning on one side and teaching on the other. The number of ICT specialists and ICT graduates is also well below the EU average.

[1] From 2014 to 2022, DESI provided a composite index summarizing countries' performance as described in the above text. Later, a methodological change occurred in 2023 following the implementation of the Digital Decade Policy Programme 2030. As a result, DESI ceased to be published as a separate composite index and was integrated into the annual State of the Digital Decade Report. The focus shifted from producing a single summary score toward monitoring progress against specific Digital Decade targets and key performance indicators (KPIs). Consequently, DESI values published up to 2022 are not directly comparable with the indicators reported from 2023 onwards. However, this discontinuity does not affect the period examined here as it stops before then.

2.2 Connectivity and digital devices

The disappointing picture provided by the DESI index conceals substantial differences across Italian regions, exposing the geographical and educational fractures that fed the cumulative downward spiral during the school closures. The ISTAT multipurpose survey, *Aspects of Daily Life*, includes a section on *Citizens and ICT* [2] that reports the share of households with a broadband connection. Data for 2018 and 2019 indicate an overall improvement in connectivity, with the national share of households connected to broadband rising from 72.7% to 74.0%. The increase was stronger in the Centre, but differences between macro-regions also widened slightly, confirming that structural progress was inherently unequal (Table 1).

Table 1: Broadband connectivity of Italian households (in percentage)

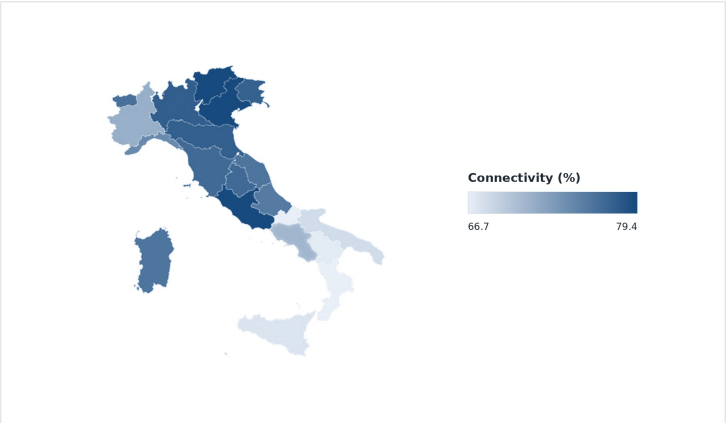
Macro-Region	**2018**	**2019**
Italy (μ)	72.7	74.0
North	75.5	76.5
Centre	75.1	77.0
South	68.6	69.5
Islands	71.0	71.8

Source: ISTAT.

Consistent with these data, the connectivity map in Figure 1 highlights a clear regional divide in broadband diffusion. All southern regions, with the exception of Abruzzo, lag behind the northern and central regions. The gap is 12.7 percentage points between Trentino, the region with the highest share of households connected to broadband, and Molise, the region with the lowest share of households connected to broadband. The share of households with a broadband connection also varies by the average education level and age composition of household members, illustrating how class boundaries reinforce technological isolation. Only 5.9% of households in which at least one member holds a university degree lack a broadband connection, whereas the share rises to 53.9% among households whose members have only a lower secondary qualification. Similarly, 66% of households composed exclusively of older people have no connection, while this share falls to 4.9% when at least one minor is present.

[2] Istat (2019) Report: Cittadini e ICT, https://www.istat.it/it/files//2019/12/Cittadini-e-ICT-2019.pdf

Figure 1: Regional levels of connectivity



Source: Author's elaboration based on ISTAT data (2019).

A second key condition for assessing the potential effectiveness of remote teaching is the availability of computers and tablets. Ideally, each student should have access to a personal device. According to ISTAT [3], in 2018-2019, 33.8% of Italian households had neither a computer nor a tablet; in the South, this share reached a critical 41%. Among households with at least one minor, the figure fell to 14.3%. More importantly, 12.3% of children aged 6-17 had no computer or tablet at home, corresponding to approximately 850,000 children and adolescents. In the South, the share was almost 20%, or about 470,000 students - more than half of all Italian students without a device. Only 22.2% of households had one PC or tablet for each member, and the share was just 14.1% in the South. Personal devices were available to only 6.1% of children living in households with at least one computer per household member.

In summary, although around 95% of households with minors were connected, distance learning was severely constrained by an insufficient number of PCs and tablets relative to the number of household members. A substantial share of students therefore had to share hardware with other family members or, worse, attend online lessons using only a smartphone. Significant inequalities between the North and the South are evident both in connectivity and in access to ICT devices, forming a rigid baseline of material exclusion.

2.3 Housing overcrowding, study space, and family support

The spatial bottleneck and the domestic environment constitute critical intermediate vectors that accelerated educational marginalization. When emergency remote teaching abruptly shifted the educational process from physical classrooms to private households, the

[3]Istat (2020) Report: Spazi in casa e disponibilità di computer per bambini e ragazzi, https://www.istat.it/it/files//2020/04/Spazi-casa-disponibilita-computer-ragazzi.pdf

material and relational resources available within domestic spaces immediately translated into asymmetric learning barriers. The transition from face-to-face to remote teaching changed the physical space in which learning occurred. On the one hand, distance learning allows students to attend school or university from any location, thereby reducing mobility costs. On the other hand, this apparent spatial freedom is limited by the quality of the home environment. Students do not always have suitable conditions for learning because of overcrowded housing or insufficient support from adult household members. This spatial bottleneck was a documented global challenge during the pandemic; as highlighted by the OECD (2020), housing quality quickly transformed from a private welfare indicator into a primary determinant of educational equity.

Eurostat defines overcrowding according to the bedroom standard, which assigns more demanding space requirements as children grow older and varies them by gender composition[4]. In 2019, on the eve of the pandemic, 28.3% of the Italian population lived in overcrowded housing. The situation was worse for minors, particularly those in low-income households. Table 2 distinguishes between poor households (defined as those with income below 60% of the median equivalized income) and non-poor households. More than half of poor households with minors experienced overcrowding[5]. Among non-poor households, the overcrowding rate was 34.1% for children under 6 and increased to 44.9% for children aged 12-17, reflecting the stricter bedroom standard applied to this age group.

Table 2: Overcrowding rates among minors by age and economic condition

Minors	**Above 60% of the median equivalized income**	**Below 60% of the median equivalized income**
0-6 years	34.1	46.2
6-12 years	36.5	51.6
12-17 years	44.9	53.0

Source: EU-SILC, 2019.

[4]Precisely, Eurostat definition of overcrowding states that an overcrowded household is one which has fewer rooms than the sum of: one room for the household as a whole; one room per couple in the household; one room for each single person aged 18 or more; one room per pair of single people of the same gender between 12 and 17 years of age; one room for each single person of different gender between 12 and 17 years of age; one room per pair of children under 12 years of age.

[5]Source: European Union Statistics on Income and Living Conditions (EU-SILC), Overcrowding rate by age, sex and poverty status (ILC_LVHO05A). Although overcrowding has declined somewhat in recent years, with the average overcrowding rate falling to 23.9% in 2024, Italy continues to display comparatively high levels of housing crowding relative to other major European countries, especially among low-income households.

A further obstacle to effective distance learning is the lack of family support for early-grade primary pupils and for students with disabilities. This vulnerability aligns closely with international literature tracking the unequal toll of remote learning across Europe. Evidence from the Netherlands—a country with near-universal broadband access—demonstrated that even short periods of school closures resulted in substantial learning losses that were up to 60% larger among students from less-educated homes (Engzell et al., 2021). Similarly, research in the UK showed that parental resources and available time directly conditioned the quantity and quality of home-learning hours (Andrew et al., 2020).

In the Italian context, these dynamics were compounded by structural factors. Under ordinary circumstances, the education system is expected to provide assistance through classroom teachers or specialized support educators (*insegnanti di sostegno*). Distance learning increased childcare responsibilities, especially for women (Bovini and De Philippis, 2021), thereby intensifying unpaid work within the household. However, family members do not always have the time, skills, or resources required to provide effective support, causing initial class disadvantages to multiply. An *ad hoc* ISTAT survey on the inclusion of pupils with disabilities[6] shows that almost 300,000 students with disabilities attend Italian schools, corresponding to 3.5% of enrolled pupils. Between April and June 2020, more than 23% of them — about 70,000 students — did not participate in remote lessons; in the South, this share reached a critical 29%. The survey identifies several reasons that illustrate how different forms of deprivation reinforce each other: the severity of the condition (27%), difficulties in cooperation with family members (20%), socio-economic hardship (17%), difficulties in adapting the Individual Education Plan to distance learning (6%), lack of technological tools (6%), and a lack of specific teaching aids (3%).

3 Students' experiences and educational outcomes

This second analytical section shifts from material preconditions to students' experiences and outcomes. It first reconstructs students' achievement and digital skills before the pandemic, then examines participation in remote teaching during the first lockdown, and finally connects perceived learning effectiveness and school-track differences to post-pandemic indicators of dropout and educational poverty.

A comprehensive assessment of the impact of remote teaching on students in Italian schools is constrained by the lack of representative data for the entire education system. This prevents a fully accurate evaluation that accounts for the functional and geographical complexity of Italian schooling. Nevertheless, the available evidence makes it possible

[6]ISTAT (2020), Report: L'inclusione scolastica degli alunni con disabilità - A.A. 2019-2020, https://www.istat.it/it/archivio/251409

to reconstruct the learning conditions in place when the pandemic emergency and the spring 2020 school lockdown occurred, and to identify the challenges that distance learning introduced.

3.1 Evidence from OECD PISA and INVALSI on student performance

This subsection maps the baseline cognitive and functional literacy constraints of Italian students prior to the crisis. These pre-existing educational divides directly restricted the students' cognitive readiness to transition from guided physical instruction to autonomous digital knowledge construction.

To evaluate education systems, the OECD launched the Programme for International Student Assessment (PISA) in 2000. PISA measures the performance of 15-year-old students in mathematics, science, and reading. Repeated every three years, the survey provides internationally comparable data designed to support improvements in education policies and outcomes. In Italy, additional evidence is collected by INVALSI (*Istituto nazionale per la valutazione del sistema educativo di istruzione e di formazione*), whose specific aim is to assess students' competences across all levels and grades of the Italian school system.

In 2018, Italy scored below the OECD PISA average in reading and science and around the OECD average in mathematics[7]. After 2012, average scores declined in reading and science, while mathematics remained broadly stable and above the levels observed in 2003 and 2006. The decline in reading performance was concentrated among girls, while boys' performance remained stable. The decline in science was particularly marked among high-achieving students and was similar across gender.

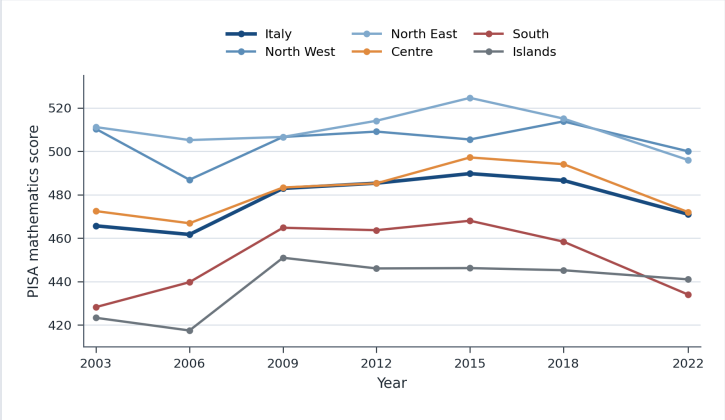
The career expectations of the highest-achieving 15-year-old students reveal strong gender stereotypes. Among high performers in mathematics or science, about one in four boys in Italy expected to work as an engineer or science professional by age 30, compared with only one in eight girls. Only 7% of boys, and almost no girls, expected to work in ICT-related occupations, providing further evidence of Italy's limited overall orientation toward digital fields.

Students' performance is strongly associated with family socioeconomic background, as lower scores are correlated with low household income and low parental education. Weaker educational profiles are also often observed among students with a migration background, pointing to integration difficulties that may contribute to economic and social

[7]OCSE PISA 2018, https://public.tableau.com/app/profile/invalsi/viz/OCSEPISA2018_15765811689360/Copertina

exclusion. Figure 2 reports Italian mathematics scores since the beginning of OECD PISA and shows pronounced geographical differences, a pattern that also characterizes reading and science. Students in the North systematically score above the national average, those in the South and Islands systematically score below it, while students in the Centre occupy an intermediate position.

Figure 2: Student performance by Italian macro-region, 2003-2022



Source: Author's elaboration based on OECD PISA and INVALSI data.

The 2022 data further reinforce this interpretation by showing a twofold post-pandemic effect: a general deterioration in students' achievement and a further differentiation among macro-areas. The decline in performance appears to be a national phenomenon, but it is more pronounced in the South, where pre-existing educational disadvantages were already stronger. Thus, the pandemic did not affect all students and territories in the same way; rather, it amplified existing regional inequalities and made the territorial divide in educational outcomes even more evident.

Crucially, these regional and socio-economic disparities in academic domains established a fragile baseline. When educational delivery shifted to the home, existing cognitive inequalities directly merged with technological deficits, leaving specific demographics uniquely vulnerable. Consequently, the traditional geographical fracture between the North and the South served as a predictive map for how severe the digital exclusion would be once remote teaching commenced.

Drawing on Potter and McDougall's (2017) concept of digital literacy, the subsequent PISA insights (OECD, 2021) state that literacy in the twentieth century concerned the extraction and processing of pre-coded and usually curated information, whereas in the twenty-first century it concerns the construction and validation of knowledge. For this reason, OECD PISA recognized the importance of assessing students' digital skills. Although the 2021 survey cycle was postponed to 2022 to allow sufficient time for implementation,

preliminary frameworks highlight a close relationship between reading performance and digital skills. They also indicate that digital divides mirror existing economic gaps and may amplify the disadvantages of students from less affluent backgrounds, thereby widening learning inequalities.

This weakness is corroborated by international large-scale assessments specifically targeting digital literacy. According to the 2018 International Computer and Information Literacy Study (ICILS), which measures the skills of 13-year-old pupils through computer-based tests, Italian students scored an average of 461 points. This is considerably lower than their peers in other European countries, such as Denmark (553), Finland (531), and Germany (518). Furthermore, 24% of Italian students failed to reach the minimum threshold of basic digital skills, revealing a substantial gap compared to Denmark (3%), Finland (8%), and France (10%) (Fraillon et al., 2020).

The fact that nearly a quarter of Italian 13-year-olds lacked foundational digital literacy prior to the crisis underscores that the digital divide was not only an issue of hardware availability, but also of functional capability. In a system where one in four students could not navigate a basic computer-based environment autonomously, the sudden, absolute reliance on remote teaching meant that a substantial segment of the student population was structurally and cognitively locked out of effective learning from day one. This 24% baseline deficit represents a critical mass of students who were functionally unprepared for the shift from passive information consumption to active digital knowledge construction.

These macro-level structural gaps align closely with localized findings. Save the Children (2020), in a pilot study on digital educational poverty among 13-year-old students in selected Italian provinces[8], showed that about 20% of participating children were unable to perform simple operations using ICT tools. For instance, 11% could not share a screen during a Zoom call, and 29.3% were unable to download a document shared by a teacher on the school platform. Overall, 20.1% of the minors failed to correctly answer more than half of the questions designed to assess basic digital skills. This percentage was higher among boys than girls, indicating a gender gap in digital proficiency that disadvantaged boys. Consistent with PISA findings, the incidence of digital educational poverty declined significantly as parental education increased.

When woven together, these multi-layered data points reveal a cumulative and reinforcing chain of evidence. The structural socio-economic and regional fractures historically documented by PISA and INVALSI provide the baseline context; the macro-level international data from ICILS exposes the specific, pre-existing deficit in digital proficiency;

[8]The "Autovalutazione di base delle Competenze Digital" (AbCD) questionnaire was administered to a sample of 772 children who attend the last class of lower secondary school, in 11 italian cities and provinces: Ancona, Chieti, Mestre, Milan, Naples, Udine, Palermo, Rome, Turin, Velletri, Sassari.

and the micro-level findings from Save the Children illustrate how these combined vulnerabilities materialized into immediate operational failures during remote interactions. Ultimately, this evidentiary trajectory demonstrates that the pandemic did not generate new inequalities but rather acted as an accelerant—weaponizing pre-existing digital educational poverty to disproportionately penalize students who were already at the margins of the Italian education system.

3.2 Evidence from AlmaDiploma on distance learning

In spring 2020, AlmaDiploma, an association of upper secondary schools, in collaboration with the AlmaLaurea inter-university consortium, conducted a comprehensive survey of students in their final and penultimate years of upper secondary education to capture their real-time experiences with distance learning during the pandemic. The survey gathered responses from more than 70,000 students, yielding a final analytical sample of 23,305 respondents (a 32% response rate).

Methodologically, because the questionnaire was administered via Computer-Assisted Web Interviewing (CAWI), the sample exhibits an unavoidable selection bias against the most socio-economically disadvantaged students. Since completing the survey required active ICT access, the respondents inherently belonged to households that were already digitally included. Consequently, the survey's findings must be interpreted as an optimistic upper bound of the Italian student experience. From an epistemological standpoint, this selection bias can be leveraged as a robust "pessimistic lower bound" for the systemic evaluation of educational disruption. If severe pedagogical friction, track-based stratification, and consolidated learning losses significantly emerge even within an over-represented, digitally affluent student cohort, it logically and statistically follows that the systemic disruptions suffered by highly marginalized, non-responding students were drastically more severe, validating the cumulative nature of the deprivation.

Subject to this analytical boundary, the survey evaluates three core dimensions: remote teaching tools, study load and organization, and perceived study effectiveness.

Remote teaching tools. The vast majority of respondents (93.6%) stated they received no institutional hardware or connectivity support from their schools, relying exclusively on private family resources. While 56.6% of students possessed a personal, non-shared device, this access was deeply stratified by educational track: it peaked at 59.5% among students in academic high schools (*licei*) but dropped to 43.8% among those in vocational institutes (*istituti professionali*). This indicates that personal device ownership was significantly more prevalent among older, upper-secondary students than the baseline suggested by the general ISTAT estimate of 6.1%, which covers the entire, younger student population.

Withal, a critical 4.9% of respondents reported having no access to a large-screen device (PC or tablet), forcing them to participate in remote schooling entirely via smartphone. This hardware deficit was heavily skewed by track, ranging from a marginal 3.3% in academic high schools to a staggering 15.3% in vocational schools, illustrating how institutional stratification converted family background into immediate tech-spatial limitations.

In terms of connectivity, 79.7% of students rated their connection quality as good or very good, with academic tracks maintaining a slight advantage (81.4%). Despite the widespread necessity of sharing ICT tools within the household, 89.6% of respondents reported having overall adequate equipment to attend lessons, a figure that again varied from 91.4% in academic tracks to 82.9% in vocational ones. Operationally, 72.5% of students attended daily distance learning that covered at least half of their regularly scheduled school hours. Concurrently, only 38.4% of respondents stated that their parents were able to play an active supportive role (13.1% answering "definitely yes" and 25.3% "more yes than no"). This confirms that roughly one in three older students required stronger structural support for effective learning—a proportion bound to be drastically higher among younger, less autonomous primary and lower-secondary pupils.

Study load and teaching organization. Regarding the perceived volume of work, 79.6% of students reported a substantial increase in assignments compared to traditional face-to-face instruction. Within this group, 24.7% deemed the expanded workload unsustainable, while 54.8% felt that, although heavier, it remained manageable. Conversely, the institutional response of schools was evaluated positively: 77.6% of respondents praised the organizational efficiency of their schools in planning the transition (22.5% very positively and 55.2% moderately positively). Furthermore, the pedagogical continuity provided by instructional staff achieved an overwhelming 90.6% satisfaction rate, highlighting the extensive emergency mobilization of Italian teachers.

Learning effectiveness, school tracks, and unequal educational consequences The final segment of the survey exposes the structural limitations of the digital medium regarding actual learning consolidation. A striking 75.1% of students reported significantly lower attention spans and higher rates of distraction during remote lessons compared to physical classrooms. Only 29.6% judged remote teaching to be effective for mastering entirely new academic topics, and a mere 16.7% believed it improved their overall comprehension of the subjects relative to face-to-face instruction. Accordingly, the vast majority of students (72.1%) concluded that their final academic preparation via distance learning was inferior to what they would have achieved in person, an assessment that held true regardless of the educational track.

Looking toward the future, only 31.6% of respondents felt it would be useful to retain distance learning in a blended format after the resolution of the COVID-19 emergency. Beyond academic performance, the survey highlights a profound disruption in the non-cognitive and relational dimensions of schooling. The sudden erosion of peer-to-peer socialization and physical institutional routines led to widespread psychological fatigue, with a vast majority of students reporting feelings of isolation.

Crucially, this relational deficit was accompanied by severe anxiety regarding future employability, an issue that once again exposed the structural divide between educational tracks. While academic high-school students faced delays but maintained a clear trajectory toward university education, vocational students experienced a drastic suspension of practical laboratory activities and mandatory school-to-work internships (*Percorsi per le Competenze Trasversali e per l'Orientamento* - PCTO). For these students, who rely on immediate post-diploma labor market insertion, the lockdown did not merely disrupt their lessons—it froze the vital networks and hands-on training essential for their transition into employment, significantly dampening their professional expectations and acting as the final act of the cumulative educational divide.

In summary, while the AlmaDiploma survey paints a commendable picture of the structural resilience and adaptability of Italian schools and teachers during a crisis, it simultaneously lays bare the severe pedagogical friction of remote teaching. When these insights are paired with macro-data—such as the 8% of students who completely dropped out of remote lessons during the first wave (ISTAT, 2021)—the long-term threat to the educational capital of this generation becomes clear. Although longitudinal tracking for Italy is ongoing, international econometric simulations suggest substantial, compounding learning losses directly attributable to prolonged school closures (Hanushek & Woessmann, 2020; Azevedo et al., 2021). Crucially, the AlmaDiploma data confirms that these losses are not distributed equally: they hit vocational tracks and resource-constrained households the hardest, proving that remote teaching acted as a mechanism that converted pre-existing socio-economic inequalities into permanent educational deficits.

3.3 Dropout and educational poverty

The final component of the student-centred section links the emergency phase of remote teaching to the longer-term risk of educational deprivation. Dropout and educational poverty are read here as outcomes of a cumulative mechanism in which unequal material preconditions, unequal participation in remote schooling, and unequal learning effectiveness translated into differentiated risks of disengagement, underachievement, and school abandonment. Learning difficulties and school failure may generate educational poverty and social exclusion through different forms of dropout. In statistical terms,

two dimensions can be distinguished. The first is *explicit dropout*, commonly measured by the Early Leavers from Education and Training (ELET) indicator, which captures the share of 18–24-year-olds who have attained at most a lower secondary qualification and are no longer in education or training. The second is *implicit dropout*, which refers to students who remain enrolled or formally complete their schooling but fail to reach minimum proficiency levels in basic competences. In this sense, the share of low achievers provides an important indication of a less visible form of educational fragility.

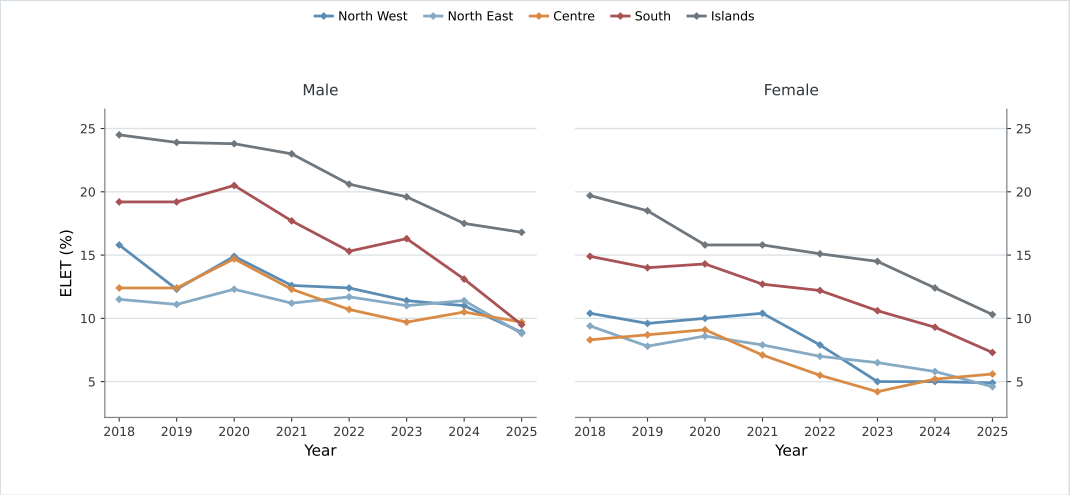
The historical territorial cleavage emerges once again in these indicators. The South and the Islands have traditionally recorded the highest rates of early school leaving, while dropout is systematically lower among females across all macro-areas. However, young women in southern regions still remain at a disadvantage compared with their peers in northern and central Italy. In light of the high share of upper secondary students who completely disengaged from remote platforms during the crisis, the risk that temporary educational detachment would turn into permanent dropout was particularly severe. Save the Children (2021) estimated that approximately 34,000 additional students were placed at immediate risk of formal school abandonment due to prolonged educational detachment during the lockdown phases.

In the following years, however, the ELET indicator followed a clear downward trajectory in Italy. As shown in Figure 3, the share of 18–24-year-olds leaving education and training early decreased from 11.5% in 2022 to 9.8% in 2024, progressively approaching the European Union average. More recent figures indicate a further decline to 8.2% in 2025, placing Italy below the European benchmark set for 2030. This aggregate improvement, however, should not be interpreted as the disappearance of educational inequalities. Figure 3 shows that ELET rates decreased after 2020 for both males and females, but with different intensities across territories and gender groups. Male early leaving remains systematically higher than female early leaving in all macro-areas, with the highest values concentrated among male students in the Islands and the South. The post-pandemic reduction in explicit dropout therefore coexists with enduring forms of vulnerability, which remain embedded in specific social and territorial contexts.

A less visible but equally relevant dimension of post-pandemic educational fragility is captured by the share of low achievers. Figure 4 reports the percentage of 15-year-old students who fail to reach baseline proficiency levels in mathematics in Italy and in the EU-27.

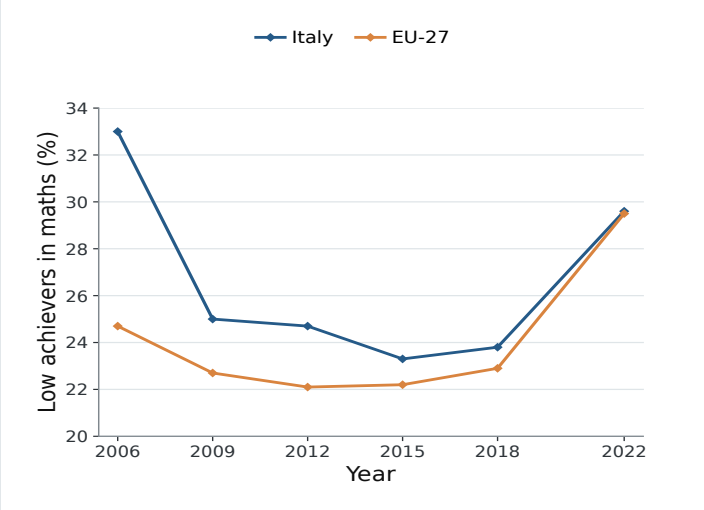
After a decline between 2006 and 2012, the share of low achievers in Italy increased from 2015 onwards, remaining consistently above the EU-27 average. The 2022 data are particularly relevant because they capture the deterioration in basic skills after the Covid-19 disruption. As Figure 4 shows, Italy experienced a marked increase in the proportion of

Figure 3: Early Leavers from Education and Training by gender and Italian macro-area



Source: Author's elaboration based on Eurostat data.

Figure 4: Low achievers in Mathematics in Italy and the EU-27, 2006–2022



Source: Author's elaboration based on Eurostat data.

students performing below the minimum proficiency level in mathematics. This worsening does not simply reflect a temporary decline in test scores; it signals a broader weakening of students' learning foundations and may increase the risk of disengagement from school. The comparison with the EU-27 average reinforces this point. Although the increase in low achievement after the pandemic is visible at the European level, the Italian trend is especially problematic because it adds to pre-existing territorial, social, and school-track inequalities.

The figure therefore helps clarify why the consequences of remote teaching cannot be assessed only through formal dropout indicators. Even where early school leaving later declined, the deterioration in basic skills points to a hidden dimension of educational deprivation that may continue to affect students' trajectories over time. A gender-disaggregated interpretation of low achievement is limited by the lack of comparable EU-level data by gender in the dataset used here. This prevents a systematic comparison between Italy and the EU-27 along this dimension. Nevertheless, the Italian data show a clear gender pattern in mathematics: male students consistently display lower shares of low achievement than female students. This suggests that the post-pandemic deterioration in basic mathematical skills intersects not only with territorial and socio-economic inequalities, but also with gender differences. However, this pattern is subject-specific. In reading, the relationship is reversed, with female students performing better than male students, while in science gender gaps are much less pronounced and in both directions. Educational vulnerability should therefore be understood as multidimensional, varying across territories, social groups, gender, and domains of competence.

Overall, this evidence indicates that the Italian school system entered the pandemic crisis with a dual structural fragility: a visible problem of early school leaving, especially in the South and Islands, and a less visible but widespread crisis of underachievement. The pandemic did not create these vulnerabilities from scratch; rather, it exposed and intensified them, contributing to a broader socio-technical polarization of educational opportunities.

4 Concluding remarks

Digital infrastructure has ceased to be a mere auxiliary asset; it now constitutes one of the structural conditions of educational participation. The Italian experience during the COVID-19 pandemic shows that digital education can create new opportunities only when the material and cognitive preconditions of access are broadly secured. When these preconditions are unevenly distributed, remote teaching does not simply compensate for the temporary loss of in-person schooling. It can instead reproduce, intensify, and

legitimize pre-existing inequalities.

The first analytical section showed that the material preconditions of remote teaching were deeply unequal before the pandemic. Italy entered the crisis with a weak position in European digital readiness, especially in human capital and digital skills, and with marked territorial gaps in broadband connectivity and device availability. These infrastructural inequalities were reinforced by domestic learning environments: overcrowded housing, the absence of a quiet study space, unequal family support, and the difficulties faced by pupils with disabilities converted the home into a highly differentiated educational setting. In this sense, digital exclusion was never only a question of internet access. It was a broader socio-material condition shaped by infrastructure, household resources, space, time, and care.

The second analytical section showed that these preconditions translated directly into unequal student experiences and outcomes. Before the pandemic, Italian students already displayed marked differences in achievement, functional literacy, and digital skills, with clear socio-economic and territorial gradients. During the first lockdown, participation in remote teaching depended heavily on private household resources, personal devices, school-track location, and students' capacity to sustain attention and autonomy in a digital environment. The evidence from upper secondary students indicates that even relatively digitally included respondents experienced increased workloads, lower attention, weak perceived effectiveness for learning new content, and strong differences between academic and vocational tracks. These mechanisms help explain why the crisis was not limited to a temporary interruption of instruction, but became part of a wider process of educational poverty, explicit dropout, and implicit dropout.

The cumulative mechanism identified in the paper can be summarized through the relationship between the two analytical sections. The section on material preconditions shows why access to remote teaching was unequal from the outset: connectivity, devices, housing space, and family support were distributed according to territorial and socio-economic lines. The section on students shows how these unequal starting points became unequal educational consequences: weaker participation, reduced learning effectiveness, stronger difficulties in vocational tracks, and higher risks of disengagement and educational poverty. The transition from the first section to the second is therefore also the transition from inequality of access to inequality of outcome.

In conclusion, the Italian case demonstrates that digital innovation in education cannot be evaluated only in terms of technological availability or institutional adoption. Its social effects depend on the distribution of the resources that allow students to use technologies meaningfully. When a school system relies on remote platforms without ensuring universal access to devices, reliable connectivity, adequate study spaces, family or institutional

support, and functional digital literacy, digital education risks becoming an institutional mechanism that magnifies learning losses and reduces social mobility. Addressing this risk requires a coordinated policy shift away from the mere procurement of technology and toward the structural reduction of educational poverty. Investments in high-quality ICT resources, digital pedagogical training, targeted support for vulnerable territories, inclusive provision for students with disabilities, and specific measures for vocational tracks should therefore be understood not as emergency responses, but as democratic preconditions for an equitable digital future of education.

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