DIGITAL INEQUALITY AND MIGRANT STUDENTS' EDUCATIONAL PERFORMANCE: EVIDENCE FROM CAMPANIA[1]

Alessio Buonomo, Stefania Capecchi, Francesca Di Iorio, Patrizia Giannantoni

Abstract. This article explores the relationship between digital access, migratory background, and educational performance among Grade 10 students in the Italian region of Campania. Using data from the 2022-2023 INVALSI assessment and employing multilevel modeling, the study examines how inequalities in access to digital technologies impact proficiency in the Italian language, focusing particularly on differences between native-born students and those with a migratory background. The findings reveal significant disparities in digital access, especially among first-generation immigrant students; over one-quarter of these students report lacking both a personal computer and an internet connection at home. These material disadvantages are strongly correlated with lower educational achievement. For students with a migratory background, access to digital resources emerges as a strong predictor of language proficiency, regardless of socio-economic status. Additionally, second-generation students consistently outperform their first-generation peers, although both groups still fall short compared to native-born students. The analysis indicates that while digital inclusion is important for addressing educational inequality, it is not sufficient on its own to overcome the broader socio-cultural and institutional barriers faced by youth of immigrant origin. The results highlight the need for targeted policy responses that combine improved access to technology with broader integration strategies, particularly in regions experiencing significant structural disadvantages.

1. Introduction

In recent decades, increased immigration has reshaped the demographic and social landscape of many European regions, generating significant challenges and opportunities within educational systems. Italy has been no exception, experiencing a substantial rise in the number of school-age children with a migratory background. This demographic shift has intensified concerns about persistent educational disparities between native-born students and those with immigrant origins, especially in regions marked by structural disadvantage. Research consistently shows that these disparities are shaped by a combination of socio-economic

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vulnerability, limited familiarity with the host country's schooling system, and linguistic barriers (Rumberger 1995; Strozza 2015; Strozza *et al*., 2018).

While traditional explanations for achievement gaps have focused on parental education, economic hardship, and language proficiency, increasing attention has been paid to the role of digital access as a determinant of educational opportunity (Azzolini and Schizzerotto, 2017; Buonomo *et al.* 2024). The growing integration of digital technologies into teaching and learning processes has made access to a personal computer and a stable internet connection indispensable for full participation in school life. This trend was further accelerated by the COVID-19 pandemic, during which remote learning became the norm across education systems. Students without adequate digital tools, particularly those from low-income or immigrant households, were placed at an acute disadvantage, unable to engage fully with online materials, maintain continuity in learning, or develop digital competencies essential for academic success (Buonomo *et al.*, 2019).

The interplay between digital deprivation and educational underachievement is particularly relevant for first-generation immigrant students, who frequently encounter multiple vulnerabilities: economic hardship, limited parental support in navigating technological demands, and fewer opportunities for digital skill acquisition (Buonomo *et al.*, 2025). Second-generation students, though typically more integrated linguistically and socially, are also affected by unequal access to digital infrastructure within the home (Feliciano 2001). These patterns raise critical questions about the extent to which digital exclusion may compound existing inequalities in educational outcomes, particularly in territories where structural disadvantage is most pronounced.

Despite growing scholarly attention to digital divides, much of the existing research has been conducted at the national level, often overlooking the importance of regional contexts. Yet, localised socio-economic conditions, infrastructural disparities, and variations in school provision strongly mediate the lived experience of students and their ability to benefit from digital tools. Campania, a region in Southern Italy with both a significant immigrant student population and high levels of socio-economic disadvantage, represents a salient case for investigating these dynamics.

This study focuses on Grade 10 students in Campania to assess how digital access, or lack of it, intersects with migratory background in shaping language proficiency outcomes. Employing recent standardised data and a multilevel modelling approach, the analysis distinguishes between first- and second-generation immigrant students and their native peers, while controlling for relevant socio-demographic variables. In doing so, it addresses a critical empirical gap and contributes to a better understanding of how digital inequality functions as both a symptom and a driver of educational stratification. The findings not only highlight

the persistent disadvantages faced by immigrant-origin students in the digital domain but also underscore the urgent need for regional policies that promote equitable access to educational technologies and foster inclusive learning environments for all.

2. Theoretical background

Persistent disparities in educational achievement between native students and those from immigrant backgrounds have been widely documented across various countries. These differences arise from a mix of linguistic, socio-economic, and institutional factors that affect students' academic paths. In countries like Italy, where immigration has significantly increased in recent decades, educational systems have faced challenges in accommodating a more diverse student population, many of whom may have limited knowledge of the host country's language and educational practices. First-generation immigrant students typically encounter the toughest obstacles, while second-generation students generally show better outcomes. However, they still face socio-economic challenges and varying levels of integration into society (OECD 2006).

A variety of explanatory frameworks have been proposed to understand the disparities in educational outcomes. Classical assimilation theory suggests that, over time, the academic performance of immigrant-origin students will converge with that of their native peers (Alba, and Nee 1997). However, empirical evidence reveals a more complex picture, with segmented pathways where generational progress is uneven and heavily influenced by social class, ethnicity, and the structures of educational opportunities (Portes and Zhou 1993). In highly selective educational systems, early academic tracking and limited institutional support often reinforce existing inequalities, placing immigrant students, particularly those from disadvantaged households, at a significant disadvantage. Factors such as parental education, occupational status, and access to cultural capital continue to be strong predictors of academic success (Buonomo *et al.*, 2024).

Within this broader context, digital access has emerged as a new and increasingly salient axis of educational inequality. The integration of digital technologies into everyday teaching and learning practices, accelerated by the COVID-19 pandemic, has deepened the divide between students who can readily engage with digital learning environments and those who cannot. The so-called “digital divide” is often conceptualised in two dimensions: a first-order divide related to basic access to devices and internet connectivity, and a second-order divide concerning the ability to use these tools effectively (Di Maggio *et al.*, 2004). While both dimensions are relevant, basic infrastructural access remains a critical barrier for many students, particularly those from migrant and low-income backgrounds.

Unequal access to digital resources affects not only students' ability to complete assignments or access information, but also their long-term academic engagement and skill development. For immigrant-origin students, digital exclusion can reinforce other structural disadvantages, including language difficulties, lack of parental educational support, and reduced familiarity with national curricula (Coleman 2021). Conversely, digital inclusion, when paired with adequate support, can serve as a compensatory resource that mitigates, at least in part, the effects of social disadvantage.

Despite increasing policy attention, empirical research on the specific role of digital access in shaping immigrant students' academic performance in Italy remains limited. Most studies address socio-economic determinants of educational inequality but fail to isolate the impact of technological exclusion. This gap is particularly concerning given the growing centrality of digital infrastructure in the contemporary education landscape. While digital inclusion alone cannot resolve the broader challenges faced by marginalised students, it constitutes a necessary foundation for equitable participation in school life.

Understanding how digital inequalities intersect with migratory background is therefore essential. It calls for a more integrated approach that considers both material and structural factors in explaining achievement gaps. In contexts where socio-economic vulnerability and high immigration rates coincide (such as Campania) examining the role of digital access becomes critical to identifying how disadvantage is produced and sustained within the educational system. This study contributes to this topic by investigating how differences in digital access relate to language proficiency among native and immigrant students, highlighting the intergenerational and socio-economic dynamics that shape educational inequality.

3. Data and methods

This study draws on data from the 2022-2023 administration of Italy's INVALSI standardised assessment, which tests nearly the entire national student population. The analysis focuses on students in Grade 10 (approximately age 15), a critical stage in upper secondary education just before compulsory schooling ends. This cohort allows for a comprehensive assessment of educational outcomes before dropout becomes legally permissible.

Our dependent variable is Italian language proficiency, measured through a Rasch-scaled INVALSI test score that enables comparability across students and schools. The analysis concentrates on how digital access and migratory background influence these outcomes.

Digital access is captured through students' self-reported access to both a personal computer and a home internet connection, an indicator reflecting basic technological availability. Migratory background is measured using both citizenship and generational status, distinguishing between first-generation (foreign-born), second-generation (foreign citizens born in Italy), and native students.

To ensure robustness and disentangle the potential interaction between digital access and migratory background, we implement two models, each incorporating different operationalisations of socio-economic status (SES). The first model extends a baseline set of demographic and educational covariates (namely gender, school track, and region of enrolment) by including a series of disaggregated SES indicators at the individual level. These comprise parental educational attainment (highest qualification obtained by either parent), parental employment status (whether at least one parent is in work), and a set of household-level conditions reflecting the student's learning environment, such as the presence of a dedicated study space, a personal desk, and a private bedroom. This detailed specification allows for control how specific dimensions of economic and cultural capital are associated with both digital access and academic performance.

The second model replaces these disaggregated controls with a composite SES index drawn from the INVALSI dataset. This index consolidates multiple socio-economic attributes, including those included in the first model, while also incorporating additional proxies of household cultural capital, such as access to encyclopaedias and home digital resources. This aggregated measure serves both as an alternative SES operationalisation and a robustness check for the initial specification. Furthermore, Model 2 integrates a contextual SES variable at the school level, which reflects the average SES profile of the student body within each institution.

In order to explore more precisely the interaction between digital access and migratory background, we implemented an alternative modelling strategy inspired by the contrast-based approach outlined in Yaremych *et al*. (2023). Rather than including digital access and migratory generation as independent covariates, we introduced three analytically distinct contrasts: (1) a Digital Access contrast, distinguishing between students with and without access to key digital resources; (2) a Digital Migrant vs. Digital Native contrast, comparing immigrant-origin students with digital access to their digitally connected native-born peers; and (3) a Digital Generational contrast, isolating the difference in outcomes between first- and second-generation immigrant students who both report access to digital tools.

In this specification, digital access is defined using a stringent operational criterion: students are classified as digitally connected only if they report simultaneous access to both a personal computer and an internet connection within the home. This dual-condition measure offers a more comprehensive representation

of effective digital availability, avoiding partial or inadequate forms of technological access.

The models were estimated separately using two analytical samples. The first sample includes the entire population of Grade 10 students in the Campania region, which allows for an assessment of broader patterns and disparities among different groups. The second sample focuses specifically on students with a migratory background, enabling a more detailed examination of variations within this group and intergenerational differences among immigrant-origin students.

4. Results

In Campania, the analysis of Grade 10 students in the 2022-2023 school year reveals significant inequalities in access to digital technologies, particularly among pupils with a migratory background. A substantial share of students in this group, especially those born abroad, report lacking essential digital resources such as a personal computer or a reliable internet connection at home. Notably, over one in four first-generation immigrant students are digitally excluded, lacking both a computer and internet access (28.3%). Even among second-generation students, levels of digital deprivation remain high, with nearly a quarter reporting insufficient access (26.0%).

These figures reflect a broader pattern of structural disadvantage affecting immigrant-origin students in Campania, many of whom reside in socio-economically marginalised households. While digital inequalities also affect some native-born students, the gap is markedly more pronounced among those with a migratory background. This digital divide raises serious concerns regarding the equitable distribution of learning opportunities, especially as educational processes increasingly rely on technological infrastructure.

Language proficiency outcomes mirror these disparities. Students with full digital access, defined as having both a personal computer and internet connection at home, consistently achieve higher scores in Italian language assessments compared to their digitally excluded peers. This holds true across all student groups. Among native-born students, the mean score in Italian is significantly higher for those with access to digital tools. Yet the performance gap is particularly acute among immigrant-origin students. First-generation students without digital access show the lowest average proficiency, while those with access perform considerably better, though still below the levels of their native peers. Second-generation students occupy an intermediate position, outperforming their foreign-born counterparts but remaining behind native-born pupils.

The multilevel estimates presented in Table 1 further highlight the relationship between digital access, migratory background, and language proficiency in Campania. The results offer robust evidence of the persistent disadvantages faced by immigrant-origin students, while also highlighting the distinct and beneficial role of digital inclusion.

Among the general student population, digital access does not appear to have a statistically significant independent effect on performance in Italian language assessments once we control for socio-demographic and socio-economic variables. In both Model 1 and Model 2, the coefficients associated with digital access are negative and non-significant. This suggests that, for native-born students, the benefits of home technological resources may largely stem from broader patterns of socio-economic advantage. When we take household and institutional socio-economic status (SES) into account, digital access no longer adds explanatory power for this group. However, the findings change significantly when we focus solely on students with a migratory background. In this case, digital access becomes a strong and statistically significant predictor of Italian language proficiency. In Model 1, which includes specific socio-demographic factors and disaggregated SES controls, the effect size is positive, and this association

Table 1 – *Multilevel estimates of Italian language achievement by digital access and migratory generation contrasts[a] (grade 10, school year 2022-2023)[c].*

Proficiency in Italian	Mod.1		Mod.2		Mod.1		Mod.2	
	Coef.	Pval.	Coef.	Pval.	Coef.	Pval.	Coef.	Pval.
	Whole sample				*Foreigners*			
	Campania							
Digital access (ref: no)	-2.822		-2.845		17.171	***	26.635	***
Foreigners digital (Ref: Ita. digital)	-13.015	***	-13.523	***				
2G digital (Ref: 1.5G digital)	5.035	***	5.535	***	6.033	***	7.238	***
N	42544		42544		1704		1704	
AIC	415168		415500		16744		16775	
BIC	415376		415639		16869		16857	
Socio-demographic[b]	✓		✓		✓		✓	
SES student (specific)[b]	✓				✓			
SES student (composite)[b]			✓				✓	
SES institution (composite)[b]			✓				✓	

Table notes. Notes: a. Contrasts include: (1) Digital Access (with vs. without access); (2) Digital Foreigners (migrant vs. native students with digital access); (3) Digital Migratory Generations (generational differences among digitally connected migrant students). b. The ✓symbol indicates that the corresponding variable is included in the model. A blank cell indicates that the variable is not included. c. Full model in the Table A3.
*Statistical significance: *p < 0.1; **p < 0.05; ***p < 0.01*
Source: INVALSI data.

In addition, the generational gradient within the immigrant population remains clearly visible. Second-generation students with digital access consistently outperform their first-generation counterparts, even when controlling for a comprehensive set of background characteristics. The difference in proficiency between these groups is both statistically significant and substantively meaningful, with positive coefficients in both Models.

Finally, the contrast between digitally connected foreign and native-born students confirms a persistent performance gap. Even when both groups report full digital access, migrant students continue to score significantly lower in Italian in both Models. This suggests that digital access alone is not sufficient to equalise outcomes and that structural and linguistic barriers continue to shape educational trajectories.

5. Conclusions

This study has examined the intersection between digital access and migratory background in shaping educational outcomes among Grade 10 students in Campania, a region marked by both structural disadvantage and high levels of immigration (compared to other Southern regions). Drawing on recent INVALSI data and employing multilevel modelling, the analysis has revealed three core findings.

First, access to digital tools remains highly unequal, with students from immigrant backgrounds, especially those born abroad, disproportionately affected by digital exclusion. These disparities are not merely a function of household deprivation but reflect broader patterns of structural inequality embedded within the regional educational landscape.

Second, digital access plays a critical, independent role in shaping educational performance, particularly among students with a migratory background. While digital access alone does not account for the entirety of the achievement gap between native and immigrant students, it nonetheless serves as a key enabling factor. Among immigrant-origin students, those with access to both a personal computer and home internet consistently outperform their digitally excluded peers, even when socio-economic conditions are held constant.

Third, important generational differences persist within the immigrant population. Second-generation students perform significantly better than their first-generation counterparts, suggesting that familiarity with the Italian school system and cultural context enhances students' ability to capitalise on digital resources. However, despite this intergenerational improvement, second-generation students still lag behind their native peers, underscoring the continued relevance of structural barriers and the need for targeted intervention.

Taken together, these findings indicate that digital access should be understood not only as a technical issue of infrastructure provision but as a critical dimension of educational equity. Policies aiming to reduce educational disparities in contexts such as Campania must therefore go beyond generic investments in connectivity and address the social and structural conditions that prevent marginalised students from fully engaging with educational technologies.

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Alessio BUONOMO, University of Naples Federico II, alessio.buonomo@unina.it
Stefania CAPECCHI, University of Naples Federico II, stefania.capecchi@unina.it
Francesca DI IORIO, University of Naples Federico II, fdiiorio@unina.it
Patrizia GIANNANTONI, INVALSI, patrizia.giannantoni@invalsi.it