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Evaluating digital skills policies: Assessing the potential impact of outreach programs in Italy☆

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A R T I C L E I N F O

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A B S T R A C T

Scholars and policymakers have long identified stakeholders whose activities should help reduce digital inequalities; these include "outreach initiatives," where entities proactively go beyond their traditional boundaries to reach marginalized citizens. However, few studies have attempted to evaluate the potential impact of this approach quantitatively.

Our research fills this gap, employing a static and dynamic analysis of a pseudo-panel dataset relating to Italy. We aggregate data from a representative national survey for the years 2014–2020, and we proxy outreach through the number of public events promoted to spread digital literacy.

The static model highlights the role of systemic variables: education, employment, broadband coverage, and social connectedness. The dynamic model shows that outreach and library activism create positive fluctuations around the trend but reach a plateau.

We conclude that a policy mix is needed: outreach is a helpful tool to stimulate communities in the short term, but other, more structural interventions are required to close the digital skills gap. These results are relevant especially for countries, like Italy and the US, that are now experimenting with outreach-oriented policies to boost basic digital skills.

1. Introduction

In an interview released in May 2021, Google CEO Sundar Pichai stated that the digital divide is "easier to bridge than most people think" and that "people are actually hungry to be part of the digital economy" (La Roche, 2021). However, many citizens still lack basic digital skills – defined as the ability to use "digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information *in order to function in a knowledge society*" (International ICT Literacy Panel, 2002, p. 16). Digital skills are scarce and unevenly distributed, with significant inequalities between and within countries (Livingstone et al., 2022; van Deursen et al., 2017). Even in high- and upper-middle-income countries, such as the US and in the EU, about 10% of the population does not even use the Internet (World Bank, 2022). In the EU, only 54% of the population is equipped with basic digital skills, with no substantial change since 2015 (European Commission, 2023).

The reality is that, more than 20 years after the term *digital divide* was coined (Hoffman et al., 2001), scholars "are only just beginning to formulate a theory explaining the phenomenon" and "they are not yet in a position to offer concrete policy directions"

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(van Dijk, 2020, p. 102).

Policymakers, however, have been trying to deal with the issue. van Dijk and van Deursen (2014, p. 172) have identified five types of strategies followed globally to improve digital skills: 1) strategies based on *awareness and organization*, i.e., on mobilizing multiple stakeholders, and improving monitoring and measurement; 2) strategies based on *design improvement*, to increase accessibility and usability of hardware and software; 3) strategies leveraging on *technology provision* (infrastructure, devices, access points); 4) strategies based on *content development*, i.e., trying to standardize and certify skills and curricula, improving the quality of educational software; and 5) more traditional *educational strategies*, e.g., emphasizing teacher training and digitally-oriented courses for lifelong learning.

Nevertheless, we have virtually zero evidence about the effectiveness of the policies implemented so far, and it is not clear, both from a theoretical and from a policy perspective, to what extent the different dimensions of the digital divide and the various policy approaches overlap and interact with each other. Furthermore, strategies could follow one another over time to take advantage of possible complementarities, e.g., between technology provision and educational interventions.

Focusing on Europe, Helsper & van Deursen (2015, p. 142) underline that, together with limited theory, unstable measurement frameworks, and poor collaboration imply that “the evaluation of policy effectiveness beyond infrastructure provision, related to digital skills and engagement, is poor” if not wholly absent.

In this paper, we deepen a policy approach that puts together, under the umbrella of *outreach*, different possible strategies: awareness initiatives, stakeholder organization, public-private partnerships, public access provision, special tools for vulnerable citizens, targeted contents, personal guidance (van Dijk & van Deursen, 2014). Such an approach is designed to leave the implementing organizations enough room to adapt their interventions to each target and context, avoiding one-size-fits-all solutions that have proven less and less effective over the years (Damodaran et al., 2014; Park, 2017).

Taking stock of the theory and measurement frameworks available, we start overcoming the obstacles that so far have hindered quantitative evaluations of digital skills policies. Taking advantage of multiperiodal data available for one European country – Italy, which is currently scaling up an outreach-oriented approach at the national level –, we pursue the following research question: *Do outreach initiatives in the field of digital literacy exert a positive impact on the digital skills of citizens?*

Conceptually, we identify a positive impact as a generalized improvement in the digital skills possessed by the population. Operationally, we follow the examples of Bourguignon and Ferreira (2003) and Todd and Wolpin (2011), and we simulate the implementation of a national-level policy based on outreach by examining a specific type of initiative: (past) public events that stimulate digital awareness. In our case, we focus on the digital skills level of population aggregates (by region, municipality type, and age group), thus adopting a macro-oriented perspective; by doing so, we estimate the net effect of initiatives that might have very different targets and tools, regardless of the strategy adopted by the implementing agencies – for example, regions in the North and South of Italy are affected by different levels and types of digital inequalities (Di Gioacchino et al., 2015), thus requiring different strategies.

Since most of the extant literature underlines the role of social and cultural determinants of the skills divide (Scheerder et al., 2017), outreach initiatives should foster skills by targeting underserved communities and overcoming the structural constraints that hinder access to digital technologies. This should be particularly true for policies with multisector support and integrated across various actors’ work. Such hypotheses, however, should be validated empirically, both because it is unclear whether such multi-stakeholder alliances are indeed effective in delivering their interventions, and because we do not have, yet, any measure of the magnitude, heterogeneity, and duration of such potential effects.

2. Theoretical background

2.1. *Digital inequalities and digital skills policy*

In this work, we focus on the set of skills “that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning and socializing” (Ferrari, 2012, p. 3).

Differences in digital skills and usage are at the heart of van Dijk’s (2020) Resource and Appropriation Theory of the Digital Divide: skills and usage are not only affected by pre-existing inequalities but can also affect participation outcomes such as economic well-being, social connectedness, location, political participation, nature of institutions (van Deursen & van Dijk, 2014). These social offline and online outcomes further fuel a cycle of digital inequalities, impacting personal and positional categories – e.g., age, gender, health status, education, labor status, location, social network – as well as individuals’ initial resources – be they mental, social, cultural – through a *loop of reinforcement* (Blank & Groselj, 2014; Helsper, 2010; Mossberger et al., 2003). Scheerder et al. (2017) provide a comprehensive overview of the socioeconomic determinants of digital skills, uses, and outcomes.

Public policies can intervene to break the vicious loop both by acting directly on skills “by all kinds of educational means” (van Dijk & van Deursen, 2009) and by coupling digital inclusion with social inclusion strategies (Mervyn et al., 2014; Ragnedda, 2018; Reisdorf & Rhinesmith, 2020).

We focus in particular on so-called *digital skills for all* policies, i.e., on the development of skills for low-level users of ICT, with initiatives that “aim to raise public awareness of digital inclusion issues and publicize the need for digital skills” (Atchoarena et al., 2017, p. 38). Thus, we do not investigate other relevant policy areas, such as computer skills for all children and young people (Resnick et al., 2009), specialized skills for all professionals (Sostero & Tolan, 2022), or soft and complementary skills, such as 21st-century skills (van Laar et al., 2017).

Policies for basic skills put particular emphasis on marginalized citizens, since individuals who belong to ICT-rich social networks – i.e., surrounded by individuals with high levels of access, usage, and skills – are more inclined to use digital technologies (Mariën & Van Audenhove, 2010). van Deursen et al. (2014) and Asmar et al. (2020) show that support-seeking strongly influences the development of digital skills, the benefits one can attain from the internet, and the quality of the support received.

However, for proper policymaking on these topics, it is fundamental to understand that digital inclusion can flourish in manifold environments (Asmar et al., 2020). Wong et al. (2009) and van Dijk and van Deursen (2014) suggest that the strategy to bridge the digital gap should be multi-stakeholder, with governments collaborating with civil society and the private sector. The community-level capacity of volunteers, peers, and leaders can compensate for limited e-leadership at the national level (Graham & Hanna, 2011), especially for underserved groups, such as older adults (Sourbati, 2009).

2.2. Outreach programs: actors, typologies, and success factors

Outreach entails services being removed from their normative and mainstream institutional settings and provided in local community settings (Dewson et al., 2006). An outreach program aims to help, uplift, and support those deprived of certain services and rights (Childhope Philippines, 2021). Such activities can also include needs assessment and information provision, making potential customers aware of the available help (Basler, 2005). Outreach services are provided as close as possible to the underserved community, and they are usually voluntary, meaning that it is not mandatory for customers to participate (Dewson et al., 2006).

Starting from this definition, we have scoped the literature to answer three preliminary questions: 1) What type of actors are typically involved in this approach? 2) How can we classify the different types of outreach initiatives? 3) What factors determine their success?

Actors. School-community partnerships are often pivotal for a multi-stakeholder strategy (Valli et al., 2016) since schools can bridge the digital divide not only for students but also for parents and low-income neighborhoods as a whole (Epstein et al., 2018). Libraries are ideally positioned to lead the way in this direction because of their diverse client base and lifelong contact with members (Harding, 2008). They can be seen as a 'third place' alternative to the home-school dichotomy (Elmborg, 2011), which can provide both internet connection and devices (Jaeger et al., 2012) and have the employees necessary to provide assistance and training (Kinney, 2010). Universities, instead, have often limited themselves to tackling the shortage of digitally competent graduates, benefiting the economic system rather than society as a whole (Davenport et al., 2020; Johnston, 2020). However, in the last decades, the concept of university outreach has expanded to services, programs, and partnerships that achieve full engagement with their communities (Leong, 2013; Slagter van Tryon, 2013). Furthermore, many other local facilities are equipped to provide access and educational opportunities to those who lack connectivity or skills: ICT centers, telecentres, and public internet access points (Arifoglu et al., 2012; Park, 2014), municipal ICT schools (Hartviksen et al., 2002), vocational colleges (Ngqulu et al., 2019), senior centers (Lenstra, 2017), internet cafés (Ferlander & Timms, 2006), makerspaces (Kafai et al., 2014; Ratto, 2011).

Typology. Outreach programs employ different types of intervention, that we have broadly classified as follows, taking inspiration from van Dijk (2020)'s wheel policy instruments to bridge the digital divide.

- *Public one-stop service offices* – digital access points established by local, regional, or national governments to provide eFacilitation services, i.e., to help citizens become autonomous in the use of basic digital applications: digital identity, eHealth platforms, internet browsers, personal devices, basic software (Aires et al., 2018; Schou & Pors, 2019);
- *Workshops and events* – public gatherings to raise awareness, discuss or perform practical work related to a specific theme or activity (M. Becker et al., 2019; Del Prete et al., 2011; Hill et al., 2008; Moreno-León & Robles, 2015);
- *Tutoring activities* – provision of support by professionals or volunteers aimed at transferring skills or expertise to respond to a particular need expressed by an individual or a small group (ChanLin et al., 2012; Crump & Logan, 2010; Damodaran & Sandhu, 2016; Hsiu & Lin, 2017; Lam & Lee, 2006; Loureiro, 2015; Nyce et al., 2013; Orser et al., 2019; Willis, 2019);
- *Informal training and education* – face-to-face educational activities involving teachers or experts, targeting trainers or disadvantaged groups; contents are generally pre-defined (Aguilera & Caballero, 2019; A. Berger & Croll, 2012; Chao & Yu, 2016; Kambouri et al., 2006; Kowalska-Chrzanowska et al., 2021; Lev-On et al., 2021; Mącik & Mącik, 2014; Rabayah, 2008);
- *Technology provision* – free or low-fee Internet connectivity or devices to be utilized at home or in public spaces; it can be coupled with tutoring and typically includes technical assistance and support (Assadi & Chard, 2014; Cabello & Claro, 2017; Cid et al., 2020; Cohen Zilka, 2016; Jewitt & Parashar, 2011; Lin et al., 2007);
- *Communication and content creation* – awareness campaigns or special content created to incentivize the usage of the technologies and reduce the barriers encountered by specific disadvantaged groups (Manžuch & Macevičiūtė, 2020; Vaz De Carvalho et al., 2018, 2019).

Success factors. The policies analyzed in the studies cited above focus on different targets – all citizens, the elderly, women, young people, migrants, people with disabilities, etc. –, but qualitatively identify a set of factors that determine the success of interventions aimed at helping underserved communities outside mainstream institutional settings.

- *Tutor competences* – volunteers and professionals interacting with the citizens should possess a good level of ICT skills to provide customized support (Aires et al., 2018; Kambouri et al., 2006; Schou & Pors, 2019); however, interpersonal skills and complementary skills such as language proficiency are at least equally important, especially when dealing with individuals who lack

confidence (Lam & Lee, 2006; Nyce et al., 2013) or are subject to physical or cultural barriers (A. Berger & Croll, 2012; Chang et al., 2012; Manžuch & Macevičiūtė, 2020);
- *Scope of the intervention* – especially in the case of eFacilitation and tutoring, sessions should be personalized and tailored to the needs of the groups involved (Chang et al., 2012; Lin et al., 2007; Manžuch & Macevičiūtė, 2020; Rabayah, 2008); digital needs should be coupled with "cultural components, rhythm, and motives" that emphasize the usefulness of technology also in its social dimension (Del Prete et al., 2011);
- *Mobility* – although most interventions are provided in a specific place, Cohen Zilka (2016) and Kambouri et al. (2006) underline the importance of mobile technologies and roving services to get closer to the communities in need and to facilitate practicing with technology even after the end of the session;
- *Repeated interventions* – even if being "just in time" to address a specific need is often crucial for attracting citizens (Orser et al., 2019), learning cannot happen in one quick session or with a one-shot event; successful programs are based on multiple interactions with the participants, to increase the time spent in using ICTs and bond with the tutors (Kambouri et al., 2006; Vaz De Carvalho et al., 2018, 2019);
- *Connectivity* – often an overlooked element, ensuring a high-speed connection where the intervention is supplied is crucial, especially in rural or underserved areas, and incentivizes people to return after the first session (Hsiu & Lin, 2017).

In sum, the literature provides three general intuitions related to the potential relationship between outreach and skill formation. First, outreach makes it possible to target more isolated pockets of population that typically characterized by low basic digital skills. Second, it takes advantage of channels that are informal and linked to concrete individual needs, thus leveraging motivation to learn and use technologies to reap direct benefits even in the short term. Third, by extensively using close, problem-solving-oriented modes of interaction, outreach programs base learning on relationships and on the personalization of tools and solutions.

Regarding outcomes and evaluation methods, the literature does not highlight any peculiarities of outreach programs concerning other approaches followed in digital skills policy. Given the definition of outreach, these programs should be assessed against their ability to reach people who would not have been reached otherwise; this is true for every counterfactual impact assessment design. In our case, however, (a) we look at the net effect on the whole population, and (b) we don't have experimental or quasi-experimental data that allows us to perform this type of evaluation.

As for the outcomes, depending on the target, the programs focus on different variables: internet skills and usage, employability, motivation and attitude, self-efficacy, gender pay gap, social ties, citizenship. In our study, we focus on digital skills, but, in theory, the same evaluation approach could also be adopted for other outcomes related to digital inequalities. What matters here is that – since digital inequalities are linked to disparities in terms of positional categories, personal categories, social outcomes, or digital domains related to the one under examination – it is difficult to expect individuals to take initiative to close the digital divide, due to a lack of resources; therefore, to close the gap, organizations within the community mobilize to reach out to them in the ways and places where the need is most perceived or observed.

However, notwithstanding the potential of this broad network of organizations and the theoretical alignment of this approach with the sociopolitical nature of digital inequalities (Selwyn, 2004), we know very little about the effectiveness and the impact of all these activities on a large scale. This is true in general for studies addressing digital skills programs: with the exceptions of Chao and Yu (2016), Cohen Zilka (2016), Jewitt and Parashar (2011), Lam and Lee (2006) – who focused on the quantitative impact of specific programs on their target populations –, most of the available studies provide rich overviews of the activities performed by an actor in one particular region and of the difficulties encountered (e.g., Wong et al., 2009), or offer suggestions about the role that an actor might be able to play within a community (e.g., Martinez, 2019), also thanks to interviews and short surveys delivered to representatives of such organizations (e.g., Unterfrauner et al., 2020; Yilmaz & Cevher, 2015); other works have focused on the pedagogy of specific initiatives, trying to optimize the learning experience (e.g., Kumpulainen et al., 2020).

Another element that has been often overlooked is time: the literature acknowledges the existence of different stages in the emergence of digital inequalities (van Deursen & van Dijk, 2014, 2019), but little has been done to analyze potential complementarities among the determinants of the digital divide, and the policy tools to address them, that may arise over time. This is why we have set out a dual (static and dynamic) empirical analysis, pointing out different strategies that can be followed to address various determinants.

In the following two sections, we illustrate the data and the methodologies used to fill these gaps and provide a first country-wide assessment of the potential of outreach-oriented policies.

3. Data and sample

3.1. The Italian case

Italy is a promising context to test the validity of an outreach-oriented approach. Despite being the 3rd largest country in the EU in terms of GDP and population, Italy has been lagging at the bottom of the European rankings for digital skills since Eurostat surveyed them in the early 2010s (European Commission, 2023). Furthermore, Italy couples the overall lack of basic digital skills with relevant internal inequalities: almost 20 percentage points separate the best- and the worst-performing regions in terms of digitally skilled population (Istat, 2023).

This scenario, together with the strong impact that Covid has had on the country, has pushed the Italian government towards asking for relevant financial support from the European Commission in this area. As a result, Italy now displays the largest EU-backed investment in basic skills in the Union: 11.2bn euros for digital skills and education plus 21.8bn euros for general education and early childhood education and care – more than France, Germany, and Spain combined (European Commission, 2021, 2022).

These allocations include a 200M support for two "twin" policies explicitly aiming at boosting citizens' basic digital skills: a national policy – the *Digital Civilian Service* – and a set of regional policies – the *Networks of eFacilitation Services* (Italiadomani, 2022). These policies scale up interventions that have been experimented with in some Italian regions over the last 15 years, resorting to volunteers or professional "eFacilitators" who provide different forms of user support desks or through short (offline) informal courses. The target is ambitious: reaching and improving the skills of 2M citizens over five years.

More importantly, both policies adopt a bottom-up approach and finance heterogeneous initiatives promoted by a vast network of local governments, non-profits, cooperatives, schools, libraries, universities, and local health authorities. This policy design is meant to impact "non-users' social environment, including the local community, workplace, and neighborhood" (Park, 2014).

This approach is not entirely novel in high-income countries (IFLA, 2020; Jaeger et al., 2012; Martin, 2017) and, for example, different States in the US have experimented with similar programs employing either AmeriCorps volunteers (Duvivier, 2023) or so-called *Digital Navigators* (NDIA, 2022) to promote digital equity in underserved communities. The Italian one, however, is the first systematic attempt to use it as a policy tool to reduce digital inequalities at the national level in a country possessing both the correct scale and the data to test our hypotheses. Hence, by analyzing the effectiveness of past digital-related outreach initiatives, our study should help understanding whether there is hope for success for policies designed with the same rationale.

3.2. Dependent variable and pseudo-panel approach

The first step of our analysis is represented by constructing the dependent variable measuring the digital skills of individuals. Outside an experimental or quasi-experimental setting, any causal claim requires longitudinal data to cancel out the effect of unobservable individual characteristics (Wooldridge, 2010). However, longitudinal surveys on digital skills are currently unavailable in European countries. Thus, we opted for a pseudo-panel approach.

Pseudo-panel methods are one way of making up for the lack of panel data and have been employed in different fields (Guillerm, 2017). Their use dates back to Deaton (1985), who first acknowledged their advantage in terms of data availability and time coverage. When the same individuals cannot be followed, types of individuals can be tracked, referred to as "cohorts" or "cells."

In our case, Eurostat and national statistical offices in the EU estimate the digital skills level of individuals from the type of usage and the number of online activities that citizens self-declare when answering multi-purpose household surveys (Eurostat, 2022). As for Italy, this information is collected through the *Aspetti della Vita Quotidiana* (AVQ) survey. The survey sample is built to be representative of the Italian population by gender, region, municipality type, age group, and education level.

Despite the richness and representativeness of the dataset, however, AVQ remains a repeated cross-section dataset. Thus, we have identified synthetic cohorts, balancing representativeness and statistical power, aggregating the stratified AVQ sample using the triplet: region (r) – 20 items; municipality type (m) – 3 categories; age group (a) – 7 groups. These cells can be followed over the years and linked with data from other sources, as depicted in Fig. 1.

Table A2 shows how observations are distributed over each cell.

The aggregation into cohorts, however, comes with a cost: by discarding individual-level information, we dampen the capacity to consider fixed effects that may at least partly explain the variation in digital skills across regions. Thus, we should keep in mind that pseudo-panels are a second-best strategy, to be used in the absence of proper panels that would enable a more powerful identification.

The dependent variable resulting from this process is a composite index built following the Eurostat methodology and the DigComp 2.1 framework (JRC, 2017), aggregating 22 dichotomous indicators grouped in the following competence areas: information and data literacy, communication and collaboration, digital content creation or software skills, and problem-solving. Each area weighs 25%, and the score of each competence area is the arithmetic average of the dummies belonging to it.

We use the 2.1 version of DigComp, not the more recent 2.2 version, since we need to harmonize data from waves of the AVQ survey where variables included in the latest update were unavailable. This choice implies the exclusion of the competence area related to

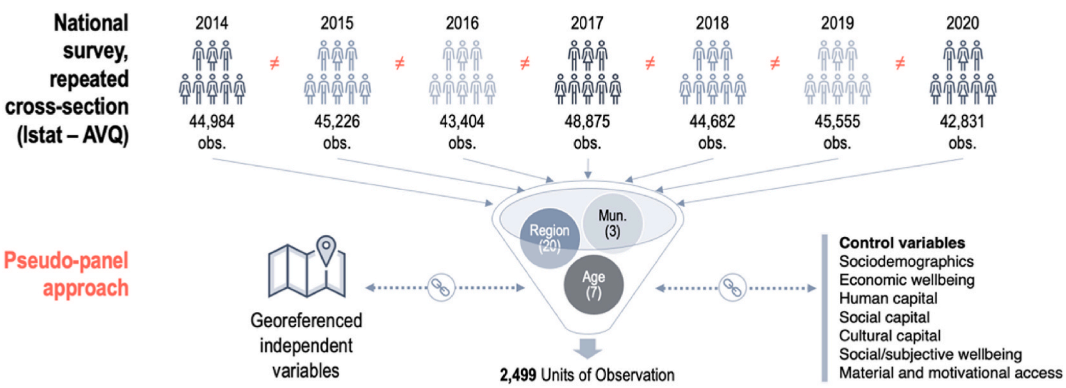

Fig. 1. Synthesis of the pseudo-panel approach.

safety. Furthermore, Eurostat did not survey all DigComp variables every year; hence, we substituted the missing variables with their closest match identified minimizing the Hamming distances between variables (Hamming, 1980) in the years when all AVQ variables were available. Table A3 lists all the indicators used, while Figure A2 shows the distributions of the DigComp Index for each year.

We should note that the DigComp approach to measuring digital skills has been criticized because it assumes that individuals who use the internet to perform certain activities possess the related skills. This might not hold true since (a) those skills may also be possessed by individuals who do not perform such activities (Petrovčič et al., 2022) – because they don't need to, for instance –, and (b) usage does not always imply competence (van Deursen & van Dijk, 2016), in the sense that the activity might not be performed successfully or correctly – e.g., I might declare I have sent an email but my statement might be false or I could have made several errors in form and content. Furthermore, a study on seven countries by the ECDL Foundation (2018) compared assessments made with the DigComp approach with a digital skills test; the findings revealed that the distributions of indices built from self-reported skills and activities differ significantly from cognitive test results.

The objective of our work, however, is not to estimate the level of digital skills among the population but rather to identify *variations* in digital skills to determine their drivers. Hence, we allow our measure to be imprecise in magnitude as long as it strongly correlates with a (non-observable) measure of digital competence. We have verified this hypothesis by collecting data on a separate sample of individuals representative of the Italian population and measuring their digital skills simultaneously with different approaches (see Annex 1).

3.3. Measuring outreach through digital skills-related events

Data availability has always been an issue in digital divide studies (DiMaggio et al., 2004), especially when dealing with skills measurement and when evaluating policy interventions aimed at reducing digital inequalities (Helsper & van Deursen, 2015). In particular, very few datasets cover multiple years.

A relevant exception is represented by the Code Week (CW), an international initiative supported by the European Commission that spreads digital awareness through volunteer events and activities. Launched in 2014, the Code Week is a grassroots initiative that aims to bring coding and digital literacy to everybody in a fun and engaging way (CodeWeek.eu, 2023).

Despite its name, CW is not only about coding. Activities also include other general digital-related topics such as motivation and awareness raising, promoting diversity, or using art and creativity. Basic programming skills and other topics – such as, e.g., robotics or mobile app development – are just the tip of the iceberg of a broader movement aiming at empowering local communities in the digital world. Moreover, the CW is not only about a week; events span mainly over the whole month of October and, more importantly, they are often followed up throughout the year with complementary activities.

Between 2014 and 2020, over 550,000 events were promoted only in Italy, the most active country in the network, followed by Poland and Turkey. Moreno-León and Robles (2015) provided a descriptive assessment of the first two editions of the Code Week. Over time, schools are the main organizers: 97% of the events feature a school or a teacher as the leading promoter. However, each event must be organized in collaboration with other organizations; hence, being active in the network implies being able to count on a receptive local community comprising non-profit organizations, libraries, firms, and volunteers. Furthermore, CW events are typically open to the public: they can target school students, individuals in higher education, employed or unemployed adults, older people, or just the whole population. Organizers also have incentives to provide information about their activities and have them featured within the CW network, since they receive support from the partners and sponsors through learning resources, toolkits, training, and certifications.

We use the number of CW events per 1000 inhabitants held in Italy to proxy how proactive a cohort is in reducing barriers between citizens and digital technologies. To address the needs and requirements of marginalized citizens, CW organizers rely upon two main strategies and tools: 1) inter-organizational collaboration between schools and non-profits that work with older adults, people in low-skilled occupations, ethnic minorities, etc.; 2) targeting the families of students in schools located in underserved communities or neighborhoods. Annex 2 provides further information about these strategies and how CW activities develop, using the example of Naples.

Table A4 illustrates the descriptive statistics, detailed by year, for the dependent variable (DigComp Index) and for the main treatment variable, digital-related outreach.

3.4. Civic engagement and outreach-oriented organizations

The CW variable is not only meant to capture dynamics related to schools' outreach or public events, but is to be interpreted as a signaling device, the tip of the iceberg indicating that a cell is proactive in promoting awareness about digital technologies. However, collaboration between schools and other community organizations might not capture other relevant digital and social inclusion drivers. Hence, we include other variables in our model accounting for voluntarism and for the activity of relevant "outreach-oriented" organizations: associations, libraries, and universities.

Also in these cases, we hypothesize that density is a good indicator of activism, following the approach adopted by quantitative migration studies to proxy the strength of social networks (Dustmann et al., 2013; Siciliano et al., 2020; Åslund & Fredriksson, 2009). Thus, we measure social participation (*part*) as the share of individuals who are active either in associations, unions, or political parties. Second, we measure exposure to the activities of libraries (*lib*) as the number of public libraries per 1000 inhabitants, as recorded by the National Registry of Libraries (ICCU, 2023). Lastly, we measure university outreach (*tm*) – also accounting for its quality – through the multi-year assessment of third mission activities promoted by Italian higher education institutions, focusing on the indicators evaluating public engagement (Anvur, 2021).

Figure A3 illustrates the territorial distribution of these three independent variables, which also enter the models through interactions with the main treatment variable.

3.5. Control variables

In our models, we also include a set of control variables, drawing from the categorization of the determinants of digital divides made by Scheerder et al. (2017).

First, we account for population density to control for the intensity of social interactions that are often correlated with higher returns from possessing digital skills (Courtois & Verdegem, 2016; Helsper, 2012; van Deursen et al., 2014). Second, we account for economic well-being in terms of both household income and employment rate, since we expect more affluent cohorts to be more skilled, and we also expect this skill premium to be mirrored by the local labor market (Lissitsa et al., 2017; van Deursen & Helsper, 2015; Yoon, 2018). The employment rate also serves as a proxy for the digital skills training provided "on the job", since an increasing share of jobs now deal with ICT (T. Berger & Frey, 2016; Horrigan, 2018; Jona-Lasinio & Venturini, 2023).

These three variables also capture some dynamics related to the individuals' material and motivational access to digital technologies. However, we also included a direct measure of access, which is broadband coverage, one of the critical indicators of digital inequality (Lee et al., 2015; Mossberger et al., 2013; Robinson et al., 2020; van Deursen & van Dijk, 2019). More specifically, we have employed an indicator measuring the coverage of fast (NGA) broadband; Matteucci (2020) and Quaglione et al. (2020) have observed that this type of broadband coverage has remained highly heterogeneous over our reference period.

Digital skills are also correlated with other types of (formal) skills (García-Mora & Mora-Rivera, 2021; Litt, 2013). Hence, we account for human capital through the share of individuals who possess at most a lower secondary school diploma – which we expect to be negatively correlated with the outcome variable. Since we focus on basic skills, we prefer this indicator to other indicators looking at higher education levels – e.g., tertiary graduates-that we expect to have a positive sign.

Lastly, since we are also investigating the links between social inclusion and digital inclusion, we include three relevant sets of social and individual determinants identified by Scheerder et al. (2017): social capital – in terms of friendship, household composition, and trust in others –, cultural capital – looking at religiosity and at exposure to museums –, and subjective well-being – as measured by the subjective health status.[1]

Table A5 in Annex 3 lists the definitions and sources of this data and provides further details on their granularity in terms of the triplet region-municipality type-age group. Table A6 reports the descriptive statistics for all variables, while Table A7 illustrates the bivariate correlations among all dependent and independent variables.

4. Methods

Let's begin to compose our models starting from a basic ordinary least squares model:

$$DigComp_i = \beta_0 + \beta_1 CW_i + \boldsymbol{\gamma} Z_i + u_i \tag{1}$$

Where: $i = 1, \ldots, N$ is the number of units of observation (r, m, a) available each year; $DigComp_i \in [0, 1]$ is the index of citizens' digital skills in each cell; CW_i is the independent variable measuring digital skills-related outreach; Z_i is the set of control variables; u_i is the error.

We first extend this basic model to include a matrix X of further independent variables – $X = \{part, lib, tm\}$ – together with their interactions with the main treatment variable (CW):

$$DigComp_i = \beta_0 + \beta_1 CW_i + \delta_x X_i + \theta_x (CW_i \times X_i) + \boldsymbol{\gamma} Z_i + u_i \tag{2}$$

Causal claims from equations (1) and (2) – which we do not estimate – would be biased by cell effects, hence we need to move to the panel specification. We do so by implementing a dual (static and dynamic) perspective, where all variables are also indexed by time (t).

We start with the static model. Since our data is grouped by region (level 3), municipality type (level 2), and age group (level 1), we estimate a mixed-effects multilevel model (Snijders & Bosker, 2011), which in our case is basically a fixed-effects model where we preserve a random-effects component (v_i) to allow for level-specific intercepts:

$$DigComp_{it} = \beta_0 + \beta_1 CW_{it} + \delta_x X_{it} + \theta_x (CW_{it} \times X_{it}) + \boldsymbol{\gamma} Z_{it} + \lambda_t + v_i + \varepsilon_{it} \tag{3}$$

The vector λ_t represents the year fixed effects while the random effects are defined as:

$$v_i = v_{r..} + v_{rm.} + v_{rma} \tag{4}$$

Where: $v_{r..} \sim N(0, \sigma^2_{r..})$; $v_{rm.} \sim N(0, \sigma^2_{rm.})$; $v_{rma} \sim (0, \sigma^2_{rma})$.

Since digital skills are accumulated over time, following the traditional dynamic path of human capital accumulation (see Heckman et al., 1998), we also estimate a dynamic model. Digital skills in a cohort depreciate over time but are not reset in every period; hence,

[1] Our dataset included also a measure of life satisfaction, but we opted for excluding this measure since the level and path of life satisfaction are often found to be shaped by cognitive skills (see Rotondi et al., 2017) and this would represent a source of reverse causation bias.

the skills level at time t depends on previous levels or lags, according to the following model:

$$DigComp_{it} = \beta_0 + \alpha_l DigComp_{il} + \beta_1 CW_{it} + \delta_x X_{it} + \theta_x (CW_{it} \times X_{it}) + \gamma Z_{it} + \lambda_t + \varepsilon_{it} \tag{5}$$

Where $DigComp_{il}$ represents the auto-regressive component and $l = 1, 2, \ldots L$ is the number of lags.

We use the Generalized Method of Moments (GMM) to estimate the dynamic model, to control for endogeneity of the lagged dependent variable, omitted variable bias, and unobserved panel heterogeneity; GMM models are also designed for situations characterized by heteroskedasticity, serial correlation, and arbitrarily distributed fixed effects (Wooldridge, 2001).

Furthermore, GMM models are appropriate when the number of groups ($N = 357$) is strictly larger than the time span ($t = 7$) considered (Blundell & Bond, 1998). Importantly, GMM uses instrumental variable estimation and requires instruments to be non-larger than the number of groups; this implies using model specifications that are more parsimonious in the number of variables employed, to reduce the number of instruments and strengthen overidentification tests (Roodman, 2009).

We use system GMM since it corrects endogeneity by introducing more instruments, thus improving efficiency. These instruments are transformed to make them uncorrelated with the fixed effects (Blundell & Bond, 1998). Given the clustering of our data, we use a two-step GMM estimator.

To sum up, our study focuses on equations (3) and (5), mainly on the β_1 coefficient. Understanding potential channels for impact and mediating or moderating variables, however, implies also focusing on the coefficients of the other independent variables ($\delta_1, \delta_2, \delta_3$), of the interaction terms ($\theta_1, \theta_2, \theta_3$), and on the vector γ, i.e., on the concurrent role of other potential determinants.

Table 1
Static mixed-effects panel models.

VARIABLES	(1) DigComp Index	(2) DigComp Index	(3) DigComp Index	(4) DigComp Index	(5) DigComp Index	(6) DigComp Index
Fixed-effects parameters						
Digital outreach (*CW*)	0.0139 (0.0149)	0.0292 (0.0197)	0.0265 (0.0193)	0.0278 (0.0191)	0.0288 (0.0197)	0.0244 (0.0198)
Income		1.20e-06 (1.32e-06)	1.57e-06 (1.37e-06)	7.79e-06 (1.38e-06)	1.13e-06 (1.27e-06)	9.96e-07 (1.36e-06)
Employment rate		0.213*** (0.0113)	0.210*** (0.0124)	0.203*** (0.0126)	0.213*** (0.0113)	0.199*** (0.0134)
Broadband coverage		0.111*** (0.0114)	0.111*** (0.0116)	0.110*** (0.0114)	0.112*** (0.0113)	0.110*** (0.0115)
Population density		−0.000437** (0.000181)	−0.000455** (0.000177)	−0.000407** (0.000171)	−0.000440** (0.000182)	−0.000428** (0.000167)
Secondary education		−0.246*** (0.0178)	−0.244*** (0.0186)	−0.246*** (0.0177)	−0.245*** (0.0178)	−0.243*** (0.0183)
No friends			−0.110 (0.0755)			−0.107 (0.0748)
One-person households			−0.111* (0.0645)			−0.118* (0.0635)
Trust			0.0224 (0.0204)			0.0253 (0.0207)
Religiosity				−0.0584*** (0.0138)		−0.0602*** (0.0133)
Museum density				−0.00423 (0.0134)		−0.00212 (0.0141)
Health status					0.0254 (0.0709)	0.0408 (0.0752)
Social participation (*part*)	0.152*** (0.0325)	0.109*** (0.0284)	0.106*** (0.0280)	0.113*** (0.0291)	0.109*** (0.0284)	0.109*** (0.0286)
Third Mission (*tm*)	−0.0130* (0.00751)	−0.00129 (0.00732)	0.000162 (0.00740)	0.000130 (0.00766)	−0.00144 (0.00746)	0.00164 (0.00798)
Library activism (*lib*)	0.0810 (0.0722)	0.0123 (0.0546)	0.0316 (0.0564)	0.00244 (0.0513)	0.0101 (0.0548)	0.0156 (0.0537)
Interaction 1 ($CW * part$)	0.0501 (0.0416)	0.0273 (0.0317)	0.0308 (0.0308)	0.0379 (0.0310)	0.0278 (0.0314)	0.0423 (0.0297)
Interaction 2 ($CW * tm$)	0.00614 (0.0216)	−0.0174 (0.0176)	−0.0194 (0.0175)	−0.0204 (0.0169)	−0.0170 (0.0177)	−0.0221 (0.0170)
Interaction 3 ($CW * lib$)	−0.169 (0.1899)	−0.199 (0.1901)	−0.195 (0.1885)	−0.196 (0.1864)	−0.199 (0.1901)	−0.191 (0.1837)
Constant	0.216*** (0.0191)	0.196*** (0.0265)	0.218*** (0.0295)	0.222*** (0.0285)	0.180*** (0.0590)	0.220*** (0.0599)
Random-effects parameters (standard errors)						
Region (level 1)	6.05e-13 (9.75e-11)	2.71e-12 (2.07e-10)	3.64e-12 –	5.26e-12 –	3.57e-12 –	5.61e-12 –
Municipality type (level 2)	1.46e-12 (2.85e-08)	6.46e-11 (5.07e-09)	5.21e-11 (2.64e-09)	7.86e-11 (5.29e-09)	6.11e-11 (2.57e-09)	5.89e-11 (2.86e-09)
Age group (level 3)	0.1487*** (0.1028)	0.0967*** (0.0211)	0.0959*** (0.0017)	0.0935*** (0.0018)	0.0968*** (0.0017)	0.0927*** (0.0018)
Observations	2499	2499	2499	2499	2499	2499
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

5. Results

5.1. Static analysis

Table 1 displays the results of the static panel analysis illustrated by equation (3). We always use mixed-effects estimation, with clustered standard errors for the fixed-effects part of the model. Table A8 reports the results of the diagnostic tests on time fixed-effects, heteroskedasticity, and auto-correlation.

The first relevant result is that our main independent variable, i.e., our measure of digital-related outreach, is never significant in the static configuration. What matters, instead, are more structural drivers of the economy (employment, education, connectivity), all moving in the expected direction.

Units where the labor market conditions improve over time display growing levels of digital skills among their population (coefficient $\approx +0.21$). Human capital is positively correlated, too: units where a decreasing share of the population holds at most a secondary school diploma, i.e., increase their human capital, witness improvements in basic digital skills (-0.24). Cohorts where fast broadband coverage increases over time witness a more frequent use of the internet ($+0.11$). Lastly, in line with the literature that links access to digital media and social isolation (Courtois & Verdegem, 2016; van Deursen et al., 2014), also population density is positively correlated with increases in digital skills.

Other control variables are generally not significant, with two relevant exceptions: the share of individuals who attend places of worship is negatively correlated with the outcome variable (-0.06); the share of individuals who live in one-person households, another measure of social connectedness, is negatively correlated with digital skill increases ($+0.06$).

As for the other independent variables, only social participation is positive and significant (coefficient between $+0.106$ and $+0.152$). This means that the units where the population is more active in society over time see their digital literacy increase, although there seems to be no significant interaction between this phenomenon and school-led digital outreach ($CW * part$).

Lastly, looking at the random-effect intercepts reveals that our effects will likely vary across age groups rather than regions or municipality types. Intuitively, this may be explained by the fact that the variability of our dependent variable is primarily linked to the cognitive traits of individuals rather than to varying geographical characteristics. Future research should investigate these variations, since we could not estimate heterogeneous coefficients with our dataset and variables.

Table 2
Dynamic panel models, system GMM estimation.

VARIABLES	(1) DigComp Index	(2) DigComp Index	(3) DigComp Index	(4) DigComp Index	(5) DigComp Index	(6) DigComp Index
DigComp Index = L1	0.927*** (0.148)	0.907*** (0.144)	0.899*** (0.137)	1.034*** (0.128)	0.989*** (0.124)	0.984*** (0.122)
DigComp Index = L2	−0.188** (0.0802)	−0.186** (0.0786)	−0.188** (0.0781)	−0.129* (0.0806)	−0.151* (0.0806)	−0.155* (0.0805)
Digital outreach (*CW*)	**0.322**** **(0.161)**	**0.309**** **(0.151)**	**0.314**** **(0.151)**	**0.310*** **(0.185)**	**0.246 (0.168)**	**0.251 (0.171)**
Income	4.02e-07 (6.45e-06)	1.68e-06 (5.10e-06)	2.08e-06 (4.95e-06)	8.25e-07 (6.43e-06)	1.49e-06 (5.08e-06)	1.70e-06 (5.00e-06)
Employment rate	0.0817* (0.0449)	0.0866* (0.0447)	0.0906* (0.0534)	0.00300 (0.0719)	0.0137 (0.0696)	0.0145 (0.0703)
Broadband coverage	0.289 (0.224)	0.251 (0.157)	0.249 (0.154)	0.164 (0.235)	0.174 (0.189)	0.173 (0.188)
Population density	−0.000371 (0.00101)	−0.000603 (0.000996)	−0.000678 (0.000954)	−8.59e-05 (0.000945)	−0.000433 (0.000941)	−0.000477 (0.000925)
Secondary education	−0.213* (0.120)	−0.224** (0.114)	−0.222* (0.114)	−0.318** (0.161)	−0.286** (0.143)	−0.290** (0.139)
One-person households				−0.0417 (0.188)	−0.0203 (0.179)	−0.00847 (0.175)
Religiosity				0.248 (0.201)	0.167 (0.182)	0.169 (0.175)
Social participation (*part*)	−0.0543 (0.117)	−0.067 (0.111)	−0.0786 (0.113)	−0.0481 (0.138)	−0.0613 (0.122)	−0.0776 (0.121)
Third Mission (*tm*)	−0.0152 (0.0488)	−0.0348 (0.044)	−0.0415 (0.0376)	−0.00984 (0.0447)	−0.0211 (0.0412)	−0.0266 (0.0387)
Library activism (*lib*)	0.220* (0.127)	0.202* (0.120)	0.193* (0.111)	0.320* (0.193)	0.224* (134)	0.229* (0.132)
Interaction 1 ($CW * part$)	−0.354* (0.208)	−0.278* (0.164)	−0.281* (0.161)	−1.129* (0.643)	−0.900 (0.617)	−0.935 (0.623)
Interaction 2 ($CW * tm$)	−0.0503 (0.169)	−0.0027 (0.162)	−0.022 (0.147)	−0.208 (0.168)	−0.118 (0.157)	−0.0975 (0.154)
Interaction 3 ($CW * lib$)	0.659 (0.546)	0.702 (0.479)	0.725 (0.483)	0.152 (0.654)	0.200 (0.538)	0.222 (0.534)
Constant	0.0241 (0.117)	0.0433 (0.101)	0.0444 (0.0989)	0.0538 (0.125)	0.058 (0.123)	0.0646 (0.119)
Instrumented lags for *lib* (l_1 l_2):	(2 3)	(2 4)	(2 5)	(2 3)	(2 4)	(2 5)
Observations	1785	1785	1785	1785	1785	1785
Wald Prob > χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N. of instruments	38	41	43	42	45	47
AR1 Prob > χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR2 Prob > χ^2	0.3841	0.2962	0.2939	0.3716	0.3932	0.4026
Hansen test of overid. Prob > χ^2	0.2580	0.2755	0.2968	0.0080	0.0000	0.0000

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.10.

5.2. Dynamic analysis

Serial correlation in the outcome variable is coherent with human capital accumulation (G. S. Becker, 1962), but it also emerges clearly from the data (Table A8). Hence, we continue our dual empirical analysis with the estimation of dynamic models, using system GMM (Table 2).

We include in all models two lags of the dependent variable, the main explanatory variable (*CW*), the other independent variables with their interactions, and the main policy-relevant controls – income, employment, broadband, education, population density; for models 4 to 6, we also include the two controls that were significant in the static configuration. We use cluster-robust standard errors for all specifications and apply the backward orthogonal deviations transform to the instruments for the transformed equation.

Only year dummies are considered strictly exogenous, while all other variables are considered endogenous regressors and used as GMM-style internal instruments. These are divided into two groups – a key empirical solution for the robustness of our configurations.

1. Library activism (*lib*) is instrumented using the lags from lib_{t-3} to lib_{t-5};
2. All the remaining regressors are instrumented using only the second lag. For them, we also use the *collapse* option to reduce the number of instruments.

All resulting models pass the diagnostic tests for autocorrelation: we reject the null hypothesis of no first-order serial correlation, and we fail to reject the null hypothesis of no second-order serial correlation. However, only models 1 to 3 also pass the test for overidentification, with all the p-values of the Hansen test in the comfortable range between 0.10 and 0.30.

Overall, the resulting picture confirms some of the conclusions already drawn for the static configuration but, at the same time, highlights several relevant differences.

First, when taking into account dynamic fluctuations over the trend, digital outreach (*CW*) becomes positive and significant (coefficient $\approx +0.31$). Becoming more active in promoting digital awareness increases the likelihood of a positive fluctuation.

Second, the dynamic of the lagged outcome variables, significant with opposite signs, provides support to the overall coherence of

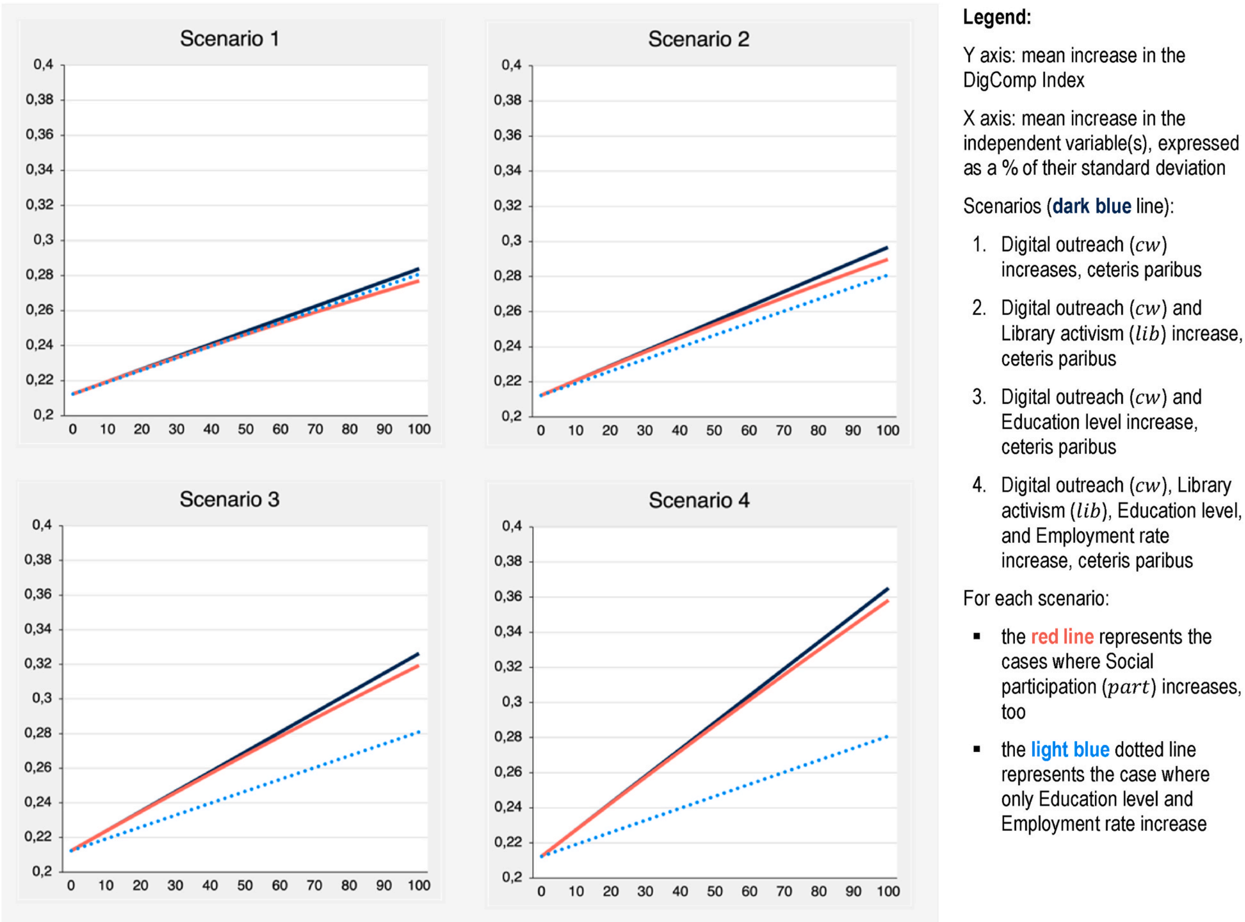

Fig. 2. Simulating the impact of increasing outreach.

the models, since it rules out any compound exponential trend at play.

Third, also the coefficient of library activism is positive and significant (between +0.19 and + 0.22), signaling that an increased presence of libraries captures an increased interest in digital technologies.

Fourth, we identify a significant negative interaction between social participation and digital outreach, while social participation per se does not impact the dynamic trend. This might seem counterintuitive but, also in this case, the variable acts as a moderator: when social participation is already high, an increase in digital skills-oriented proactiveness of local actors is less effective since part of the job related to digital/social inclusion is already taken care of.

Lastly, the most impactful variable is once again education (coefficient ≈ -0.22), more than employment – positive and significant but with a smaller magnitude (+0.09). At the same time, broadband coverage and social connectedness do not play a role in boosting the trend upward.

How large is the impact of these dynamics on the level of basic digital skills? The simulations illustrated in Fig. 2 help us get a more concrete idea of the effect size. We simulate how the mean outcome across cohorts (vertical axis) would move if we increased the mean of any significant regressor by a share of its standard deviation (horizontal axis).

When outreach activities increase by one standard deviation (which means doubling them, on average), digital skills rise between 6 and 15 percentage points on average, depending on the simultaneous dynamics of other relevant regressors. We can also see the slight plateau effect caused by increased social participation (dark blue vs red lines). Overall, the effect of an increase in outreach alone is as large as that of increasing improving education and employment by the same extent (Scenario 1).

6. Discussion

Given our results, we can answer our research question: increases in outreach activity are associated with improvements in the digital skills of citizens, but only in the short run. In other terms, digital-related outreach does not correlate with reduced structural digital inequalities but identifies positive fluctuations in the trend of digital skills development: cohorts that increase the number of events dedicated to digital awareness witness higher rates of improvements in basic digital skills, once we account for the time-series dynamics. Outreach is not significant, instead, in the static models.

In the dynamic model, the interaction between different actors, never explored so far by other studies, is significant only for one variable – social participation – and enters the model with a negative sign. This implies a saturation effect or decreasing returns of outreach as a function of local activism: the higher the social capital, the less effective outreach becomes in boosting digital skills.

Among the other policy-relevant variables, library activism displays a sizeable effect in the dynamic setting. Still, education takes the lion's share, being positive and significant in both configurations. Employment is relevant, too, though to a lesser extent, while broadband coverage and population density are significant only in the static models. The different significance of broadband coverage between the static and dynamic analysis could be explained by the fact that the availability of fest broadband is indeed relevant for citizens' skills, but yearly improvements in coverage do not directly translate into digital skills improvements. Furthermore, religiosity and household composition are significant only in the static scenario, meaning that personal resources and networks do matter for developing people's digital capabilities.

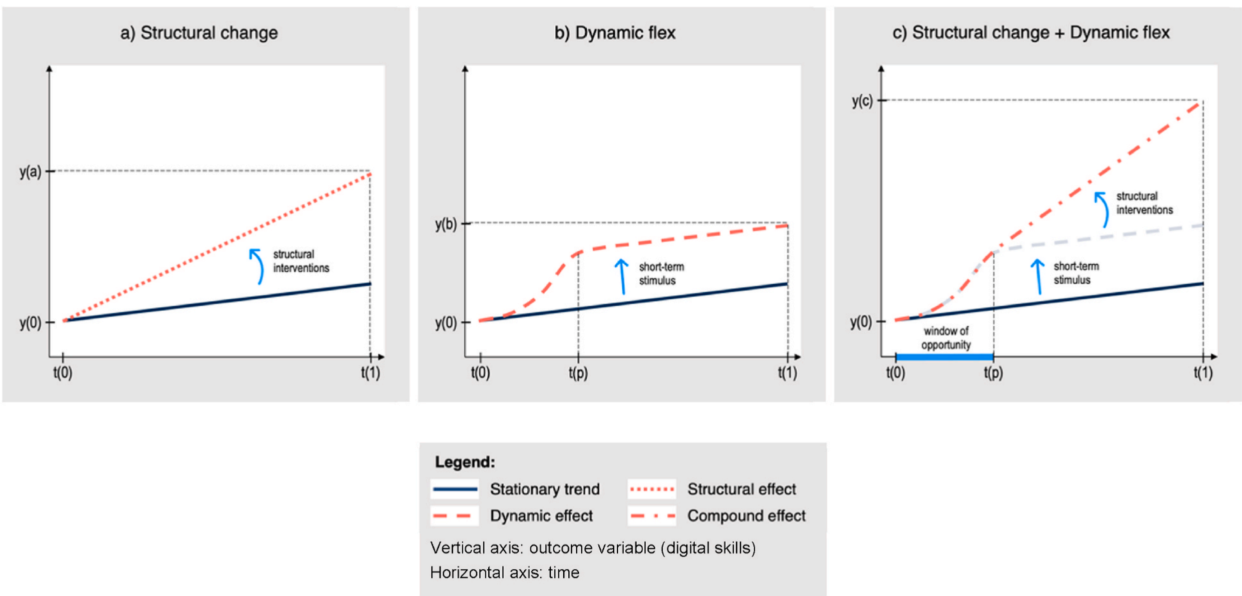

Fig. 3. Synthesis between static and dynamic analysis.

6.1. Implications for theory

Our results are coherent with the hypotheses of van Dijk's (2020) Resource and Appropriation Theory: cohorts endowed with higher initial resources are more able to capture the benefits of digitalization. However, our study sheds light on the importance of community resources that can benefit the wealthy but, potentially, also counteract some drivers of inequality. The proactivity of actors such as schools, libraries, and non-profits can moderate the reinforcement of existing inequalities, especially in the short term. Hence, we argue that the theory should be extended to better account for environmental elements, i.e., those factors in the ecosystem where individuals are embedded that influence the loop of disparities.

Our study also indicates that, for outreach to play a positive role in this regard, one of the success factors outlined in paragraph 2.2 assumes relevance: the scope of the intervention. If local initiatives focus on only one aspect – e.g., transferring knowledge related to specific digital competences – the potential synergies between different elements contributing to reducing digital inequality are not capitalized upon. Instead, these initiatives should take a holistic approach and provide support to citizens, depending on the subjects and their needs, also concerning broadband take-up, participation in the labor market or training, participation in the social life of the community, etc.

Consequently, monitoring and evaluation activities must also be equipped to portray not a single aspect – e.g., whether there has been an improvement in proficiency for a specific skill – but to capture the potential impacts on individuals in their entire social sphere. Even in cases of programs with very focused objectives, outreach initiatives entail flexible modes of interaction that do not always allow for confining interventions to distinct tasks. Therefore, it is crucial to apprehend possible positive trade-offs in the broad perspective of digital inclusion and, indeed, in the more comprehensive and relevant perspective of social inclusion.

6.2. Policy implications

In our view, the static and dynamic models provide two complementary perspectives (Fig. 3) that require integration among three of the strategic pillars identified by van Dijk and van Deursen (2014): awareness and organization (i.e., multisector support), technology provision, and education.

On the one hand, the static model identifies variables that structurally impact citizens' basic digital skills. From the viewpoint of policymakers, this implies that, if one wants to change the trajectory of the structural trend for (digital) skills development, one should aim at triggering traditional (digital) policy levers: education policies to endure basic (literacy and numeracy) skills for all; labor policies to reduce structural unemployment; strengthening broadband coverage and facilitating its take-up.

Social capital matters, too: more dense social networks facilitate digital inclusion. As Warschauer (2003) put it, technologies are socially embedded, and we must consider "people's ability to make use of those technologies to engage in meaningful social practices."

On the other hand, the dynamic model identifies variables that can cause positive fluctuations in the structural trend. These include policy levers that can also be activated in the short term: outreach initiatives promoted by schools, non-profits, libraries, and other actors that animate local communities; reforms that strengthen and innovate the education system; and active labor policies to provide short-term stimuli for the labor market.

The optimal strategy would be a mixed approach: effective short-term stimulus could open a window of opportunity until $t(p)$ that may be used to implement structural interventions.

More practically, outreach initiatives should be designed as doorways to the digital economy and society to obtain this result, providing practical and tailored support to show the immediate benefits of digital citizenship. This type of support should be linked to forms of social support to pave the way for more structural interventions; in other words, taking local governments as an example, social services may be more effective than digital transformation offices in managing such initiatives.

Furthermore, outreach initiatives should be deployed with the explicit intent to target underserved communities, e.g., avoiding digital channels to engage the population, providing access to safe connectivity and devices, and setting up a roving service when possible. The effectiveness of these approaches should be monitored by collecting at least basic information on the participants, such as age, gender, occupation, education level, and reason for participating in the initiative. This information would then be used to fine-tune more structural and demanding policy interventions.

6.3. Policy learning: linking past outreach events and new e-Facilitation programs

In addition to the implications for the optimal policy strategy to be followed to maximize the impact of digial skills policies, we argue that the validity of our results on digital-related outreach – based on data about past CW events – can be extended to the current policy context to form expectations about the new programs implemented in Italy (and in other high-income countries such as the US). Fig. 4 compares the distribution of all CW events promoted between 2014 and 2021 with the distribution of volunteers in the first two years of implementation of the *Digital Civilian Service* in Italy.

The similarity between the two maps hints to the fact that the Code Week and the new policies share a relevant feature: the presence of organizations that are reactive to digital-oriented initiatives. In the case of the Code Week, these are organizations that set up collaborations with schools to organize local events and create digital awareness; in the cases of Digital Civilian Service and Network of eFacilitation Services, instead, these are organizations that answer the government's call, apply with new projects, and post openings for eFacilitators.

Table A9, in Annex 3, displays the results of a pooled OLS regression showing that the correlation between the distribution of eFacilitators and CW activities across the 107 Italian provinces is not just driven by population size or by other drivers of the choice to

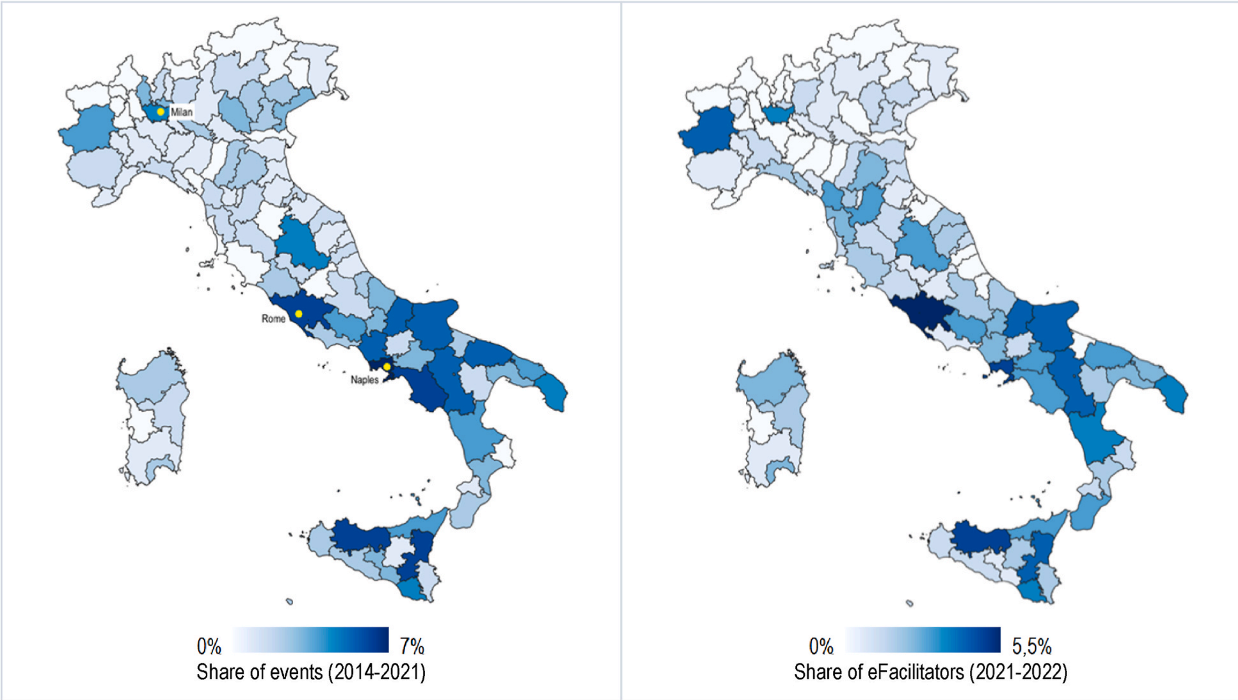

Fig. 4. Geographical distribution of Code Week events (left) and of Digital Civilian Service eFacilitators (right).
Source: Authors' elaboration on data provided by EU Code Week organizers and by the Department for Youth Policies.

apply for a volunteer position, such as being unemployed or being enrolled in university.

6.4. Limitations and future research

Our study is only a first attempt to answer a very ambitious research question that will require further investigation. Our data is limited to the most relevant observable outreach dynamics. Unfortunately, adequate longitudinal data is not currently available for other potentially relevant actors involved in the policy. Future studies should broaden the focus to all actors, employing the empirical methods appropriate for a more extensive set of variables.

The DigComp Index also represents one significant limitation: although we have shown that alternative measures of digital skill are correlated with each other, measures based on internet usage have been strongly criticized, and both scholars and practitioners have been long asking for more reliable and direct measures of skill, e.g., resorting to sample surveys that measure respondents' performance in a simulated digital environment, or including a digital module in longitudinal surveys.

A second relevant threat to the robustness of the coefficients estimated in Tables 1 and 2 is represented by potential multicollinearity among regressors. This cannot be directly assessed in our empirical setting, although the pairwise correlations in indicate that such threat might indeed make our point estimates less precise (Wooldridge, 2008). As a result, future studies should address this issue by producing a preliminary factor analysis to reduce the number of regressors and employ orthogonal factors.

More generally, he static approach could be improved in robustness through instrumental variable estimation, to support causal inference. Preliminary attempts have proved encouraging but not sufficiently consistent. Replications are welcome (and possible, especially for European countries), mainly to check the external validity of GMM results. Future studies could combine structural and dynamic approaches to obtain a more general framework by extending the multi-level modeling we have used just marginally here. Age seems to be the most relevant factor to explain heterogeneous effects and should be investigated further.

Research should focus on how to impact the policy levers identified in the two models, to trigger generalized improvements and scale up valuable activities. We should never forget that our estimates also depend on how we measure digital skills and the skill level we focus on: it is also essential to investigate higher-order competencies. Lastly, future studies should improve the measurement of the role played by outreach-oriented actors – such as universities – included in the study with second-best indicators, e.g., by resorting to social network analysis and improving public engagement measurement.

7. Conclusions

Outreach is not a panacea for all woes. Our research has shown that the local activism of certain types of organizations over the years has been associated with improving citizens' digital skills. However, it is unrealistic to think that this type of initiative can be left with the task of closing the gap in basic digital skills between countries or within a country.

Our results confirm some of the findings in the literature and the initial hypotheses we made. In addition to the potential impact of outreach initiatives, the data show a significant correlation between increases in digital skills and access to the internet, employment, educational attainment, density of social relationships (in terms of population density, household composition, and social participation), and religious culture. In contrast, the hypotheses regarding the positive role of universities, social capital (trust), and friendship are not confirmed, in our case. It is likely that the effect of these variables is captured by other regressors or that there are still limitations in measurement, especially in the case of universities.

From a policy perspective, our study indicates that outreach initiatives can create fertile ground and establish links between purely digital goals and the social sphere of individuals. Above all, they may buy time to structure more complex actions. However, they do not display the potential to affect the structural dynamics that impact people's lack of skills. To do this, school reforms are the uttermost priority: they are needed to help the education system meet the challenges of our era and, together with stimuli to the labor market, can reduce the job mismatch and help marginalized communities reap the benefits of technological progress.

From this point of view, Italy is a clear example: for years, national and international observers have called for structural reforms to help accumulate human capital, make the economic system more dynamic, and reduce inequalities (European Commission, 2014). These reforms have been delayed or weakened in their implementation, and governments have tried to remedy this with bottom-up solutions that leverage the widespread capacities of civil society. Our evidence shows that this approach is hardly sufficient to face the country's challenges.

Italy is certainly not the only country in this condition, but some peculiar conditions have allowed us to study it in detail. Our exercise shows that, from a methodological point of view, empirical designs of relatively low complexity – such as the construction of pseudo-panels – can allow us to reach policy-relevant conclusions even in the absence of first-best data (experimental or quasi-experimental, large-scale). Such data, however, would be necessary to make proper causal claims that are not feasible in our setting.

It is crucial to continue in this vein, by investing heavily in the availability of quantitative and qualitative data on phenomena related to digital inclusion. Few initiatives are as well documented as the EU Code Week, and many official statistics are not collected with sufficient regularity and granularity to provide policy-relevant insights (Hernandez & Faith, 2023). Closing the gap between the theories by researchers and the needs of policymakers is more urgent than ever, to avoid structuring solutions unsuitable for the challenges and ambitions that characterize contemporary public policies.

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No potential competing interest to be reported.

CRediT authorship contribution statement

Francesco Olivanti: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Luca Gastaldi:** Writing – review & editing, Validation, Supervision, Project administration, Conceptualization.

Data availability

The authors do not have permission to share data.

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Annex 1Are online activities correlated with digital skills?

To answer this question, in February 2023 we have selected a representative sample of the Italian population with the support of the private research institute SWG. The stratified sample comprises 2227 individuals: 1927 (86.5%) were randomly selected from SWG's online panel; 300 individuals (13.5%) were sampled and interviewed offline to include low-frequency internet users.

Stratification was performed using population quotas for three variables: age group (12 categories), macro-region (4 categories), and gender (2 categories).

To obtain the 1700 online responses provided for in the collaboration agreement, SWG invited 6842 panelists over two weeks, with two reminders. 327 responses were excluded or screened out because some of the quotas had already been completed. The 227 responses that exceeded the initial sample size were kept to increase statistical power. The overall response rate for the online component is 33%.

Respondents took an average of 14:14 min to complete the questionnaire; online respondents compiled an average of 12:50 min; offline interviews lasted an average of 25:27 min.

The questionnaire included three modules implementing different measurements of digital skills: one module using the same questions asked by the Istat-Eurostat methodology; one module implementing a short cognitive test (10 questions) to assess the respondent's knowledge concerning different digital competence areas; one module implementing the Internet Skills Scale developed by van Deursen et al. (2016), based on the individual's self-perceived digital skill level.

The detailed questionnaire and the dataset are available upon request to the authors.

The table and the figures below show that the correlations between the online activities index and the alternative indices are sizeable and consistent; the relationship between the indices holds even when including relevant regressors in a simple OLS model.

Table A1
Correlation between different measurements of individuals' digital skills

VARIABLES	(1) DigComp Index activities		(2) DigComp Index activities		(3) DigComp Index activities		(4) DigComp Index activities	
	Coeff.	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*
DigComp Index – test	**0.704*****	(0.01982)			**0.606*****	(0.02175)		
DigComp Index – self-perception			**0.253*****	(0.00493)			**0.227*****	(0.00573)
Female (dummy)					−0.00149	(0.00969)	−0.037***	(0.00893)
Age					−0.00166***	(0.00029)	−0.0006**	(0.00028)
Macro-region (4 categories)					−0.00964**	(0.00401)	−0.00919**	(0.00380)
Education level (5 categories)					0.0302***	(0.00454)	0.0315***	(0.00419)
Employed (dummy)					0.0516***	(0.01031)	0.0434***	(0.00991)
Subjective income					−0.01077	(0.00680)	0.00266	(0.00630)
Constant	0.259***	(0.01054)	0.490***	(0.00495)	0.322***	(0.03318)	0.443***	(0.03117)
Observations	2227		2227		2227		2227	
R-squared	0.3383		0.4287		0.3850		0.4666	

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

Annex 2What do Code Week activities actually look like?

Given the relevance of the CW variable for our study, we use the information publicly available online to complement its description with a concrete example; the purpose of this short qualitative analysis is to provide further details on how CW events unfold and develop within one of our cohorts. We focus on the city of Naples (see figure below), which has been the most active over the years.

As we can see from the map, only a few events were organized for the first two years of activity, evenly split between richer and poorer neighborhoods. In 2014, activities were led by two primary schools: 3 events dedicated to basic coding skills were organized in Vomero, one of the most affluent neighborhoods in the city; 5 events dedicated to computational thinking were instead located in San Giovanni a Teduccio, one of the poorest neighborhoods in Italy, which since 2015 hosts a new campus of the University of Naples and an Apple Academy. Collaboration with universities is key: these activities were all part of a national program sponsored by the Ministry of Education and by the national consortium of universities for informatics. In 2015, high schools got involved, with 8 activities dedicated to web development. Furthermore, four primary schools promote events dedicated to playful coding activities sponsored by TIM, the most prominent Italian phone and internet company.

Thanks to the great emphasis put on digitalization efforts by the National Plan for Digital Schools (October 2015) and by the appointment of a national commissioner for the Italian Digital Agenda (September 2016), CW activities grew significantly between 2016 and 2018. This can also be seen in the national map available in Annex 4 (Figure A4), where we can note that new locations become involved every year, but they all tend to nest around previously involved sites.

Locally, however, the turnover rate of organizers is relatively high, with schools typically participating for two years before exiting the network. Locations vary due to the high mobility of the teachers involved, to changes in the sources of funding, but also because collaborations evolve over time. School events become increasingly open to families and adults in the community, for example, in the activities organized in the peripheral neighborhood of Cercola,[2] on the slopes of Vesuvius. With activities spreading across the city, CW initiatives also become a substitute for teacher training courses.

With the pandemic hitting in 2020, 56% of the activities were moved online, while less than 30% of the events had an online component until 2019. In the meantime, the network of collaborations has grown significantly to include municipal, regional, national,

[2] See: https://codeweek.eu/view/12161/a-scuola-di-coding.

and international organizations such as #CodeMooc,[3] linked to the University of Urbino, Associazione Dschola,[4] and CoderDojo.[5]

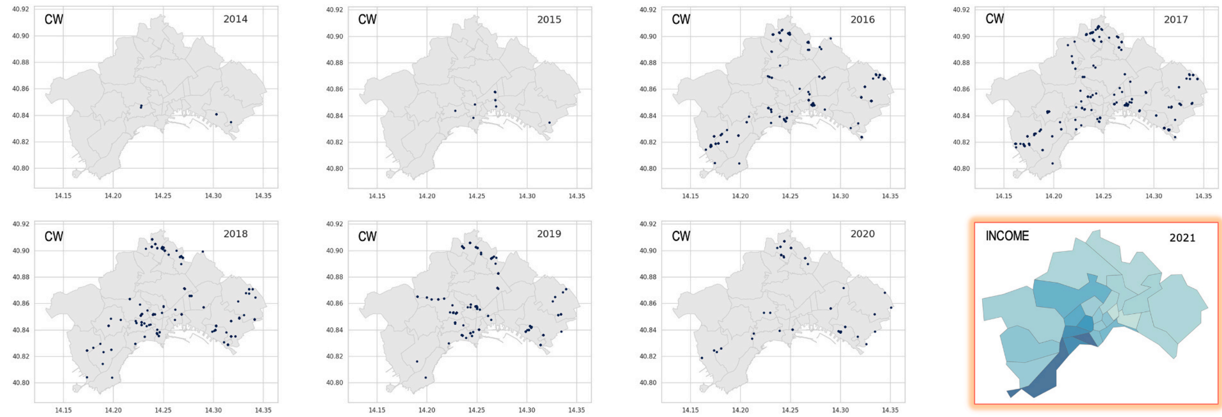

Fig. A1. Evolution of Code Week events in the city of Naples (2014–2020)
Source: Authors' elaboration on data provided by EU Code Week organizers and MEF (2022).

Annex 3Tables

Table A2
Distribution of observations by cell (r,m,a) and year (2014–2020)

Cell	Observations		*Municipality type*	*N*	*(%)*
Region	*N*	*(%)*	1. Metropolitan areas	539	21.57
1. Piemonte	147	5.88	2. Other municipalities (pop. < 10k)	980	39.22
2. Valle d'Aosta	98	3.92	3. Other municipalities (pop. > 10k)	980	39.22
3. Lombardia	147	5.88	*Total*	*2499*	*100.00*
4. Trentino-Alto Adige	98	3.92	*Age group*	*N*	*(%)*
5. Veneto	147	5.88	1. Less than 15 years of age	357	14.29
6. Friuli Venezia Giulia	98	3.92	2. From 16 to 19 years of age	357	14.29
7. Liguria	147	5.88	3. From 20 to 29 years of age	357	14.29
8. Emilia-Romagna	147	5.88	4. From 30 to 39 years of age	357	14.29
9. Toscana	147	5.88	5. From 40 to 54 years of age	357	14.29
10. Umbria	98	3.92	6. From 55 to 64 years of age	357	14.29
11. Marche	98	3.92	7. More than 65 years of age	357	14.29
12. Lazio	147	5.88	*Total*	*2499*	*100.00*
13. Abruzzo	98	3.92	*Years*	*N*	*(%)*
14. Molise	98	3.92	2014	357	14.29
15. Campania	147	5.88	2015	357	14.29
16. Puglia	147	5.88	2016	357	14.29
17. Basilicata	98	3.92	2017	357	14.29
18. Calabria	98	3.92	2018	357	14.29
19. Sicilia	147	5.88	2019	357	14.29
20. Sardegna	147	5.88	2020	357	14.29
Total	*2499*	*100.00*	*Total*	*2499*	*100.00*

Note: Observations do not sum to ($20 \times 3 \times 7$) since not all Italian regions have a metropolitan area.

[3] See: https://codemooc.org/codemooc-live-napoli/.
[4] See: https://archivio2022.icvittorinodafeltre.edu.it/dschola-coding-italian-scratch-festival-2017/.
[5] See: https://www.tecnosrl.it/assets/front/img/press/60e2bdefd099f.pdf.

Table A3
DigComp index methodology, list of indicators

Comp. area	Indicators of online activity (performed in the last 3 months before the survey)	Year 2014	2015	2016	2017	2018	2019	2020
1. Information and data literacy	Copied or moved files or folders	●	●	●	(a)	(a)	●	(a)
	Saved files on Internet storage space	●	●	●	●	●	●	●
	Obtained information from public authorities/services' websites	●	●	●	●	●	●	●
	Finding information about goods or services	●	●	●	●	●	●	●
	Seeking health-related information	●	●	●	●	●	●	●
2. Communication and collaboration skills	Sending/receiving emails	●	●	●	●	●	●	●
	Participating in social networks	●	●	●	●	●	●	●
	Telephoning/video calls over the Internet	●	●	●	●	●	●	●
	Uploading self-created content to any website to be shared online	●	●	●	●	●	●	●
3. Digital content creation skills	Used word processing software	(b)	●	●			●	
	Used spreadsheet software	●	●	●	(c)	(c)	●	(c)
	Used software to edit photos, video, or audio files		●	●			●	
	Created presentation or document integrating text, pictures, tables, or charts	●	●	●	(d)	(d)	●	(e)
	Used advanced functions of spreadsheets to organize and analyze data	(f)	●	●	(f)	(f)	●	(g)
	Have written code in a programming language	●	●	●	(h)	(h)	●	(h)
5. Problem solving skills	Transferring files between computers or other devices	●	●	●	(i)	(i)	●	
	Installing software and applications (apps)	●	●	●	●	●	●	(j)
	Changing settings of any software, including o.s. or security programs	(k)	●	●	(k)	(k)	●	(l)
	Online purchases (in the last 12 months)	●	●	●	●	●	●	●
	Selling online	●	●	●	●	●	●	●
	Used online learning resources	(m)	●	●	●	(m)	●	●
	Internet banking	●	●	●	●	●	●	●

Authors' elaboration from Eurostat (2021).
Circles identify perfect matches. Proxies, when used, are indicated by footnotes in the parentheses.

a) Read or download books online or ebooks;
b) Change safety settings in a browser;
c) Purchase or renew insurance policies online;
d) Using online payment methods to buy goods or services;
e) Watching TV via streaming services;
f) Participating in a professional social network online;
g) Attending an online course;
h) Playing or downloading games online;
i) Looking for a job or sending a job application;
j) Buying any of the following online services: music, films, books, games, software, health apps, other apps;
k) Ordering or buying sports items online;
l) Instant messaging;
m) Looking for information on educational activities or courses.

Table A4
Detailed descriptive statistics for DigComp Index and digital-related outreach

VARIABLE/year	Mean	St. dev.	Min	Max
DigComp Index (overall)	**0.2678**	**0.1661**	**0.00379**	**0.69474**
2014	0.2521	0.1646	0.00651	0.56636
2015	0.2653	0.1681	0.01120	0.69474
2016	0.2562	0.1696	0.00379	0.62676
2017	0.2213	0.1330	0.00468	0.52495
2018	0.2393	0.1417	0.00529	0.47807
2019	0.2826	0.1711	0.00853	0.62481
2020	0.3574	0.1756	0.03552	0.67419
Digital-related outreach (overall)	**0.1973**	**0.2226**	**0**	**2.05052**
2014	0.0080	0.0136	0	0.08668
2015	0.0401	0.0348	0	0.13931
2016	0.2294	0.1733	0	0.67811
2017	0.2635	0.2064	0.00803	0.94540
2018	0.3352	0.2300	0.01087	1.07385
2019	0.2972	0.1982	0.01093	0.86449
2020	0.2077	0.2935	0	2.05052

Table A5
List of control variables by category of digital skills divide determinants and granularity.
Sources: Digital skills divide determinants from Scheerder et al. (2017). Data sources: Istat (2022c, 2022a, 2022b, 2022d); Istat-AVQ (2022); Istat-ASC (2022); Agcom (2023).

Variables by category of digital skills divide determinants	Source	Region	Mun. type	Age group
Sociodemographics				
Population density: number of inhabitants per squared-km	Istat	●	●	●
Economic well-being				
Average taxable income (euros)	Istat	●	●	
Employment rate (%)	Istat	●		●
Human capital				
Secondary education: share (%) of individuals that possess at most a lower secondary school diploma	Istat-AVQ	●	●	●
Social capital				
No friends: share (%) of individuals who declare having no friends	Istat-AVQ	●	●	●
One-person households: share (%) of households composed by a single individual	Istat-AVQ	●	●	●
Trust: share (%) of individuals who claim to trust others	Istat-AVQ	●	●	●
Cultural capital				
Museum density: number of museums per 1000 inhabitants	Istat-ASC	●	●	
Religiosity: share (%) of individuals who have attended a place of worship at least weekly	Istat-AVQ	●	●	●
Subjective well-being				
Health status: share (%) of individuals who claim they are in good health	Istat	●	●	●
Material and motivational access				
Broadband coverage: share (%) of addresses covered by fast fixed broadband (NGA) of at least 30 Mbps download. The technologies considered are FTTH, FTTB, Cable Docsis 3.0 and VDS.	Agcom / DESI survey	●	●	

Table A6
Descriptive statistics for all variables employed

Variable	Range		*Unique values*	Missing	Mean	St. dev.	Median
	Min	Max					
DigComp Index	0.0038	0.6947	2499	0	0.2678	0.1661	0.2884
Digital-related outreach (*CW*)	0	2.050	347	0	0.1973	0.2225	0.1306
Social participation index (*part*)	0	0.7792	2407	0	0.1836	0.1078	0.1898
Quality of Third Mission (*tm*)	−0.1699	1.002	264	0	0.4670	0.3071	0.5377
Libraries per 1000 inhabitants (*lib*)	0.0643	0.4542	357	0	0.1726	0.0773	0.1543
Population density (*dens*)	0.1379	297.3	2499	0	196,1	344,2	10,89
Average income (*inc*)	12222.3	28617.7	357	0	18514.3	3180.7	18750.1
Employment rate (*emp*)	0	0.875	481	0	0.3976	0.3069	0.474
Education level below secondary (*educ*)	0	0.9395	2140	0	0.4144	0.1936	0.3978
Individuals with no friends (*friend*)	0	0.2606	1316	0	0.0121	0.0179	0.0189
One-person households (*mono*)	0.244	0.491	88	0	0.3276	0.0437	0.325
Trust most people (*trust*)	0	0.6502	2454	0	0.1915	0.1039	0.2009
Museums per 1000 inhabitants (*mus*)	0.0344	0.5533	140	0	0.1207	0.0851	0.1017
Religiosity (*rel*)	0	0.5946	2462	0	0.2144	0.1152	0.2006
Subjective health status (*health*)	0.587	0.822	85	0	0.6944	0.0363	0.694
Broadband coverage (*bbc*)	0.0590	1	357	0	0.627343	0.180278	0.65566

Table A7
Pairwise correlation matrix
Note: light grey cells indicate coefficients below the threshold of 5% significance level; dark grey cells indicate coefficients below the threshold of 1% significance level.

	DigComp	*CW*	*part*	*tm*	*lib*	*dens*	*inc*	*emp*	*educ*	*friend*	*mono*	*trust*	*mus*	*rel*	*health*
CW	-0.0862														
part	0.4713	-0.1442													
tm	0.0870	-0.0464	0.0442												
lib	0.0794	-0.3216	0.2226	-0.0720											
dens	-0.1022	-0.0061	-0.0655	0.0219	-0.1973										
inc	0.2164	-0.2497	0.1835	0.4517	0.1629	0.2506									
emp	0.6167	-0.0592	0.6342	0.0568	0.0908	0.0013	0.1683								
educ	-0.7226	-0.0114	-0.2140	-0.1460	0.0134	0.0794	-0.2585	-0.5763							
friend	-0.2556	-0.0256	0.0910	0.0863	0.0292	0.1547	0.1203	-0.0834	0.3939						
mono	0.1129	-0.1767	0.0886	0.0731	0.4611	-0.1463	0.4075	0.1091	-0.1197	0.0531					
trust	0.4843	-0.1101	0.6449	0.0957	0.1430	0.0581	0.2853	0.5420	-0.1881	0.1287	0.1684				
mus	0.0678	-0.1840	0.1740	0.1841	0.6041	-0.1979	0.2211	0.0887	-0.0669	0.0360	0.5119	0.1289			
rel	-0.7343	0.0837	-0.2620	-0.0330	-0.2134	0.1377	-0.2595	-0.4775	0.6578	0.2708	-0.3258	-0.3014	-0.2191		
health	0.1299	-0.1539	0.1904	0.1622	0.2124	0.1013	0.4024	0.1052	-0.1053	0.0611	0.0016	0.2250	0.1405	-0.1123	
bbc	0.6268	0.0051	0.1801	0.1679	0.0409	-0.0144	0.4009	0.3111	-0.7008	-0.3684	0.1502	0.1566	0.0929	-0.6093	0.1885

Table A8
Results of diagnostic tests on the static configuration

CONTROLS	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Income	□	■	■	■	■	■
Employment rate	□	■	■	■	■	■
Broadband take-up	□	■	■	■	■	■
Population density	□	■	■	■	■	■
Secondary education	□	■	■	■	■	■
No friends	□	□	■	□	□	■
One-person households	□	□	■	□	□	■
Trust	□	□	■	□	□	■
Religiosity	□	□	□	■	□	■
Museums	□	□	□	■	□	■
Health status	□	□	□	□	■	■
a) Joint F-test for year fixed-effects						
Parameters:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$F(6, 328)$	332,65	237,01	231,13	223,85	183,69	170,78
Prob $> F$	0	0	0	0	0	0
b) Modified Wald test for groupwise heteroskedasticity						
Parameters:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$\chi^2(329)$	39340,02	42987,98	43719,49	46118,65	60844,82	53874,99
(Prob $> \chi^2$)	0	0	0	0	0	0
c) Wooldridge test for autocorrelation						
Parameters:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$F(1, 328)$	246,83	248,86	239,45	258,51	229,29	228,41
Prob $> F$	0	0	0	0	0	0

■ = variable used in the model; □ = variable not used in the model.

Table A9
OLS modeling of the territorial distribution of *Digital Civilian Service* eFacilitators

VARIABLES	(1)	(2)	(3)	(4)
Code Week events (%)	0.783*** (0.0928)	0.713*** (0.0952)	0.577*** (0.102)	0.565*** (0.106)
Population share (%)		0.119 (0.121)	0.247** (0.119)	0.254** (0.121)
Employment rate (18–29 yoa)			−0.0177*** (0.00485)	−0.0147** (0.00700)
University enrollment				0.0755 (0.108)
Constant	0.202*** (0.0717)	0.157* (0.0921)	0.768*** (0.227)	0.455 (0.539)
Observations	107	107	107	107
R-squared	0.749	0.755	0.816	0.817

Robust SE in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Annex 4. Figures

Legend: Y axis: share of observations (kernel density); X axis: score of the DigComp Index.

Fig. A2. Distribution of the dependent variable (DigComp Index), 2014–2020.

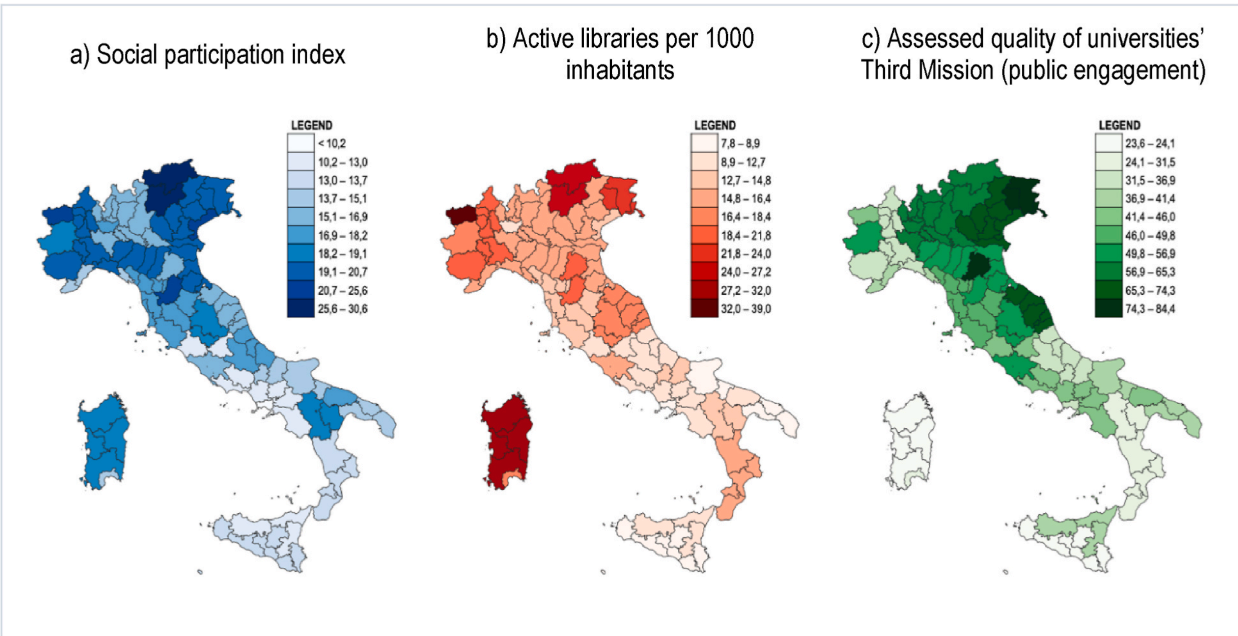

Fig. A3. Territorial distribution of other relevant outreach-related variables, year 2019.

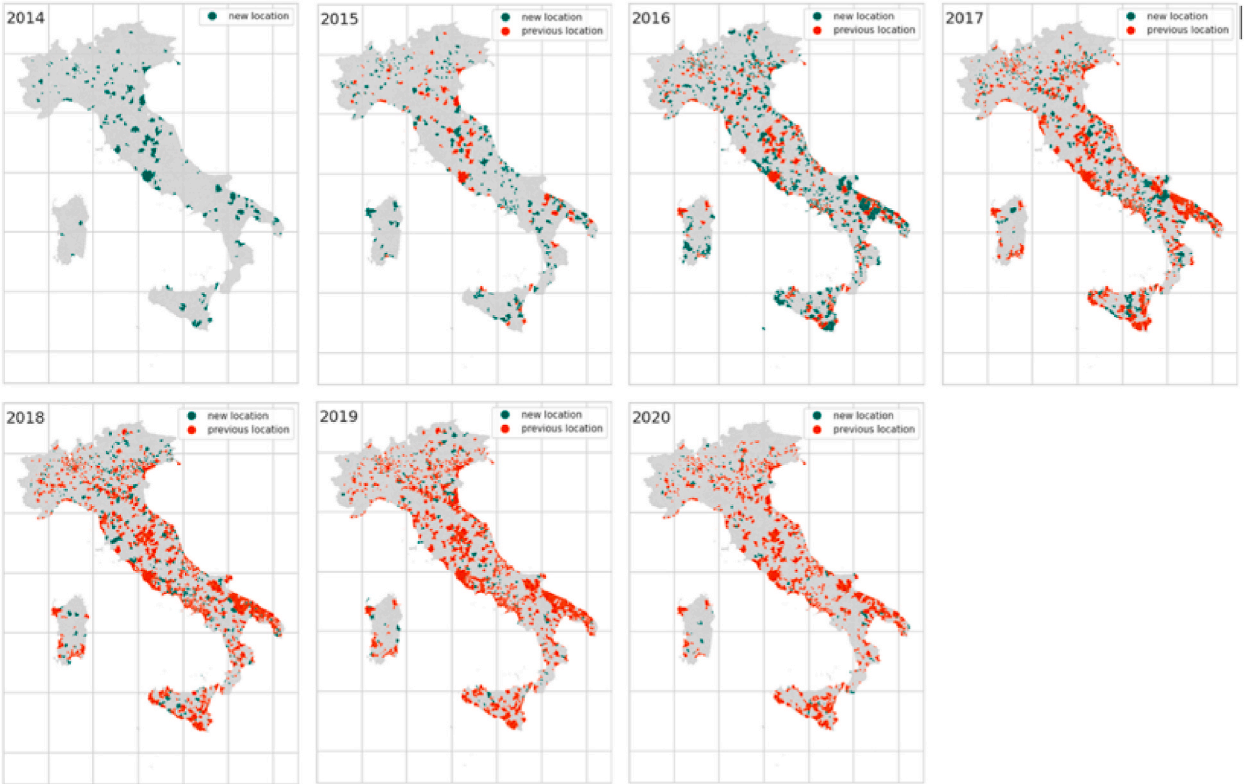

Fig. A4. Evolution of Code Week events in Italy, 2014–2020.

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