COESIONE ITALIA 21-27
GIOVANI, DONNE E LAVORO

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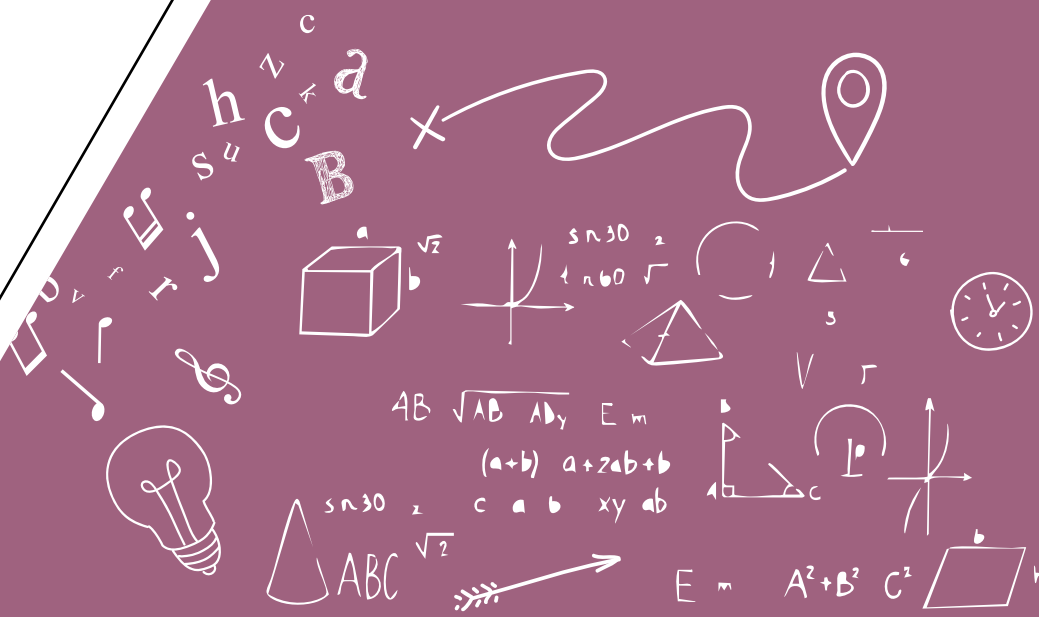
MINISTERO del LAVORO e delle POLITICHE SOCIALI

PIAAC - CYCLE 2

Cognitive Skills in Italy in the International Context

Determinants, Levels and Social and Economic Outcomes



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The aim of this Report is to present the main findings from the second cycle of the Survey of Adult Skills conducted within the framework of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC). The Report – the content and structure of which is modelled on the International Report produced by the OECD – focuses on Italy, and comparison with the other countries and economies involved in the Programme is also provided. It also highlights the geographical differences evident in Italy, presenting disaggregated results including in relation to different territorial areas. In addition to describing the situation in Italy and its geographical areas as regards the cognitive skills of the adult population in the domains of literacy, numeracy and adaptive problem solving, the Report also takes into account the factors that most frequently determine variability in the set of skills possessed by adults, as well as the different outcomes, in professional and social terms, that result from different investments in human capital. A section of the Report is also dedicated to an analysis of changes over time, i.e. comparing the results from the second cycle of the survey with those from the first cycle, again in terms of cognitive skills possessed by the adult population.

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First know, then discuss, and finally deliberate

Luigi Einaudi (1956)

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Introduction

Why and how to assess the cognitive skills of adults

Individuals' capacity to assess the quality of information presented to them and select the most relevant aspects – across a broad spectrum of situations and in the broadest sense of the term "information" – seems increasingly important not only for the well-being of those individuals, but also and above all for the functioning of societies and democracies. Without such skills, adults are unable to form accurate and truthful opinions on the complex issues and challenges facing society today, a situation that negatively affects the individuals, but also the community as a whole.

In order to be able to evaluate information, however, an individual must have the ability to access, understand, process and select such information. The possession of (general and fundamental) skills determines how individuals select from among the information available, process it and make judgements and decisions based on it. Indeed, such skills affect both the information channels and content one chooses to access and one's relative ability to understand and act upon the selected information.

High proficiency levels yield personal and collective benefits, producing competitive advantages for both the individual and the wider society in which they live.

From an individual perspective, a high level of skills does not only imply advantages in the world of work and career development – high skills are associated with a greater likelihood of being employed, a lower likelihood of being out of the labour force, higher earnings and better working conditions – but also, and more generally, facilitates a better quality of life in terms of social condition. High levels of skills enable people to make more informed choices based on objective data that are less prone to systematic errors, for example with regard to lifestyle, health care, consumption and saving behaviours, and engagement in political and social life.

The accumulation of skills also has notable positive effects for the community, as it is fundamental for economic growth, increased employment, social cohesion and the competitiveness of countries.

The possession and use of skills to navigate the information landscape is a clear example of how the social benefits of skills stretch far beyond individual benefits. Higher skills are beneficial to the individual, but if we consider the role of public opinion in shaping electoral outcomes and policy decisions, a widespread lack of fundamental skills among large segments of the population can have negative implications for the society as a whole, which also impact individuals with high proficiency levels (OECD 2024a). As such, skills occupy a crucial position in the context of a growth strategy that is both equitable and sustainable.

Accordingly, when engaging in analytical activities for the purposes of identifying public policy interventions and developing educational, training and labour policies, institutions, policy-makers and the scientific community must not fail to consider the significant role of skills in the various key aspects of people's lives.

In light of the above, it seems necessary to apply adequate and rigorous methods and tools to determine, on the one hand, what skills the population actually possesses, and what processes enable their acquisition and development and, on the other, what role skills play in generating economic, social and personal outcomes.

But what are the key skills required by the adult population to cope adequately with everyday life and participate successfully in today's economy and society? What are the primary factors and conditions that influence the development of skills? To what extent do skills influence the choices and condition the life paths of the adult population?

The Survey of Adult Skills was developed to answer these and other questions regarding the conceptualisation, definition, measurement and analysis of skills, as well as the factors that influence them and the most frequent effects of lower levels of skills.

The Survey of Adult Skills is a fundamental part of the OECD Programme for the International Assessment of Adult Competencies *(*PIAAC)[1], which involves many countries around the world, including Italy. It is a statistical sample survey of the population aged 16-65[2]. To ensure international comparability and high quality of the collected data, the survey follows strict technical standards and guidelines, as well as complex survey operational procedures and sampling methods developed at the international level.

The main purpose of the survey is to provide access to a solid, up-to-date and internationally comparable

[1] For the sake of brevity, the survey may also be referred to below as the "PIAAC Survey" or simply "PIAAC".
[2] Interviews were conducted by trained and experienced interviewers at the respondents' homes, using computer-assisted tools (tablets).

information base, with information on the quantity and dynamics of skills, the link between skills, education and labour market, and the role of skills in improving the employment prospects and quality of life of the adult population.
In 2023, the second cycle of the PIAAC Survey was conducted, following the first cycle that was carried out in Italy in 2012[3]. See OECD (2013), OECD (2016a), OECD (2019), ISFOL (2013) and ISFOL (2014) for a comprehensive overview of the first cycle of the survey.
The second cycle involved interviewing approximately 160,000 adults aged 16-65 across 31 countries and economies, representing around 673 million adults. The countries and economies that took part in the 2023 survey are: Austria, Canada, Chile, Croatia, Czechia, Denmark, England (UK), Estonia, Finland, the Flemish Region (BE), France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Singapore, Spain, Sweden, Switzerland, the United States
Due to the complexity and rigour required by the project, the planning and implementation phase of the second cycle of the survey took several years. Activities began in 2018. The Field Trial (i.e. the pilot survey) was due to begin in April 2020, but was postponed by twelve months due to the Covid-19 pandemic, and was therefore carried out in 2021. The fieldwork phase of the main survey began in September 2022 and ended in spring 2023. From that moment, all data verification and harmonisation activities began and were completed in August 2024.
In Italy, the survey was carried out by INAPP on behalf of the Ministry of Labour. The financial contribution of the European Commission was also instrumental in carrying out the survey.

Characteristics of the PIAAC Survey, Cycle 2

Data are collected through a questionnaire (Background Questionnaire - BQ) administered by a trained and experienced interviewer, and self-administered cognitive assessments in the skill domains of literacy (reading and comprehension of written texts), numeracy (understanding and using mathematical and numerical information) and adaptive problem solving (the capacity to achieve one's goals in a dynamic situation in which the solution is not immediately available).
The Background Questionnaire collects information on respondents' socio-demographic characteristics, educational background and experience in the world of work. Detailed questions are asked to gain information about adults' opportunities to develop and use their skills at work and in everyday life. More generally, the BQ is intended to collect data that make it possible to examine those factors that, in combination, contribute to the formation of human capital such as schooling, family background, social environment, attitudes, emotional character traits[4], vocational training and work experience. More detailed information on the structure and content of the BQ is available in Appendix 2 of this Report.
Upon completion of the BQ, respondents carry out a direct assessment of the cognitive skills of literacy, numeracy and Adaptive Problem Solving (APS), regarded as "key information-processing skills"[5] and defined as fundamental for accessing, understanding, analysing and using information based on texts and, in the case of mathematical information, in all forms of representation (e.g. images, graphs).
As noted, this evaluation is carried out through self-administered assessments in the three skill domains that focus on the respondents' ability to use information processing strategies to solve problems they encounter in everyday life. The completion of these assessments does not require specialised content-related knowledge and, in this sense, the skills assessed in the PIAAC Survey, which apply to a wide range of situations and contexts, can be considered "fundamental" or "general". They should not, however, be regarded as "basic" skills that are less complex than others or as "higher-level" or "specialist" skills. The assessment process underpinning PIAAC has not been designed to identify a "minimum" level of skills that adults should possess in order to fully participate in society.
Common across all three skill domains is the need for the PIAAC skills assessment to reflect the changing

[3] The PIAAC survey has been designed as a study with repeated cycles, every ten years. At the international level, the first cycle of the PIAAC survey was conducted in three separate rounds, between 2011 and 2018, in 39 countries. Approximately 245,000 adults, representing approximately 1.15 billion people aged 16-65, were interviewed in the first cycle. Italy participated in the first round.
[4] The questionnaire administered in 2023 contains a section on self-assessment of social and emotional skills grounded in the Big Five Inventory-2 (BFI-2) taxonomy, which covers five domains: extraversion, agreeableness, conscientiousness, emotional stability and openness to experience (Costa and McCrae 1995; Soto and John 2017).
[5] These are regarded as key skills insofar as they: are necessary for full integration and participation in education and training, the labour market and social and civic life; are relevant to all adults; are highly transferable; can be learned and, therefore, evolve over time (for an in-depth study of the concept of key skills, see ISFOL and Di Francesco (2013)).

nature of information in today's societies, resulting from the prevalence of complex, data-intensive digital environments. As such, many assessments are set in this type of context.
As one of the main objectives of the PIAAC Survey is to understand how the adult population is distributed across a wide range of skills in each of the domains assessed, the assessments are designed to capture different proficiency levels and have varying levels of difficulty. In the case of literacy and numeracy, in order to maximise the efficiency and accuracy of the assessment, an adaptive assessment design is used, whereby respondents are presented with assessments that are challenging for their proficiency level, but are neither too easy nor too difficult.
Each skill domain is based on a conceptual framework (the full reference frameworks are available in OECD 2021), which define the latent skills the overall assessment aims to measure, and describe how assessment items should be designed to measure such skills[6].
As regards the process of constructing the assessments and developing the items to be administered to respondents, key dimensions, characteristic of the assessment, are identified, which focus on:

- Content: the various representations of information, or types of material and tools, that adults use to complete the assessments;
- Cognitive processes: the information-processing strategies required to use specific materials and successfully complete the assessments;
- Contexts: the social and situational contexts in which the assessments are set.

Definition of the conceptual frameworks, development and selection of the single assessment (and single items in each assessment), and interpretation of the results obtained were performed with the support of international groups of experts with specific skills (OECD 2024b).
The diagram below summarises the main information in each cognitive domain.

[6] The conceptual frameworks adopted in the second cycle of the PIAAC for literacy and numeracy are based on those developed for the first cycle, but have been revised and extended to ensure relevance to contemporary reality and understanding of the phenomena measured (Rouet *et al.* 2021; Tout *et al.* 2021 and 2017). The innovations introduced do not, in any case, affect the possibility of comparing the results of the two survey cycles: the links with the first cycle of the survey remain strong, both at the conceptual and at the practical level, as the second cycle relies on many assessment items already used in the first cycle. These common items allow strong psychometric links to be established across the two assessments. More detailed information is also available in Appendix 1 of this Report.

Diagram I.1 **Summary of the characteristics of each skill domain, Survey of Adult Skills (PIAAC), Cycle 2**

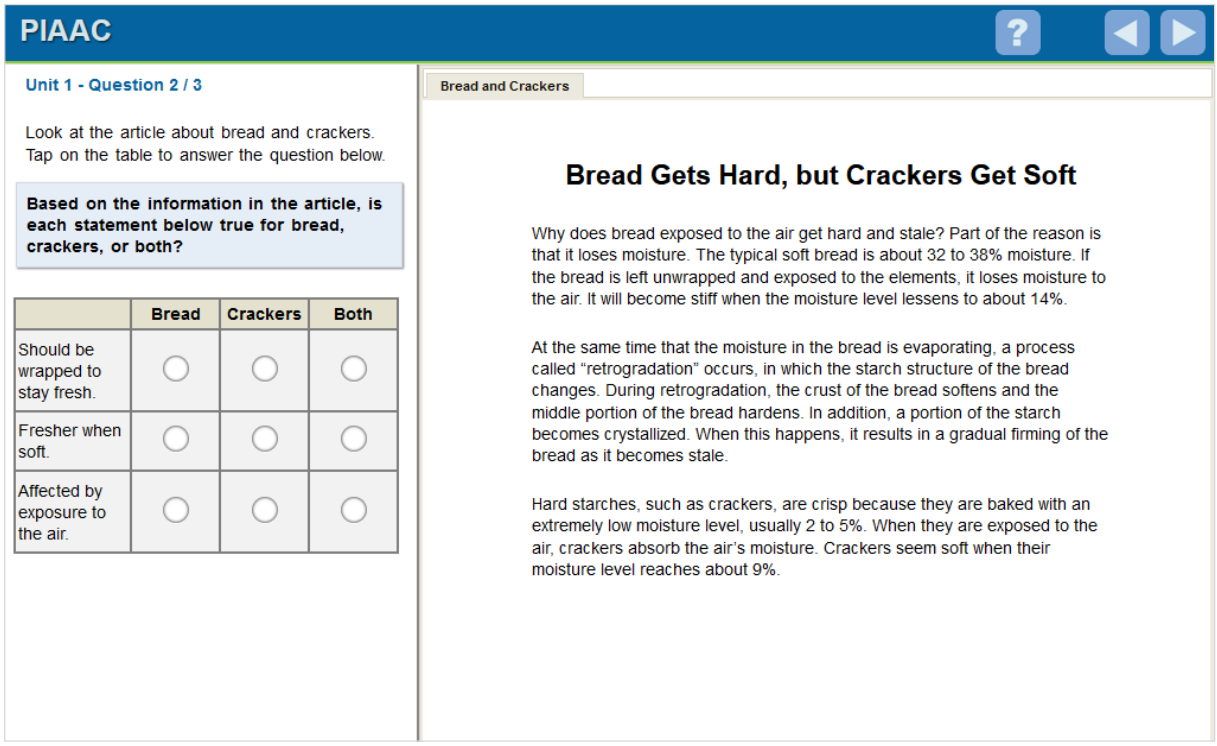
	Literacy	Numeracy	Adaptive Problem Solving (APS)
Definition	Literacy means the ability to access, understand, evaluate and reflect on written texts in order to achieve one's goals, develop one's knowledge and potential, and participate in society.	Numeracy means the ability to access, use and reason critically with mathematical content, information and ideas represented in multiple ways in order to engage in and manage the mathematical demands of a range of situations in adult life.	Adaptive problem solving involves the ability to achieve one's goals in a dynamic situation, in which a method for solution is not immediately available. It requires engaging in cognitive and metacognitive processes to define the problem, search for information and apply a solution in a variety of information environments and contexts.
Content	Content within the literacy domain includes both static and interactive texts. These texts are characterised by their source (single or multiple) and their format: • Continuous texts, in which information is presented in sentences and paragraphs; • Non-continuous texts, such as graphs and tables; • Mixed texts. Additionally, the texts relate to a range of genres (e.g. narration, description and argumentation). They may be structured using a variety of layout features, content representations, and digital tools such as scrollbars and hyperlinks.	Content related to calculation activities includes a variety of information representations: • Texts or symbols; • Images of physical objects; • Structured information (e.g. tables, graphs and diagrams); • Dynamic applications. In addition, reference is made to four key areas of mathematical content, including quantities and numbers, space and shape, change and relationships, and data and probability.	Aspects of the environment in which adaptive problem-solving tasks are embedded include: • Problem configuration: the elements presented in the problem and the available resources or operators; • Dynamics of the situation: change (or absence of change) in the problem situation and constraints; • Features of the environment: the available information and resources. In addition, APS activities include three types of information sources: • Physical resources, which are at hand and can be used; • Social resources, including interpersonal and social interactions; • Digital resources, including digital devices or functionalities.
Cognitive processes	• Accessing • Understanding • Evaluating and reflecting	• Accessing and assessing situations mathematically • Acting on and using mathematics • Evaluating, critically reflecting and making judgements	APS involves both cognitive and metacognitive processes. These processes may be required within each of the three problem-solving phases: • Defining the problem; • Searching for information relevant to the solution of the problem; • Applying a solution.
Contexts	• Work • Personal • Community • Education and training	• Work • Personal • Social and Community	• Work • Personal • Social and community

Some example of assessments from the PIAAC Survey, Cycle 2

For the purposes of enabling a full understanding of what is meant by assessment and how the assessment is carried out, an example item is presented below for each skill domain.
Literacy is a crucial skill for adults in their personal, social and professional lives, given the prevalence of written communication in various aspects of life. Throughout the day, adults engage in reading activities of different kinds, ranging from in-depth reading of long texts to quickly scanning pages in search of relevant information. Such activities include reading e-mails, brochures, timetables and instruction manuals among others.
An example of literacy item is presented in Figure I.1. In this item the respondent, having read the text on the right (stimulus section), must deduce information to determine whether the statements shown in the table on the left (question section) are true for bread, for crackers or for both. The reader is asked to select an answer for each of the statements presented. Only one answer can be selected per line.
The item focuses on the following aspects of the literacy construct.

- Cognitive process: Understanding
- Text source: Single
- Text format: Continuous
- Text display: Static
- Context: Personal

Figure I.1 **Example of a literacy item: "Bread and crackers"**

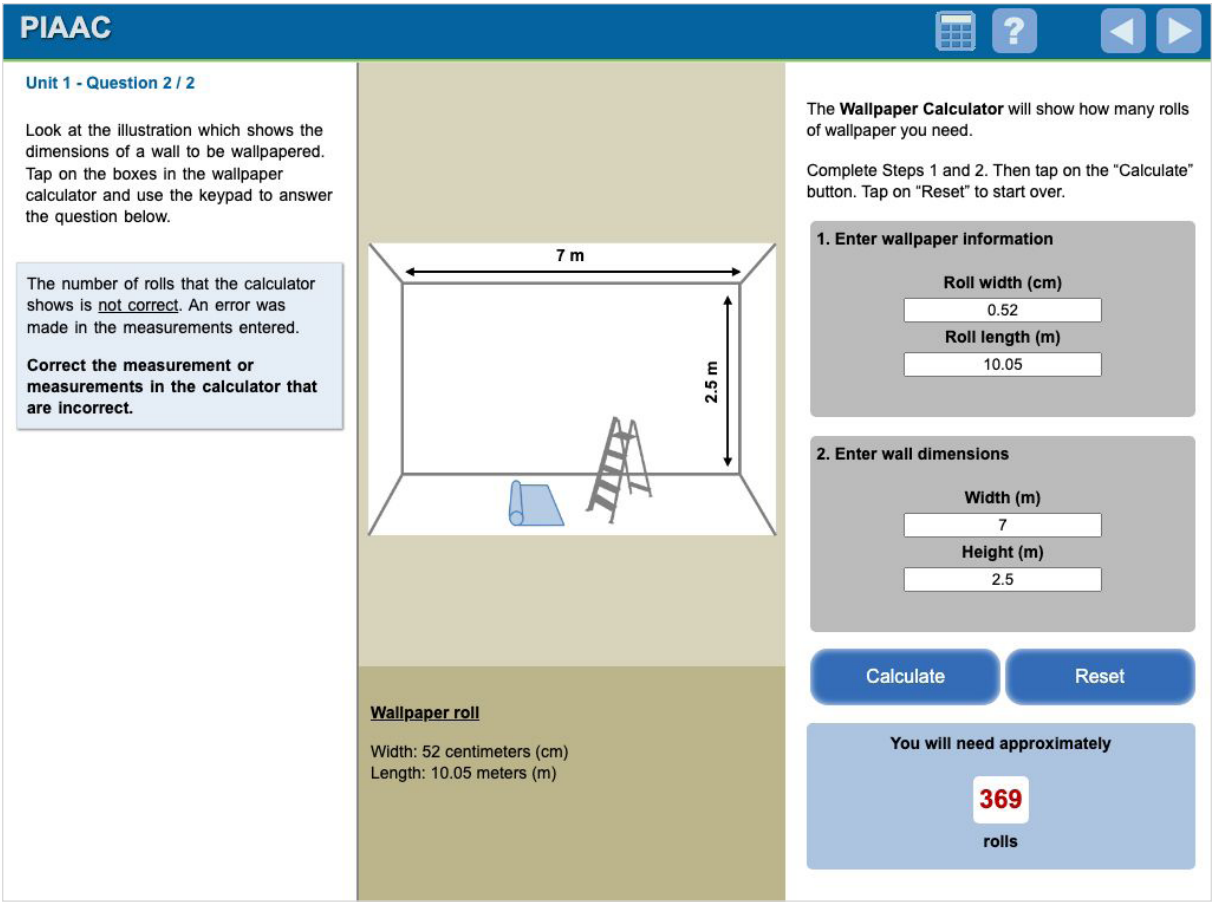


In today's society, individuals are presented with ever increasing volumes of information of a quantitative or mathematical nature – partly due to the evolution of the Internet and technology – and more frequently find themselves interpreting, questioning and analysing such information to determine its relevance.
Figure I.2 presents an example of a numeracy item based on an interactive calculation tool. In this item, the wallpaper calculator has already been used to determine the number of rolls needed. However, an error was made entering one or more values into the calculation tool. The task is to identify the error(s) and enter the correct values.
The item focuses on the following aspects of the numeracy construct.

- Cognitive process: Evaluating, critically reflecting and making judgements
- Content: Space and shapes

- Representation: Dynamic applications
- Context: Personal

Figure I.2 **Example of a numeracy item: "Wallpaper"**

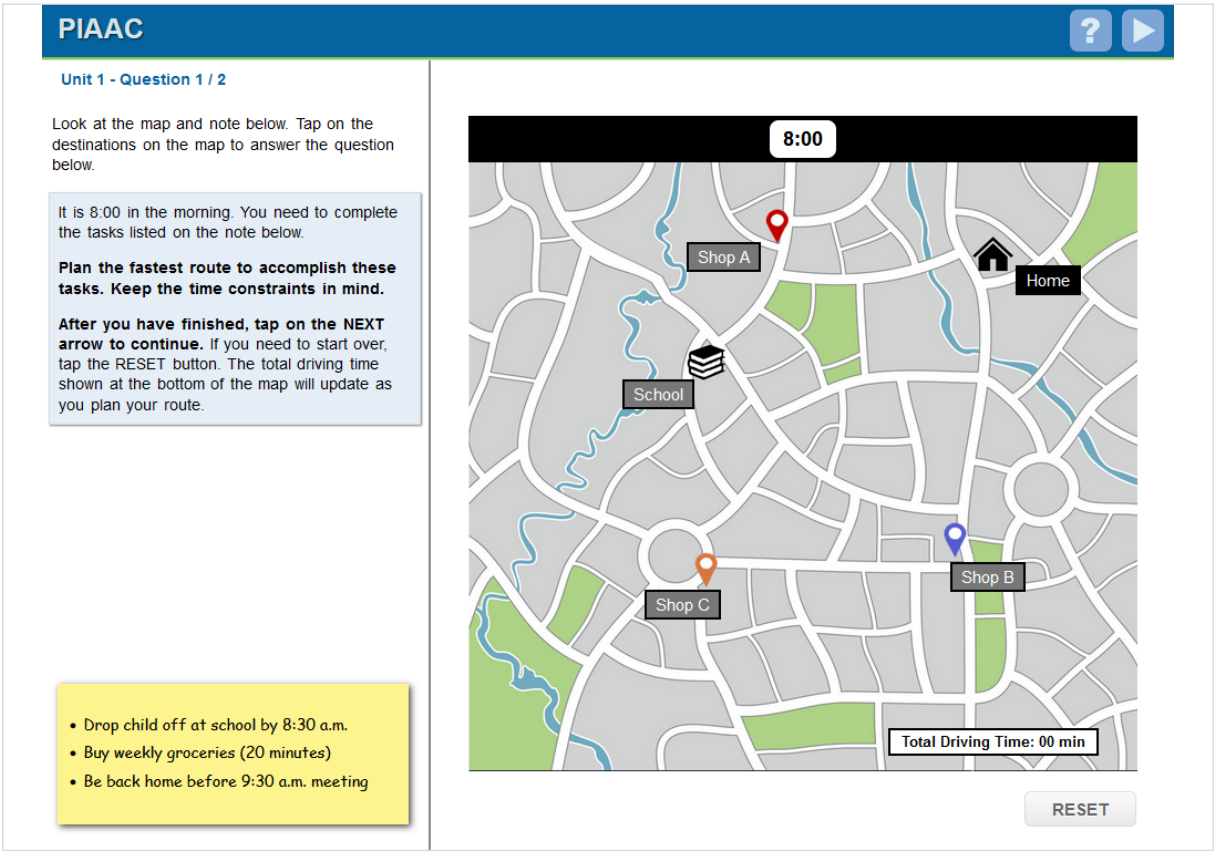


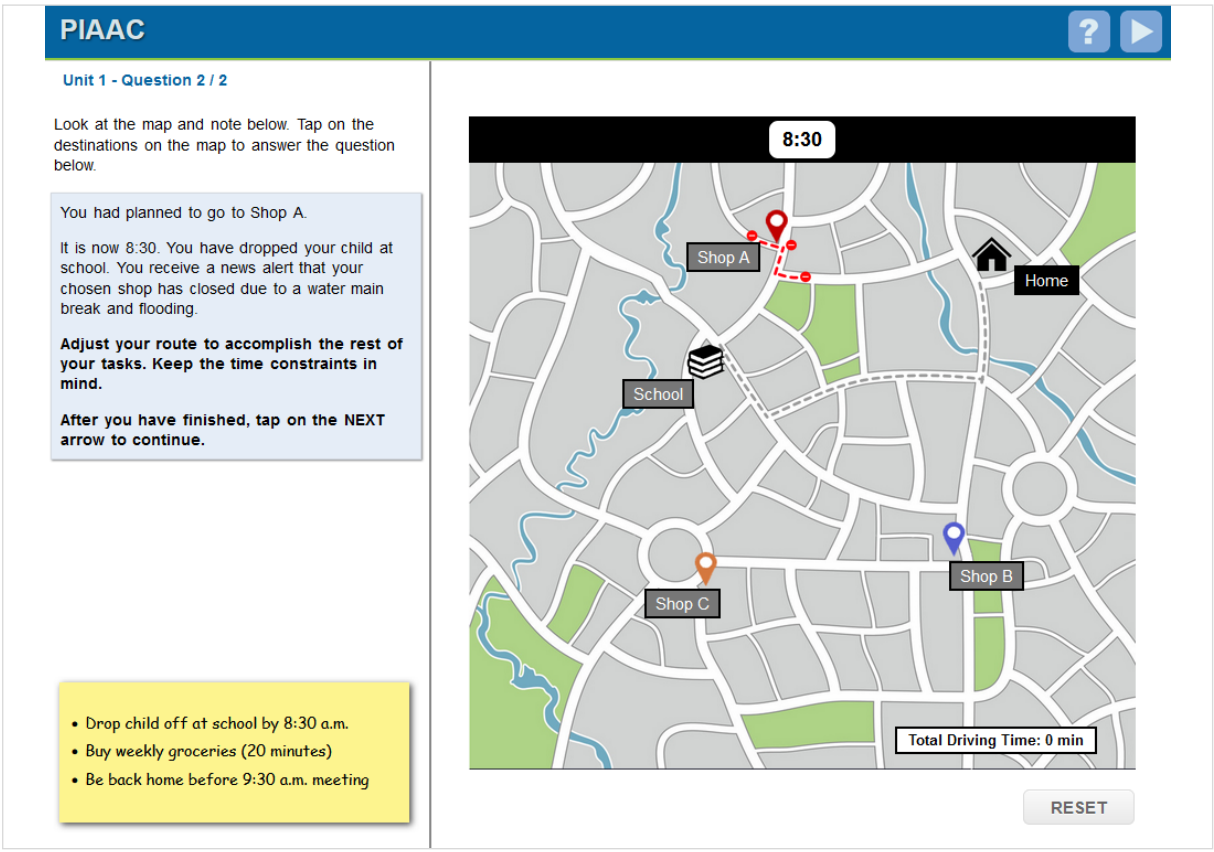
Adaptive Problem Solving is a new domain developed for the Survey of Adult Skills 2023 and presents three important key characteristics:

- individuals' capacity to flexibly and dynamically adapt their problem-solving strategies to a dynamically changing environment;
- individuals' capacity to identify and select information from among a range of available physical, social and digital resources;
- individuals' capacity to monitor and reflect on their own progress in solving problems through metacognitive processes (i.e. the ability to calibrate one's comprehension of the problem, evaluate potential solutions and monitor progress towards the goals).

An example of an adaptive problem solving item is presented in Figure I.3. Respondents must use an interactive map to achieve predefined goals. The initially static situation becomes dynamic due to obstacles that change the presented problem and the available solutions. In the first item, the respondent needs to use an interactive map to find the fastest route to accomplish three goals, keeping a set of time constraints in mind. Specifically, the respondent must: take a child to school by a designated time, purchase groceries and return home by a designated time. The total driving time (shown at the bottom right of the screen) updates as the route is selected by the respondent. This could be considered a standard problem-solving task, in which a solution needs to be found given some constraints that need to be satisfied. In the second item, the situation becomes dynamic as the respondent must deal with new circumstances that interfere with the solution initially identified. In order to achieve the goal, obstacles must be overcome and additional constraints need to be taken into consideration, adapting the solution initially identified.

Figure I.3 **Example of an adaptive problem solving item: "Best route"**





The proficiency scale

As noted, each respondent is administered a series of assessments that can only be answered if they have a sufficient level of literacy, numeracy and APS skills.

Essentially, the underlying design of the PIAAC, as regards direct assessment of skills, involves each respondent being given a subset of assessments from among all those available. In other words, as it would not be feasible to administer all assessment items to each adult respondent, respondents are only given, for each skill domain, a subset of the assessment items and each individual is assigned values, referred to as plausible values (PV), on a scale of 0 to 500 points, which represent an estimate of the skill possessed. The scores assigned to each individual are obtained through application of statistical models based on Item Response Theory[7] (Rutkowski *et al.* 2014; Van der Linden and Hambleton 2016). See Appendix 1 of this Report for more details on this topic.

Although literacy, numeracy and APS skills are all presented on proficiency scales ranging from 0 to 500, skills in the various domains must be considered distinct and cannot be compared directly[8].

The proficiency scale ranging from 0 to 500 points is also used to rank assessment items according to difficulty.

Indeed the scales in the various domains can be described in relation to their component items, which - besides being characterised by cognitive process, context and format, as illustrated above - are also defined by level of difficulty, identified by a score. Specifically, the PIAAC Survey places assessments and individuals on proficiency scales using a response probability (RP) value of 0.67. At each point on the scale, an individual with a given level of proficiency has a 67% chance of successfully completing the assessments at that level. Adults with a given level of proficiency will have a lower probability of being able to successfully complete more difficult assessments (those with higher values on the scale). Similarly, they will have a higher probability of successfully completing easier assessments.

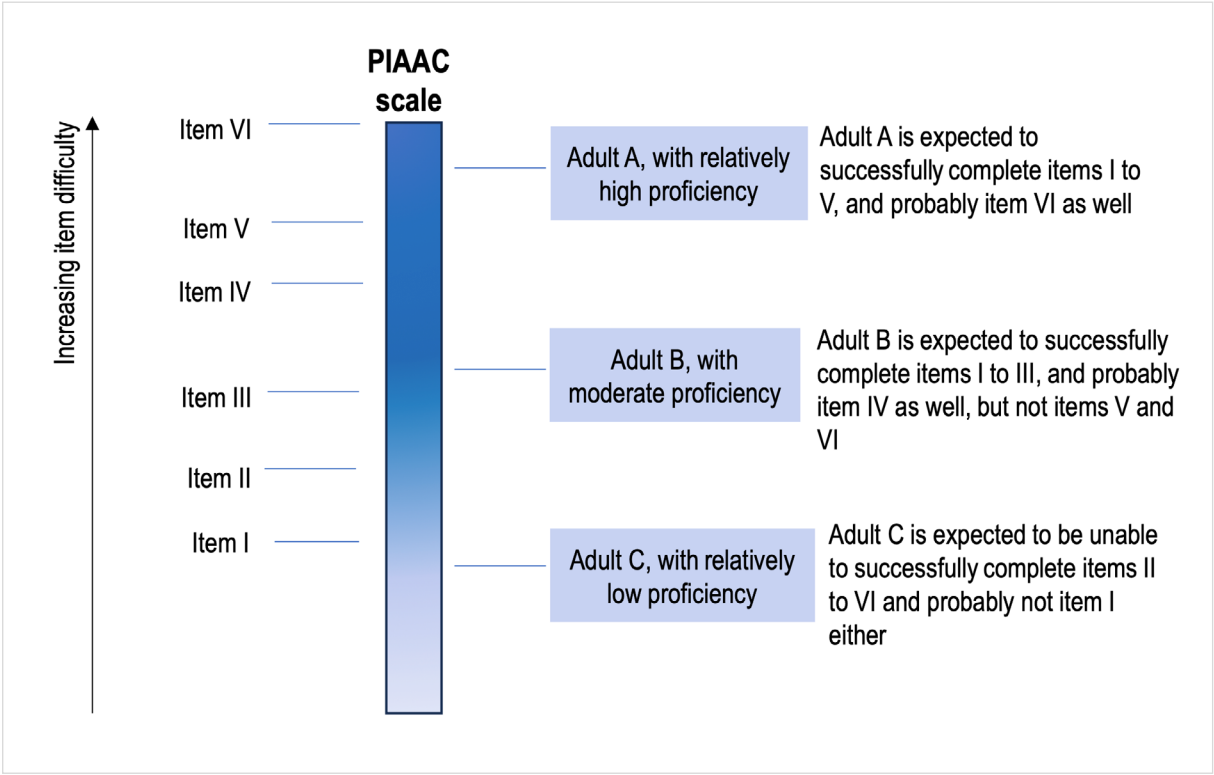
The relationship between adults' skills and task difficulty is illustrated in Figure I.4. For example, adult C, with low proficiency, is unlikely to be able to complete items II to IV and is also unlikely to be able to complete item I. Adult A, with high proficiency, is likely to successfully complete items I to V, and also item VI.

Moreover, in the case of literacy and numeracy, scores from 0 to 500 are attributable to 6 different proficiency levels (below Level 1, Level 1, Level 2, Level 3, Level 4 and Level 5). Meanwhile, in the case of adaptive problem solving, 5 levels are established (below Level 1, Level 1, Level 2, Level 3, Level 4). See Appendix 1 of this Report for a detailed definition of the levels and characteristics of each level.

[7] Although each respondent only performed some of the potential assessments, thanks to the application of the Item Response Theory – which in the case of PIAAC adopts a population model in which predictors include, in addition to the results of the assessments, the respondent's characteristics derived from the BQ – a set of standardised scores (plausible values - PV) is generated for each respondent and for each skill domain, which can correct the statistical error associated with the skills measurement and the different survey contexts. In the PIAAC Survey, each respondent has 10 PVs (PV1-PV10) which enable calculation of the adults' performance irrespective of the specific assessments they were administered. Each PV is thus an estimate of the performance that would be achieved by an adult had they performed the assessment by completing all the direct assessments. When processing the PIAAC data, all ten PVs must therefore be used in order to generate accurate proficiency estimates.

[8] For example, if the average proficiency level of a population group is higher in literacy than in numeracy, it cannot be concluded that this group performs better in literacy than in numeracy. However, although population subgroups are comparable to a reference group within each domain, relative comparisons between domains may also be valid. For example, it can be said that an individual is relatively better at literacy than numeracy if their rank in the ordered literacy distribution is higher than their rank in the ordered numeracy distribution.

Figure I.4 **Relationship between item difficulty and adult proficiency on the literacy, numeracy and adaptive problem solving scales**



Objective of the Report "Cognitive Skills in Italy in the International Context. Determinants, Levels and Social and Economic Outcomes"

This Report provides an overview of the main findings from the second cycle of the PIAAC Survey (The Survey of Adult Skills) and aims to present the elements required to understand the situation in Italy from a comparative perspective, as regards possession of cognitive skills in literacy, numeracy and adaptive problem solving among the adult population. The Report highlights the territorial differences observed in Italy, consistently presenting disaggregated results also with respect to the different geographical areas (North-East, North-West, Centre, South and Islands). Throughout the Report, the analyses compare the Italian results with those of other countries and economies participating in PIAAC and with the average OECD results.

It is important to emphasise that what is presented here is not exhaustive of the entire body of information gathered through the survey. Much of the information is still to be processed and analysed and we reserve the right to do so in subsequent in-depth publications.

The structure and content of this first Report draw heavily on and are consistent with those presented in the International Report by the OECD *Do adults have the skills they need to thrive in a changing world? Survey of Adult Skills 2023* (OECD 2024a). However, unlike the International Report whose analytical aim is to compare the different situations of the countries and economies participating in the PIAAC, the focus of this Report is on Italy and its geographical areas. The adoption of a report structure in line with that used in the OECD Report to present the initial findings on Italy is intended to facilitate the interpretation of issues that are particularly complex, especially when considered in comparative terms.

As in the International Report, in addition to quantifying adults' cognitive skills in the domains of literacy, numeracy and adaptive problem solving, the following pages also describe the different socio-demographic characteristics of the population that most frequently determine variability in the set of skills possessed by adults, as well as the different outcomes, in professional and social terms, that result from different investments in human capital. A section of the Report is also devoted to analysing the evolution of skills over time, i.e. comparing the results achieved in the second cycle of the Survey with those from the first cycle.

The results presented in the Report, as regards both the situation in 2023 and changes over the past decade, represent an important cognitive starting point, useful for verifying the effectiveness of action taken in recent years to raise the proficiency levels of the adult population and for developing new policies aimed at improving the country's situation as regards the knowledge and skill base of the adult population. Given the complexity involved in identifying the multiple factors affecting the acquisition and development of skills, however, as well as the role of skills in the evolution of various aspects of individuals' lives and in generating economic and social results, it has been decided that this Report will focus only on interpretative elements strictly related to the data and information collected. In-depth studies focused on policy advice, which also require multidisciplinary interpretative approaches, will be presented in subsequent INAPP publications.
Essentially, this Volume is just the first step in the process of disseminating the results of the PIAAC Adult Skills Survey, Cycle 2. It will be followed by further in-depth and thematic publications, as well as dissemination events aimed at enabling the broadest possible engagement by those who, with different roles and tasks, care about the topic of skills development and the evolution of Italy.

Structure and Content of the Report

The first chapter of the Report gives an overview of the results achieved in 2023 in relation to the three skill domains. Taking the average proficiency scores of adults residing in Italy as a starting point, therefore, it sets out Italy's position and that of its geographical areas in relation to the other countries and economies participating in the PIAAC. It then analyses the distribution of the adult population in terms of proficiency levels, in order to verify the percentages of the population scoring at low and high levels. Finally, the chapter takes account of the variation in average proficiency scores in relation to the main socio-demographic characteristics (i.e. education level, gender, age, family and migration background) of the adult population.
The second chapter contains analyses presenting changes over time, i.e. changes in skills between the first and second PIAAC cycles. Again, after outlining the differences in the average literacy and numeracy proficiency scores for the adult population as a whole between the first and second PIAAC cycles, it analyses the differences over time in relation to the main socio-demographic characteristics of adults.
The third chapter, meanwhile, is devoted to analysing the interaction between skills, education, the world of work and social outcomes. The first section of the chapter discusses the relationship between proficiency scores (identifying the three domains separately in all analyses), education level and employment status, as well as the potential association between proficiency levels and earnings. The second section of the chapter explores the topic of *mismatch*, understood to refer both to *qualification mismatch* and *skills mismatch*. The final section of the chapter outlines potential associations between skills and social outcomes (measured in terms of life satisfaction, self-reported health, political participation and efficacy, and trust in others).
Finally, the Report includes an extensive appendix with detailed information on the definitions adopted to measure skills, the components of the Survey and the methodological aspects of sampling.
This Introduction is followed by a Reader's Guide, summarising the key elements that enable a clear interpretation of the data and describing some technical aspects that should be borne in mind when reading the results set out in the three chapters of the Report.

Reader's Guide

This Report contains the initial results of the second cycle of the Survey of Adult Skills for Italy and its geographical areas, presented in comparative terms in relation to the countries and economies participating in the OECD-PIAAC Programme.
In order to facilitate the understanding of particularly complex topics, especially when considered in comparative terms, the section below sets out a number of guiding elements, concerning both the data collection period and the quality of the data as well as their overall interpretation, but also as regards specific aspects pertaining mainly to the study of differences between population subgroups and the analysis of changes over time.

The effects of the Covid-19 pandemic on the PIAAC Survey, Cycle 2

The data collection phase of the second cycle of the PIAAC Survey took place between September 2022 and July 2023. Initially, the data collection period had been scheduled for 2021 and 2022, ten years after the first survey cycle, but due to the Covid-19 pandemic, all activities were postponed by one year.
The pandemic has had a significant, though difficult to quantify, impact on people's and society's attitudes and behaviours. Indeed, it has been shown to have accelerated a long-standing trend of changing attitudes towards participation in direct surveys (OECD 2024a). This is reflected in a drop in response rates, also evident for the PIAAC Survey, Cycle 2, affecting most countries participating in the survey, including Italy.
Nevertheless – thanks in part to the considerable efforts by national teams to maximise response rates and minimise the effects of non-response – the international group of independent experts (Technical Advisory Group - TAG), tasked by the OECD with assessing overall data quality and adherence to technical standards for administration of the survey concluded that all countries participating in the second cycle of the survey satisfactorily adhered to the PIAAC standards, and that the data from all countries were of a sufficiently high quality to be disseminated, processed and analysed.

PIAAC Survey, Cycle 2 response rates

Response rates from participating countries for the first cycle of the Adult Skills Survey, carried out between 2011 and 2012, ranged from 45% to 75%. Response rates were much lower for the second cycle of the survey, ranging from 27% to 73%. Korea was the only country where the response rate exceeded 70%.
The drop in response rates between the two cycles of PIAAC affected many countries and economies, confirming a trend - already evident for several years - of decreasing willingness among the population to participate in surveys, whether conducted in-person or by telephone.
Italy's response rate was 29%. In other words, 29% of potential survey participants who were deemed actually responded the questions in the BQ.
Despite a relatively low response rate, the Italian data were considered valid, including by the Technical Advisory Group (TAG), on the basis of a positive assessment of additional parameters used to measure the quality of the collected data. See Appendix 3 of this Report for more details on this aspect.

The OECD average calculation

The OECD average, calculated for most of the indicators presented in this Report, corresponds to the arithmetic mean of the respective estimates for all OECD countries and economies for which data are available.

Comparing data from the first and second cycle of PIAAC

The literacy and numeracy scores from the Adult Skills Survey 2023 are psychometrically linked (and therefore comparable) with the results from previous adult skills surveys, and in particular the first cycle of the PIAAC Survey.
As such, the results of the two survey cycles can be compared in order to analyse changes in skills, also given the substantial invariance in the overall methodological framework and data collection methods.
However, given that the surveys were conducted years apart and therefore in different contexts and under different conditions, some caution must be exercised in comparative analyses over time.
Despite the substantial invariance in the overall methodological framework as mentioned above, a number of methodological changes were introduced between the first and second cycles of PIAAC, which are briefly outlined below. Further information on the comparability of data between adult skills surveys is available in the Reader's Companion to the second cycle of the PIAAC Survey (OECD 2024b).

Doorstep Interview
The Adult Skills Survey assesses literacy, numeracy and adaptive problem solving skills in the official language(s) of the country. Some adults, however, do not have a sufficient command of the language used to complete the BQ and the assessments. These adults are referred to as "literacy-related non-respondents" (LRNR).
In the first cycle of the Adult Skills Survey, the proficiency levels of these adults were not estimated. As a result, the average results for a country did not, in fact, cover the entire adult population. This potential non-response by LRNRs could, in fact, introduce bias as it is concentrated among individuals with low literacy proficiency in the survey language (presumably migrants or persons with low basic skills). In the first cycle, the share of LRNRs amounted to less than 2% in most countries (0.7% in Italy), though in some countries it even exceeded 4% (OECD 2019). To reduce the bias arising from such literacy-related non-response, Cycle 2 introduced a new instrument in the form of the Doorstep Interview (DI), i.e. a short interview that serves as an alternative to the BQ.
The DI is a short self-administered questionnaire offered in multiple languages (the official languages of all 31 countries participating in PIAAC, as well as the languages of the main linguistic minorities in each country), designed to collect key information on personal characteristics, such as gender, age, educational attainment, employment status, country of birth and length of residence in the country where the survey is conducted.
In Italy, only a very small number of individuals received a Doorstep Interview: 32 individuals[9].
Introduction of the DI minimises the share of LRNR, as the information collected makes it possible to estimate the proficiency of this particular category of respondents using advanced statistical methods; as such, the estimate of distribution of skills across the overall adult population is more accurate. Nevertheless, as the Doorstep Interview collects limited information, individuals who only responded to this short questionnaire cannot always be considered in the analysis due to the absence of some background information. Furthermore, while it clearly represents an improvement with respect to the first cycle of the survey, the population sampled is not fully comparable with that of Cycle 1: adults who completed the Doorstep Interview would have been treated as literacy-related non-respondents in Cycle 1. Therefore, in this Report, DI results are not always included in the statistics. Specifically, DIs are included only in the analyses in Chapter 1, and excluded from the second chapter on comparisons over time and the third on labour-market and non-labour-market outcomes. In each case, whether or not DIs have been included is expressly stated in the notes below each figure or table concerning the presentation of data.

Reading and numeracy components
In both cycles of the PIAAC Survey, adults who failed the Locator[10] assessments were considered to have too low proficiency to take the assessments (Direct Assessment). However, in order to gather some information on the skills of these adults, simpler assessments (components) are administered to them to detect basic skills. In the first cycle of the PIAAC, only the reading components were administered; an assessment of the numeracy component was also added for the Adult Skills Survey 2023.

[9] For more information on how this particular type of interview was used in the estimation process, see Appendix 3 of this Report.
[10] In the Skills Assessment part of the Survey, the Locator is the section in which eight Literacy and Numeracy assessments are randomly administered to the respondent in order to determine the type of assessment that should be subsequently administered. For more information, see Appendix 1 of this Report where the contents of the reading and numeracy components are defined, and Appendix 2 of this Report where the survey flow is described.

Unlike in the first cycle, the reading and numeracy components were used in the model adopted to estimate the overall skills of the respondents in the 2023 survey. This decision increased the precision of proficiency estimates for those at the lower end of the skills distribution.
This methodological change has a negligible impact on the estimation of average proficiency for the entire adult population. However, it has a more significant impact on the proficiency estimates of adults who failed the Locator and who only took the component assessments. As such, analyses of changes over time in population subgroups with significant shares of people with low proficiency levels must be carried out with great caution.

Statistical significance in differences or changes

In this Report, where results are presented that relate to differences, i.e. changes over time, differences between countries or Italian macro-areas, differences between population subgroups (e.g. men and women, those born in Italy and those born abroad, people with tertiary qualifications and those with less than secondary school qualifications, etc.), only statistically significant differences or changes are discussed, with the significance level set at 5%. Statistically significant estimates are represented in the figures and tables in darker colours and bold.

Linking error
When analysing changes in proficiency between the first and second cycles of the PIAAC Survey, a "linking error" must be accounted for. The linking error measures the uncertainty regarding equality of scale values: is a score of 235 in the second cycle of the survey equal to a score of 235 in the first cycle of the survey? This uncertainty stems from the fact that the conceptual frameworks and assessment items used in the two cycles are not identical.
By its nature, the linking error is independent of sample size and is the same for all countries participating in PIAAC. The OECD estimated a linking error of 3.27 for literacy and 2.95 for numeracy.
The linking error must be taken into account and added to the standard error (SE) of the difference when calculating a change over time, i.e. between the two survey cycles.
More formally, when calculating a difference in average scores in a given skill domain for the country (or subgroup) g, the standard error of the difference in proficiency between the first and second survey cycles is:

$$\mathrm{SE}(\Delta_{(g2-g1)}) = \sqrt{\mathrm{SE}_{g2}^2 + \mathrm{SE}_{g1}^2 + le_{1,2}^2};$$

where SE_{g1} is the standard error of the proficiency of country (group) g in the first cycle, SE_{g2} is the standard error of the proficiency of country (group) g in the second cycle and $le_{1,2}$ is the linking error between the two cycles.
When calculating the difference in the population shares by proficiency levels within a given skill domain for the country (or subgroup) g, on the other hand, the standard error of the difference in the share between the first and second survey cycles is:

$$\mathrm{SE}(\Delta_{(g2-g1)}) = \sqrt{\mathrm{SE}_{g2}^2 + \mathrm{SE}_{g1}^2 + le\_LEV_{1,2}^2};$$

where le_LEV$_{1,2}$ is the linking error between the two cycles associated with each level. The le_LEV$_{1.2}$ is calculated as the product of the linking error ($le_{1.2}$) and the normal distribution of the cut-off point of the level, with mean equal to the average score for the country (group) g and standard deviation equal to the standard deviation of the average score of the country (group) g. The difference between applying the linking error to score differences rather than to differences in the share of persons at a given proficiency level lies in the fact that the linking error is directly associated with scores, and only indirectly with the share of persons at a given level.

Reweighting to harmonise demographic characteristics between the two cycles of the PIAAC survey

In most countries participating in the PIAAC survey, the demographic composition of the adult population has changed over the past decade. Increased migration flows and an ageing population may have contributed to the decline in skills within countries, as immigrants and older adults often exhibit lower proficiency levels than the rest of the population.

In order to isolate the effect of these demographic changes, an exercise was developed to enable data from the second cycle of the survey to be reweighted, so that the reweighted estimates would match those from the first cycle of the survey in terms of demographic distribution of the population (by age group, gender and immigrant background). This exercise, i.e. application of the reweighted values to the data from the second cycle of the survey, resulted in an estimation of the proficiency that would have been observed in 2023 had the composition of the population remained the same as in 2012.

When estimates of skills in the second cycle are obtained using the reweighted values, the changes between the first and second survey cycles thus represent a hypothetical scenario highlighting how the skills of a population with a constant demographic profile would have changed over time.

Operationally, the reweighting process first involved dividing the sample of each cycle into post-strata, defined on the basis of the immigrant background of the respondents (five categories: foreign-born adults of foreign-born parents, native-born adults of foreign-born parents, native-born adults of mixed heritage, native-born adults of native-born parents, other/missing), gender (two categories: men, women) and age group (ten categories: 16-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-65). In the second step, the post-strata from the second cycle of the survey were adjusted so that the sum of the final weights in each cell corresponds to the sum of the final weights of the sample from the first cycle of the survey.

Estimates of the mean and distribution of proficiency obtained on the basis of the reweighted values for the second cycle of the survey thus represent the (counterfactual) estimate of proficiency that would have been observed had the population in the second cycle of PIAAC had the same composition as the population in the first cycle of PIAAC, in terms of age group, gender and immigrant background.

The results obtained by adopting the reweighting system are presented in Chapter 2 of this Report.

Differences between unadjusted and adjusted estimates: variations in skills proficiency based on socio-demographic characteristics

In this Report, whenever differences in average proficiency scores between population subgroups are presented, they are shown both as unadjusted and adjusted estimates. Whereas unadjusted differences represent the simple difference between two average proficiency values (or between labour-market and social outcomes), adjusted differences control for the socio-demographic characteristics of the population surveyed that are associated with proficiency (or with labour-market and social outcomes).

Unadjusted differences are useful for establishing the true size of performance gaps between groups. Adjusted differences, meanwhile, provide insights into the factors that help explain these gaps. Adjusted differences are estimated through linear regressions, in which the estimated coefficient of the variable of interest allows the differences to be captured alongside the other characteristics being observed.

Large differences between the adjusted and unadjusted coefficients suggest that the groups analysed also differ according to other factors that are correlated with skills proficiency. For example, proficiency differences between adults with low educational attainment and those with tertiary education could be due to the fact that these groups also differ according to other dimensions, independently correlated with proficiency, such as age. As older adults tend to score lower, regardless of their educational attainment, the average score of adults with a low level of education would be impacted by factors unrelated to the educational qualification achieved. The adjusted differences take this aspect into account and make it possible to compare the proficiency of adults with low and high level of education who have similar socio-demographic characteristics. This approach gives a more accurate picture of the differences associated exclusively with educational levels.

In the Report in general, adjusted estimates control for age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment, as these factors are plausibly correlated with proficiency. When analysing labour-market outcomes, the presence or absence of a partner and children, as well as work experience, are also considered. Comparing adjusted and unadjusted differences highlights the extent to which the adults analysed differ along the characteristics that are controlled for. Thus, for example, if unadjusted and adjusted differences in a given domain are very similar when analysing

differences by educational attainment, it can be assumed that adults with different levels of education do not differ significantly in terms of socio-demographic characteristics, or that these characteristics cancel each other out. In contrast, where there is a large gap between adjusted and unadjusted differences, such as between two age groups for example, this may suggest that the generational gap may also result from different characteristics beyond their different ages. With regard to the social and labour-market outcomes analysed in chapter three, adjusted estimates allow us to estimate the average effects of adult skills in relation to these outcomes, again controlling for the potential intervening effect of individual socio-demographic characteristics.

1 The cognitive skills of adults in 2023

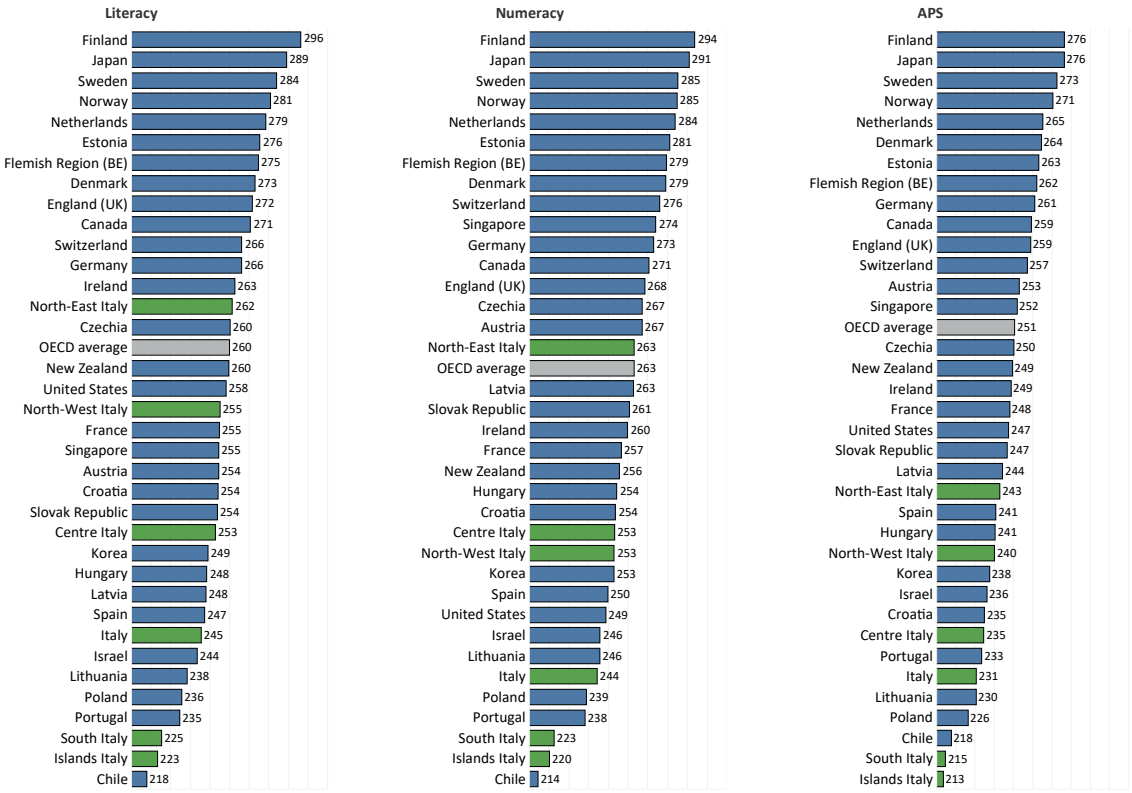
Introduction

This chapter presents the main findings from the second cycle of the Adult Skills Survey carried out in 2023. The first section examines the data on average scores in the three cognitive domains of literacy, numeracy and adaptive problem solving in Italy, and in the five macro-areas of the country (North-West, North-East, Centre, South and Islands), and compares them with the average scores across all other countries participating in the second cycle of the survey, and with the OECD average. Still from a comparative perspective, the section also looks at the distribution of adults aged 16-65 across the proficiency levels for the three skill domains analysed.
The second section of the chapter examines whether, and to what extent, skills are correlated with socio-demographic characteristics and whether skills gaps are concentrated within particular subgroups of the adult population. The groups analysed are defined according to educational level, gender, age group, family and immigrant background.
The results presented in the text, relating to differences between countries or between population subgroups, as already mentioned in the Reader's Guide to this Report, only refer to statistically significant data, with the significance level set at 5%. Similarities and differences are therefore presented not only by considering the results in terms of average or percentage values, but also with reference to the variability of the estimates produced.

1.1 The competence framework

Figure 1.1 shows the average literacy, numeracy and adaptive problem solving (APS) scores for Italy and its macro-areas in comparison with all other OECD countries and economies participating in the PIAAC 2023 Survey.
Italy has an average literacy score of 245, significantly below the average among participating OECD countries (260); the same cannot be said when looking at the results for each macro-area: the average literacy scores in the North-East (262), North-West (255) and Centre (253) are statistically equal to the average OECD score, while the scores recorded in the South (225) and the Islands (223) fall significantly below the OECD average. It is therefore the regions of the South (Mezzogiorno) that pull Italy towards the lower end of the ranking of countries, based on average literacy scores.
In addition to Italy, 14 other countries scored below the OECD average; of those, Israel (244), Latvia (248), Spain (247) and Hungary (248) achieved results statistically equal to the Italian average, while Chile (218), Lithuania (238), Poland (236) and Portugal (235) scored significantly lower than Italy; the remaining six countries scored higher than Italy but still below the OECD average.
Italy's average numeracy score is 244, a full 19 points below the OECD average (263), but higher than Chile (214), Poland (239) and Portugal (238) and statistically equal to Israel (246), Lithuania (246) and the United States (249).
A similar pattern, previously observed in literacy, is also evident in numeracy for the scores achieved in the Italian macro-areas; while the score achieved by the North-East (263) is in line with the OECD average, scores in all other macro-areas are lower than this average value and, in some cases, by a considerable margin: North-West (253), Centre (253), South (223) and Islands (220). It is worth noting that the results in the Mezzogiorno regions, besides being well below the Italian average, are also significantly below the OECD average (around 40 points difference), and not far from the score recorded by Chile (214), an economy that is certainly less advanced than Italy.
Italy's results in the new domain of adaptive problem solving are not encouraging, with scores consistent with those previously observed in the other domains, confirming Italy's position among the lower-ranking countries participating in the PIAAC in 2023. The Italian average score is 231, 20 points below the OECD average (251). Once again, a strongly heterogeneous picture emerges across Italian macro-areas: the North-East (243) and the North-West (240) score above the Italian average, albeit below the OECD average; the regions of the Centre (235) do not deviate significantly from the Italian average; the South (215) and the Islands (213) score more than 15 points below the Italian average, and more than 35 points below the OECD average, with values not dissimilar to Chile (218), which ranks last among all participating countries.

Figure 1.1 **Average score in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area**



Note: adults 16-65 years. Doorstep included. Countries and economies are ranked in descending order of scores in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

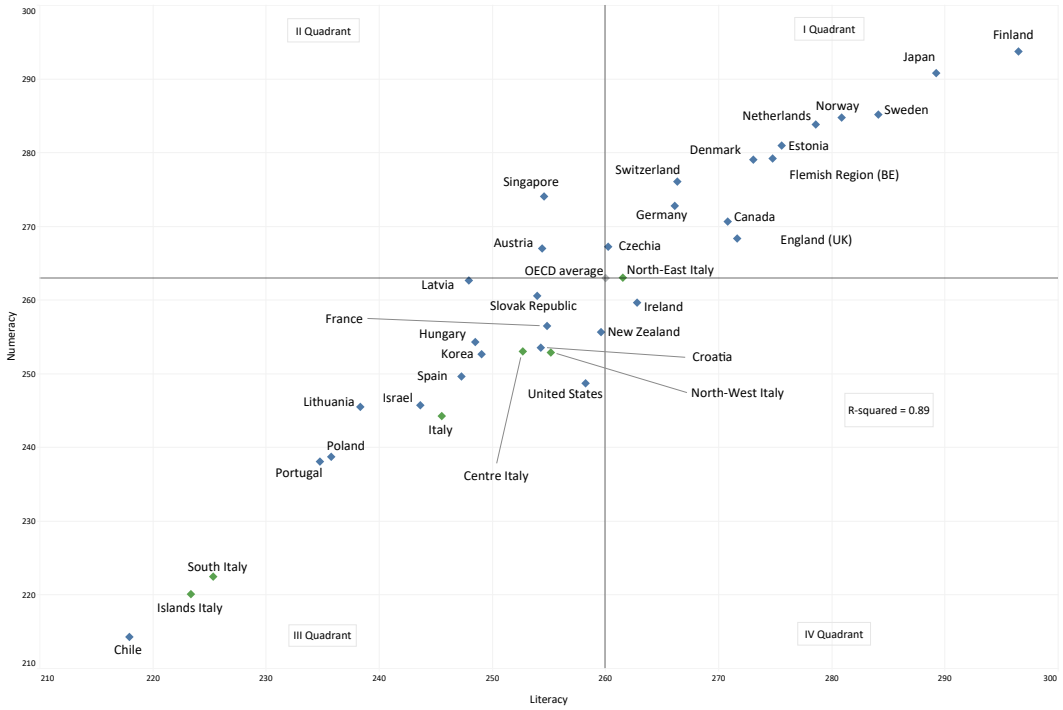
A snapshot of the relationship between average literacy and numeracy scores in the countries participating in PIAAC, which also considers Italy's macro-areas, is presented in Figure 1.2. The grey lines divide the graph into four quadrants, representing the OECD country average values for the two cognitive domains considered (literacy on the x-axis, numeracy on the y-axis)[11].

The linear relationship between the average scores in the two skill domains is in fact very clear, with a coefficient of determination (R^2) of 0.89. Countries are predominantly positioned in quadrants 1 and 3, indicating that adults who perform well in one domain will potentially perform equally well in the other domain. Countries with relatively high scores in both literacy and numeracy include Finland, Japan and Sweden, while countries with lower scores include Chile, Poland and Portugal. A smaller number of countries are found in quadrants 2 and 4, where scores below the OECD average in one domain are associated with scores higher than the OECD average in the other. One example is Singapore, in quadrant 2, with a numeracy score (274) higher than the OECD average and a literacy score (255) below the countries' average; in contrast, Ireland has a literacy score (263) that is higher, albeit only slightly, than the OECD average, and a numeracy score (260) that is slightly lower than average, placing it in quadrant 4.

While the regions in the North-East of Italy are almost completely consistent with the OECD average, placing them at the centre of the quadrants, the other macro-areas are distributed across the third quadrant, with the South and Islands in the bottom left, and the Centre and North-West in the top right.

[11] Countries with average scores above the OECD average in both literacy and numeracy are in quadrant 1, countries with average scores below the OECD average in both literacy and numeracy are in quadrant 3, countries where the numeracy score is below the OECD average but the literacy score is above are in quadrant 4 and finally countries where the literacy score is below the OECD average but the numeracy score is above are in quadrant 2.

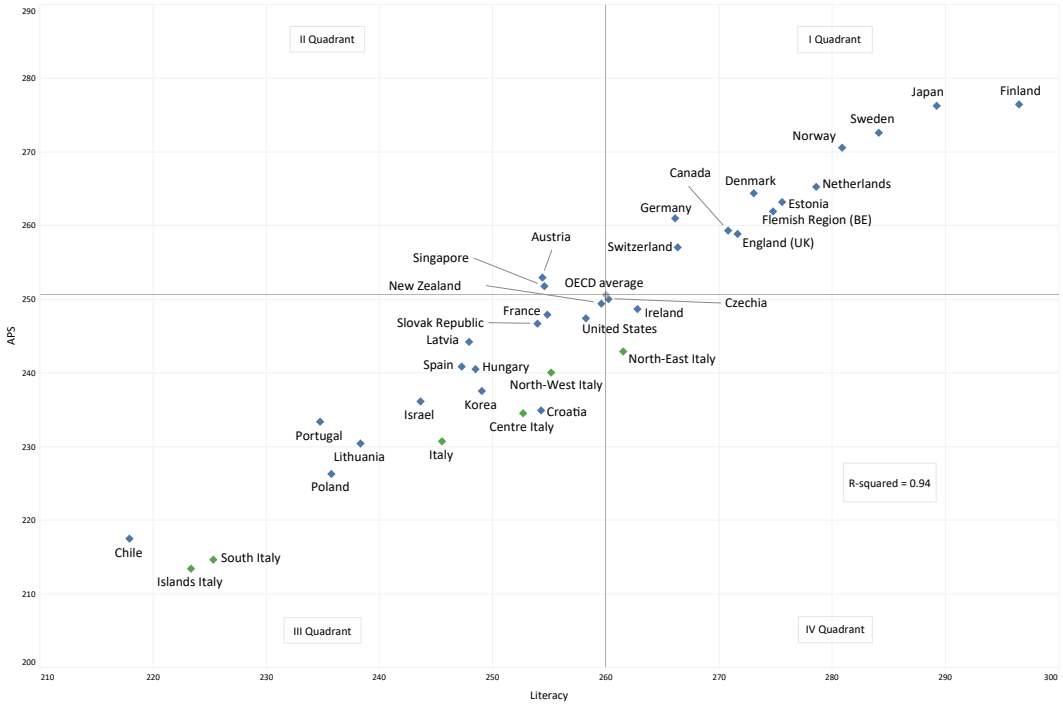
Figure 1.2 Correlation of literacy and numeracy scores by country and Italian macro-area



Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

If the average scores for the literacy domain are considered in relation to those for the adaptive problem solving domain (Figure 1.3), the coefficient of determination (R^2) is 0.94, which is higher than previously seen. The distribution of countries and Italian macro-areas across the four quadrants mirrors what was previously seen, with no particular differences.

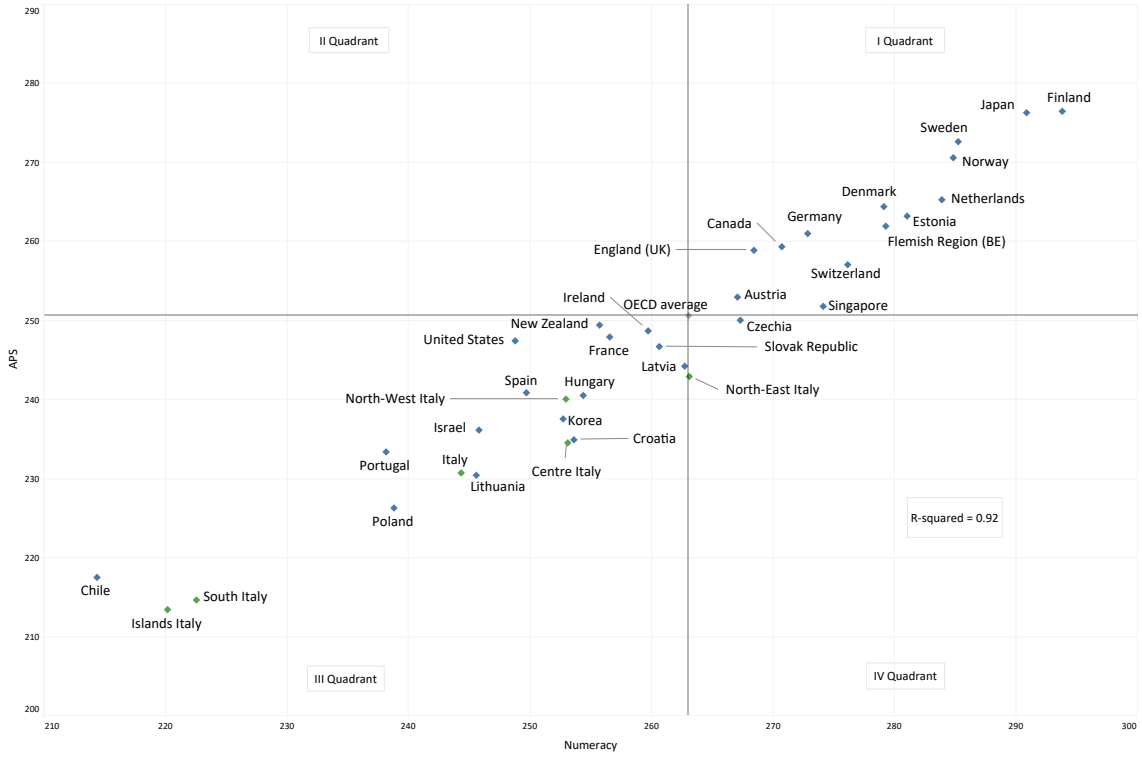
Figure 1.3 Correlation of literacy and adaptive problem solving scores by country and Italian macro-area



Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Finally, taking into account the relationship between countries' average scores in the numeracy domain and those in the adaptive problem solving domain (Figure 1.4), the coefficient of determination (R^2) is 0.92, but the distribution of countries across the four quadrants is different from that seen in the previous two cases. There are in fact no countries in the second and fourth quadrants, while there is a higher concentration in the first and third quadrants, that is, for concordant values that are lower or higher than the OECD average in the two cognitive domains considered.

Figure 1.4 Correlation of numeracy and adaptive problem solving scores by country and Italian macro-area



Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

With a view to enabling clearer interpretation of the PIAAC 2023 results regarding adult skills in the three domains, proficiency levels were identified and defined at an international level: the proficiency scale is divided into discrete categories of cutoffs[12]. For literacy and numeracy, levels range from "below Level 1" to "Level 5", and for adaptive problem solving from "below Level 1" to "Level 4". Grouping adults based on proficiency levels makes it possible both to estimate the proportion of people at a given level and also to describe what adults at each level are capable of doing. According to this classification, adults who perform at a level "below 1" or "equal to 1" are considered to have low proficiency in each domain covered and are referred to as low performers; in contrast, adults who perform at levels 4 and 5, in the case of literacy and numeracy, or level 4, in the case of adaptive problem solving, are referred to as high performers. Figure 1.5 shows the percentage distribution of adults across proficiency levels for the literacy, numeracy and adaptive problem solving domains for each participating country and economy and for each Italian macro-area. For the sake of simplicity of presentation and to ensure effective reliability of the estimates produced, the following analyses often present results in terms of "low performers" and "high performers", using the groupings described above.

In the literacy and numeracy domains, 35% (34.7% and 35.3% respectively) of adults in Italy are low performers. This figure rises to 45.6% for the adaptive problem solving skill domain.

The numbers of high performers are markedly lower: only 5.4% of Italian residents perform at high proficiency levels in literacy, 6.2% in numeracy and 0.9% in adaptive problem solving.

Looking at the results in greater detail, it emerges that the share of low performers in the literacy domain in Italy is considerably higher than in many economies and above the OECD average of 26.1%. That said, the breakdown by Italian macro-area reveals a significant lack of homogeneity: the percentage of adults with

[12] See Appendix 1 of this Report for the definition and description of the proficiency levels for each domain.

low skills is not far from the OECD average in the regions of the centre-north (30.3% in the North-West, 27.5% in the Centre and 21.2% in the North-East), but increases significantly in the South (48.7%) and in the island regions (52.9%), with levels similar to countries with the lowest proficiency levels, such as Chile (53.4%).

The share of high performers in literacy in Italy is significantly below the OECD average (11.6%), with considerable differences evident across macro-areas: while high performers account for approximately 9.2% of adults in the North-West regions, a figure not dissimilar to the OECD average, the share of high performers drops significantly in the North-East (5.7%) and Centre (6.4%) and falls below 2% in the regions of the South and the Islands, a figure not dissimilar to Chile and Lithuania, the lowest ranking countries in terms of high performer adults.

The share of adults at Level 1 or below for numeracy skills in Italy is 10 points higher than the OECD average (24.8%). Once again, substantial differences are noted across the Italian macro-areas: the South and Islands exceed the OECD average by more than 26 percentage points, with more than half of adults classified as low performers (51.2% and 54.4% respectively); the percentage drops to 30.6% in the North-West, 26.8% in the Centre and 20.5% in the North-East.

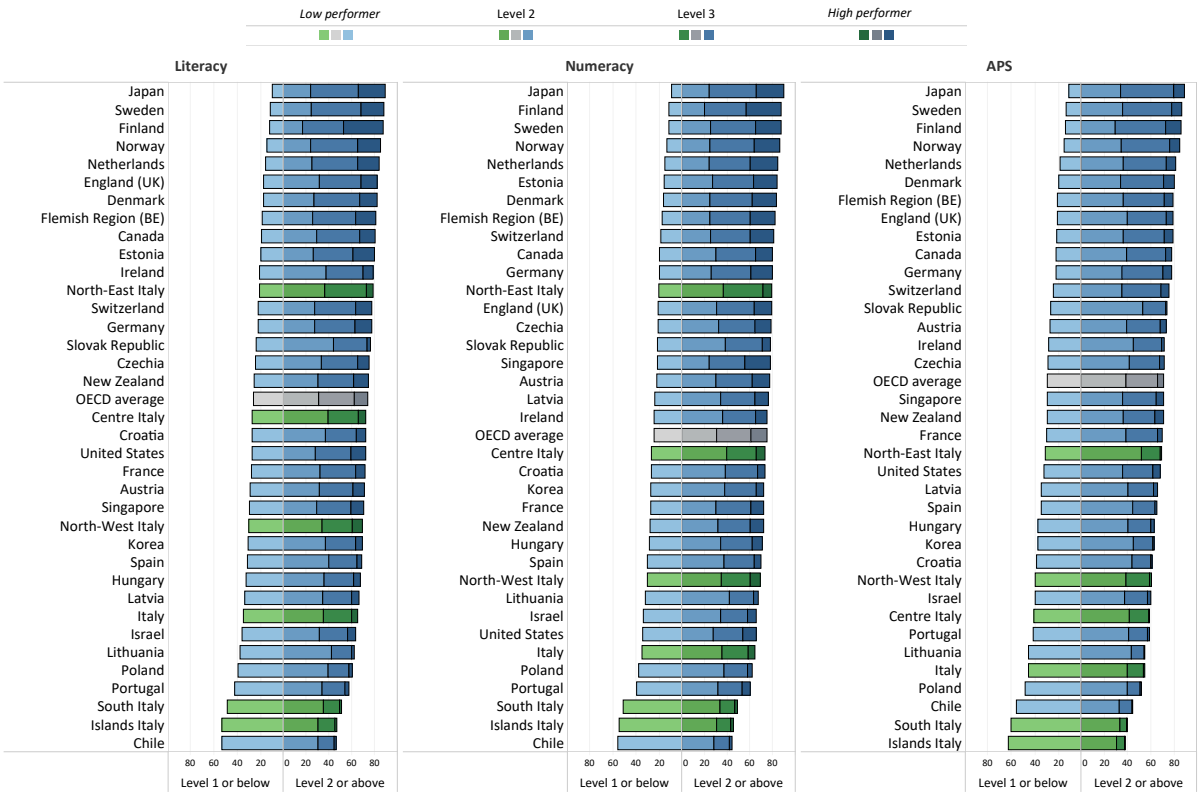
The percentage of low performers in Italy is not significantly different from certain other countries, such as Israel (34.1%), Lithuania (32.3%), Poland (38%) and the United States (34.2%).

The share of adults in Italy considered high performers in numeracy, at 6.2%, is significantly lower than the OECD average (13.9%). The share of high performers in this domain is significantly lower than the OECD average across all Italian macro-areas, but with varying concentrations: 9.3% in the North-West, 7.9% in the North-East, 7.5% in the Centre and 2.1% in the South.

As noted, just under half of the adult population resident in Italy falls into the low performer category in the adaptive problem solving domain, approximately 17 percentage points higher than the OECD average (29.3%). Substantial differences among macro-areas are also evident for this domain: in the North-East regions, the share of low performers in APS is 31% (statistically equal to the OECD average), rising to 39.8% in the North-West and 41.1% in the Centre, and reaching exceptionally high levels of over 60% in the South and the Islands (60.4% and 62.4% of adults respectively). The percentages recorded in the South of Italy are the highest of all countries and territories in the survey, with the exception of Chile.

As regards the highest proficiency level (Level 4 in the case of APS), percentages in Italy, Chile, Lithuania, Poland and the Slovak Republic are below 1%, significantly lower than the OECD average of 5%. Across all Italian macro-areas, the share of high performers falls significantly below the OECD average, with the highest value recorded in the North-West (1.7%).

Figure 1.5 Percentage of adults at each proficiency level in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults 16-65 years. Doorstep included. Countries and economies are ranked in ascending order of percentage of low performer adults in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

1.2 Competences by socio-demographic characteristics

1.2.1 Adult skills and educational attainment

The relationship between educational attainment and skills is highly complex and plays a central role in the analyses performed using the PIAAC data. Individuals with higher skills are more likely to attain high levels of education, however the process is bidirectional; people with high educational qualifications, who presumably hold high-skilled jobs, have more opportunities to further develop their skills. This virtuous circle highlights how skills and education feed into each other, creating a cumulative effect that strengthens human capital. In contrast, those with fewer skills or lower levels of education risk exclusion from opportunities for professional and personal growth, exacerbating existing inequalities.

Education, understood as a driver for the development of skills, thus assumes a crucial role in the lives of adults, which is why, in addition to analysing the results achieved in terms of average scores across skill domains in relation to educational qualification held, this section will also consider the differences observed between adults who have not attained upper secondary education and those who have attained tertiary education.

Estimates from the second cycle of the PIAAC survey – limited to the sub-group of the population aged 25-65 in order to exclude those still in education – confirm, across all countries and economies participating in PIAAC, that average proficiency values across all three domains are always higher among adults with tertiary education than the average calculated across the whole adult population and the values for adults without tertiary education (Figure 1.6). Educational attainment is therefore one of the elements that most influence the knowledge cycle and development of skills; however, mechanisms need to be put in place to promote higher levels of education and to increase the proportion of tertiary graduates.

In fact, only 20% of 25-65 year-olds in Italy have a university degree or higher (tertiary qualification), while 37.7% hold a qualification below upper secondary school. The share of adults with tertiary education in Italy is significantly lower than across the main economies participating in the survey: the OECD average share is 43.9%, and exceeds 50% in Canada, Korea, Denmark, Estonia, the Flemish Region (BE), Israel, Norway and New Zealand.

Across the three cognitive domains, adults aged 25-65 years with tertiary education in Italy tend to possess more skills than those with upper secondary education, and more again than those with lower secondary education or below. However, an analysis of proficiency scores across the three cognitive domains, taking into account the different levels of educational attainment of the population, reveals less polarisation of skills, in general, across different educational qualification levels in Italy compared to other OECD PIAAC countries and economies. In particular, individuals with tertiary educational qualifications show lower average proficiency than graduates across OECD countries as a whole; by contrast, those with less than upper secondary education display average proficiency scores that are on a par with, or even higher than, the OECD average for that group. Compared to other countries, Italy records a higher level of skill among people with low educational qualifications, while at the same time showing less benefit in terms of increase in skills associated with the attainment of tertiary qualifications.

In Italy, therefore, although higher levels of education are indeed associated with higher average proficiency, the skills profile of the adult population reveals two critical points. On the one hand, the number of people with high educational attainment is relatively low compared to other countries; on the other, the average proficiency of those with tertiary education is lower than that of the corresponding groups in many advanced economies, such as Japan and Finland. In fact, adults with upper secondary education in these countries achieve, on average, higher scores than Italians with tertiary education.

Such disparities cannot, however, be interpreted solely in terms of individual proficiency levels. They also reflect the profound differences in the education systems of the countries and economies participating in the survey, influenced by cultural, economic and political contexts that shape educational opportunities and skills acquisition, including, importantly, meaningful development of on-the-job skills.

Delving further into the analysis, adults aged 25-65 years in Italy who have not attained upper secondary education score 217 points in the literacy domain (compared to an OECD average of 207), while those with upper secondary education score 252 points (compared to an OECD average of 250, equal to the Italian score when statistical significance of the difference is accounted for) and those with tertiary education achieve 271 points (against an OECD average of 283).

As always, it is interesting to note the geographical heterogeneity in Italy that again emerges clearly from the analysis of educational attainment. With an average score of 284 points, tertiary-educated adults in the North-West exceed the national average among Italian graduates, demonstrating higher proficiency than the rest of the country. In contrast, those with a tertiary degree in the South and the Islands have average scores of 251 and 248 points respectively, significantly lower than the national average for graduates. Graduates from the North-West also perform positively at an international level, achieving the OECD average score (283 points), and also ranking in line with Austria (284 points), Canada (287 points), France (287 points), Ireland (281 points), New Zealand (283 points), England (UK) (291 points), Czechia (289 points), United States (287 points), Switzerland (289 points) and Hungary (283 points).

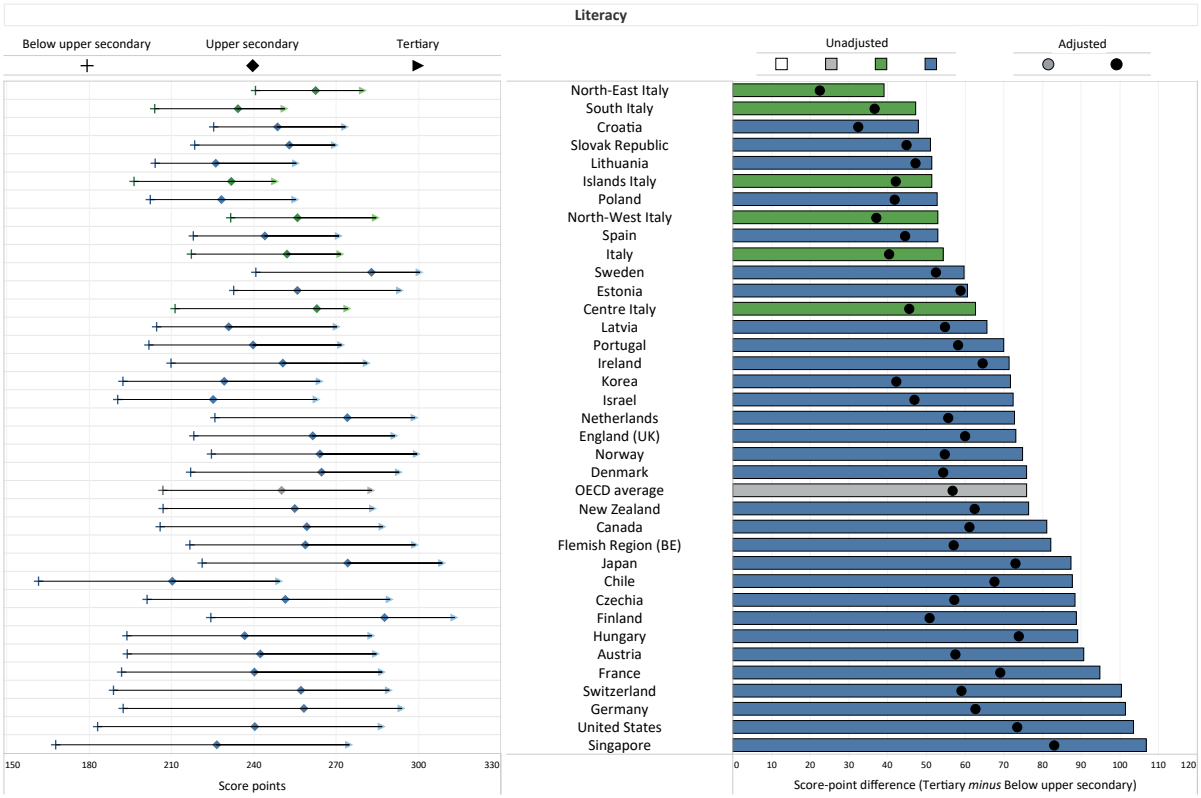
Also noteworthy is the performance of adults in the North-East and North-West who, despite not having upper secondary education, rank second and fourth in the international rankings, demonstrating that, in the absence of a qualification, other determinants come into play as regards the possession and improvement of skills in a given country/territory.

Educational attainment, however, where achieved, proves to be advantageous, however, as clearly indicated by the gap, in terms of score, between adults with tertiary education and those with less than secondary education: in Italy this difference amounts to as much as 54 points (while the OECD average difference is 76 points).

The geographical differences previously highlighted are also reflected in the analysis of the gap in educational qualifications. In the North-West, where university graduates score 284 points, the difference compared to adults without a diploma is 53 points, similar to the difference recorded in the Islands (51 points). In the latter case, however, as mentioned previously, not only is the score of adults with a tertiary degree the lowest in the international context (248 points), but also adults without upper second education are among the lowest ranking, with 196 points. The smallest, albeit wide, gap at 39 points is found in the North-East, the macro-area that records the highest scores among the overall population. This confirms that the educational attainment does not always constitute a clear proxy for skills, given that the score of 241 points achieved by adults without upper secondary education is equivalent to the score obtained by graduates in the Islands (248 points) and in the South (251 points) when considering the statistical significance of the difference. Even accounting for educational attainment, gender, immigrant background, language spoken at home and parents' qualifications[13], the differences, though narrowing, remain significant in Italy as on the international scene.

[13] See the Reader's Guide in this Report for information on how the adjusted estimates – that is, estimates net of the effects of other socio-demographic characteristics – are constructed.

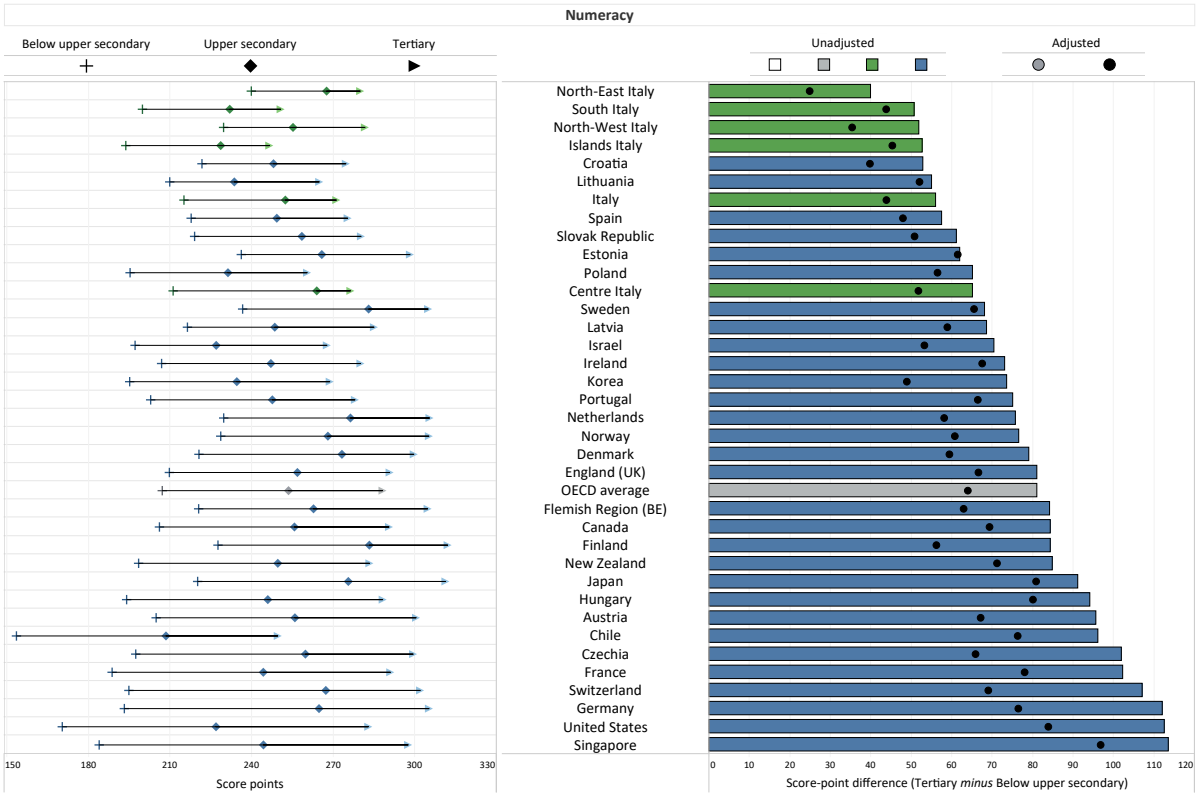
Figure 1.6 Average score in the literacy domain by educational attainment and average score difference between adults with tertiary education and adults with lower secondary education or below by country and Italian macro-area



Note: adults 25-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

With regard to the numeracy domain also, educational qualification remains a beneficial factor on average in Italy although, as in the case of literacy, it results in a different performance trend, especially when compared to the OECD average: scores of adults without upper secondary education are statistically higher than the OECD average, those of adults with upper secondary education are consistent with the OECD average, while those of adults with high educational attainment are statistically lower than the OECD average.
As shown in Figure 1.7, on average, adults residing in Italy with a low educational qualification score 215 points (compared to an OECD average of 207), those with upper secondary education score 252 points (consistent with the OECD average of 253), and those with tertiary education score 271 points (compared to an OECD average of 288). The score gap in Italy between adults with tertiary education and those without upper secondary education is similar to that observed for literacy, at 56 points (OECD average: 81 points).
As regards Italian macro-areas, the numeracy scores achieved by adults aged 25-65 analysed by educational attainment are consistent with those for literacy, with regions in the North-West, North-East and Centre still ahead, and the same size gap between the two educational attainment levels compared, i.e. with tertiary qualification and without upper secondary education.

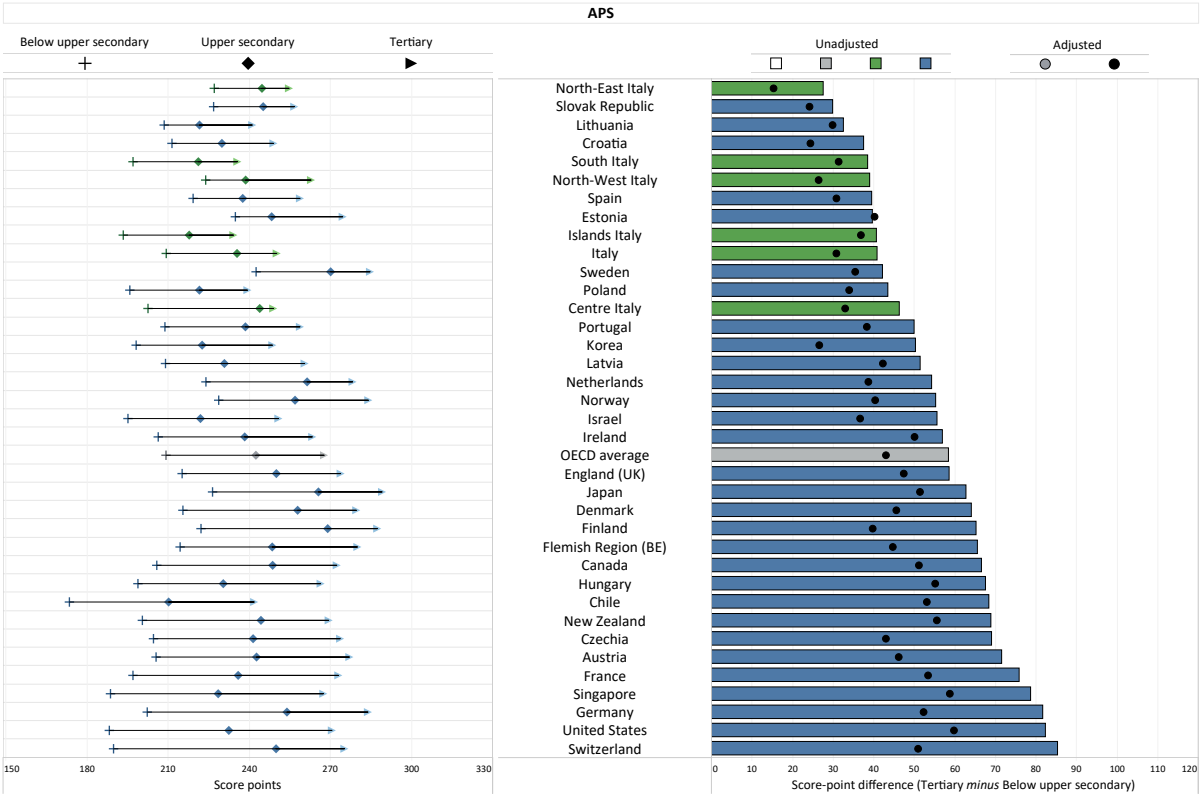
Figure 1.7 Average score in the numeracy domain by educational attainment and average score difference between adults with tertiary education and adults with lower secondary education or below by country and Italian macro-area



Note: adults 25-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Finally, an analysis of the results achieved, by educational attainment, in adaptive problem solving (Figure 1.8), shows that, on average, adults residing in Italy aged 25-65 without upper secondary education achieve 209 points (in line with the OECD average), those with upper secondary education score 235 (statistically lower than the OECD average of 242 points), while those with tertiary education achieve 250 points (also statistically lower than the OECD average of 267 points). In this domain as well, therefore, adults aged 25-65 with high educational attainment have an advantage compared to adults without upper secondary education; this difference, amounting to 41 points, although significant, is smaller than that observed in the other two domains. In this domain in general, the gaps between adults with high and low educational qualifications are narrower across all countries and economies participating in the PIAAC survey, given the lower scores achieved by all adults with tertiary qualifications.
The narrower difference in performance in adaptive problem solving between adults with high educational attainment and those with low educational attainment is also evident across the Italian macro-areas: the gap ranges from 28 points in the North-East to 46 points in the Centre, where both adults without upper secondary education and those with a university degree score very low (202 and 249 points respectively) compared to the results achieved in the literacy and numeracy domains.

Figure 1.8 Average score in the adaptive problem solving domain, by educational attainment and average score difference between adults with tertiary education and adults with lower secondary education or below by country and Italian macro-area



Note: adults 25-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Adults can achieve higher qualifications through different pathways. These pathways may already be partially set out during secondary education, but they are shaped more decisively by the choice of tertiary education.

The analysis presented below considers only the sub-population of individuals with at least one degree, broken down by field of study, namely STEM (science, technology, engineering and mathematics programmes) and non-STEM pathways. The aim is to determine whether STEM pathways correspond to higher skills, compared to non-STEM pathways.

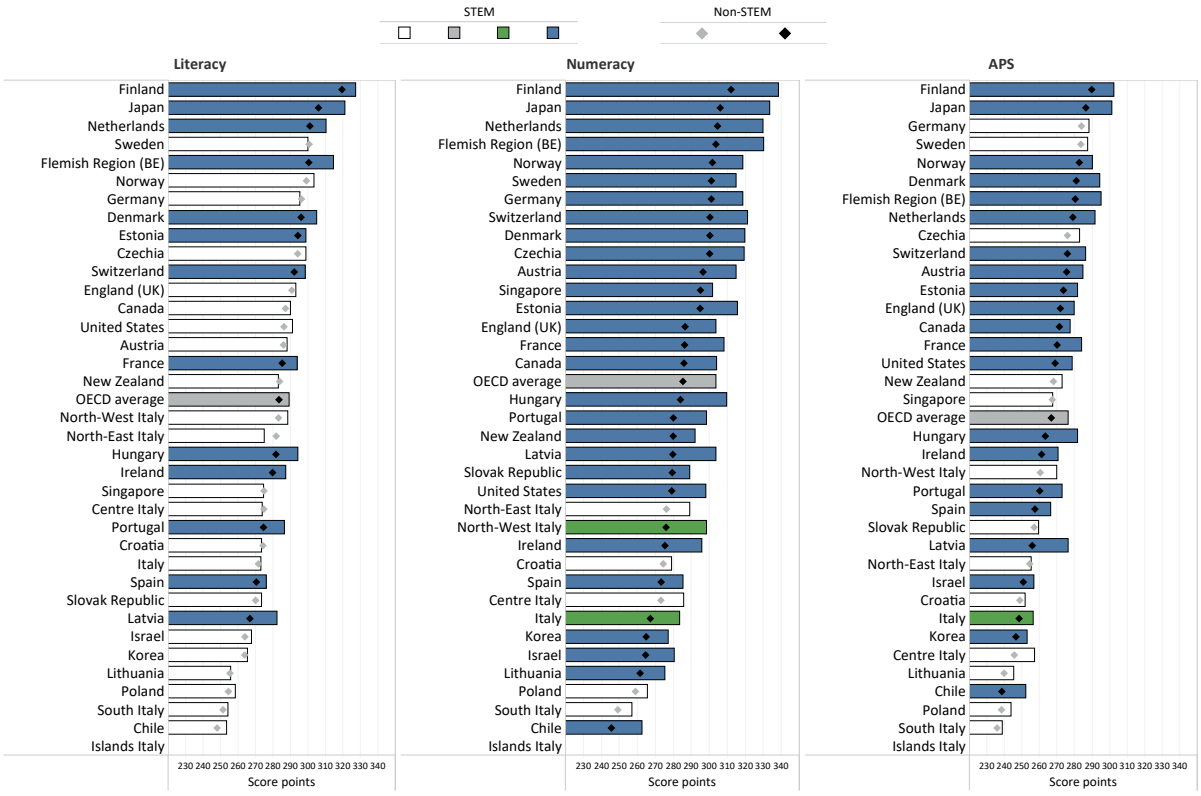
Figure 1.9 shows average proficiency scores in the three domains analysed, broken down by STEM and non-STEM fields, and highlights the advantage of graduates from STEM fields over those from non-STEM fields, particularly in the numeracy domain.

Indeed, a clearly significant link emerges between science and technology courses and proficiency in numeracy. In Italy, adults with tertiary education in a STEM field achieve an average of 284 points (the OECD average is 304 points) compared to 267 points for adults with a non-STEM qualification (in this case, the OECD average is 285). In the Italian macro-areas, STEM degrees are only associated with an advantage over non-STEM degrees in the North-West, where the gap is a full 23 points.

With a score of 299 points, STEM graduates in the North-West represent the highest-scoring category in the numeracy domain in Italy.

In Italy, as in its macro-areas and in many other countries participating in PIAAC, there are no significant differences in literacy proficiency scores between STEM and non-STEM university graduates. Finally, in the adaptive problem solving domain, differences emerge in the scores of STEM and non-STEM university graduates that are similar to the numeracy domain, though less pronounced. Significantly different scores are recorded in this domain in Italy (though not in its macro-areas) depending on field of study, a finding also reflected in the OECD average: 257 points for those with a STEM qualification (OECD average: 276 points), 248 points for those with a non-STEM qualification (OECD average: 267 points).

Figure 1.9 Average score in the literacy, numeracy and adaptive problem solving domains for adults with tertiary education by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. Darker colours denote differences that are statistically significant (at 5%). Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates. Countries and economies are ranked in descending order of STEM scores in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

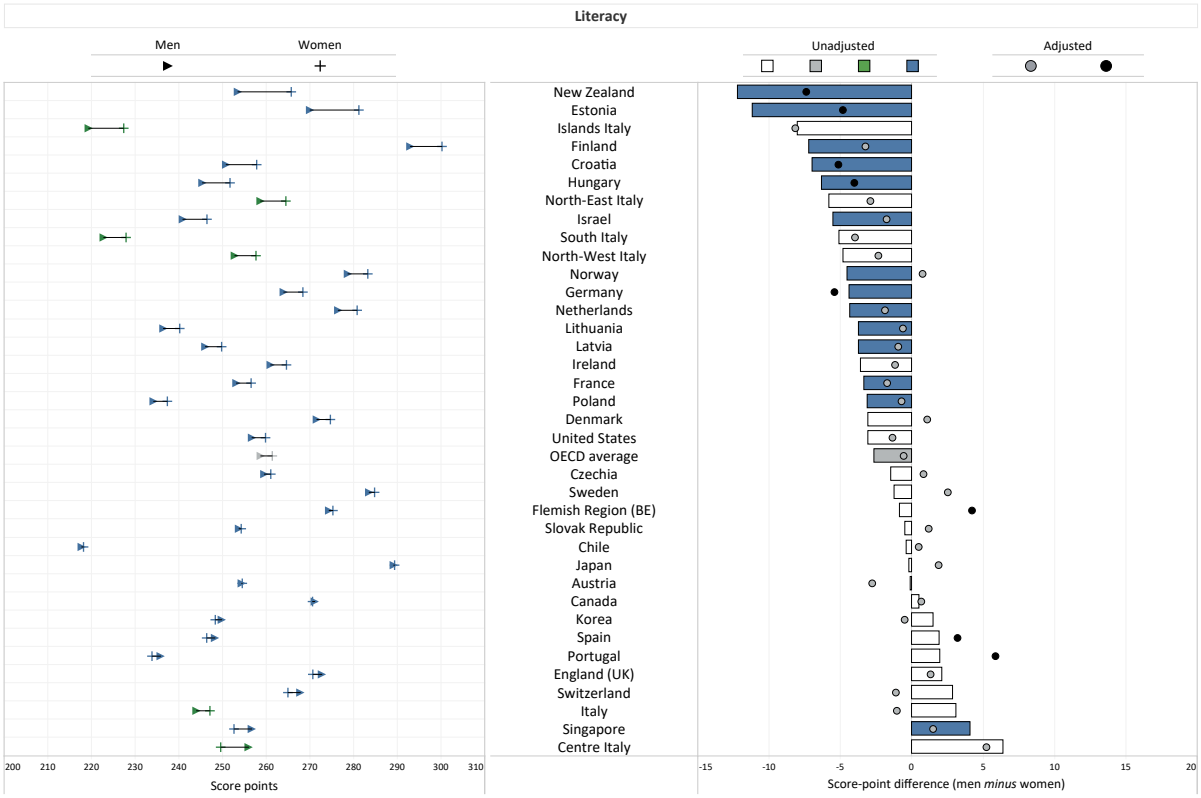
The evidence from the data on the relationship between proficiency and field of study thus indicates that, while educational attainment is undoubtedly a key element in influencing the cycle of knowledge and skills, it is equally true that the type of field of study chosen is a discriminating factor among tertiary-educated people, particularly in the case of numeracy and APS skills.
With a view to considering the extent to which fields of study can be a determinant in the possession of skills and can also cancel out performance gaps identified for certain variables, the gender gap in skills will be explored below, analysing the differences in scores between men and women graduates in STEM disciplines.

1.2.2 Adult skills and gender

In Italy, women and men perform equally in both literacy and APS, while men have a significant advantage over women in numeracy (+7 points). At the OECD average level, by contrast, women outperform men in literacy, gaining an advantage (+ 3 points) for the first time compared with the previous round of PIAAC; the advantage of men is confirmed in the other domains and is more pronounced in the case of numeracy (+11 points).
With regard to the literacy domain, Figure 1.10 shows the average achieved by men and women and the differences in score by gender in the individual countries.
In Italy, the differences in average scores recorded for men and women are not statistically significant. Men achieve an average score of 244 in literacy, while women score 247; both scores are below the average for men and women across the OECD countries and economies participating in the PIAAC survey.
Women and men in Italy perform better than women and men in Chile, Lithuania, Poland and Portugal. Women in Italy achieve results similar to those recorded in Korea, Israel, Latvia and Spain; while men perform in line with residents in Israel, Latvia and Hungary.
Women and men in the South and Islands are at the bottom of the international rankings, performing better than Chile alone, with scores statistically lower than both the OECD and the Italian average. The situation changes in the other macro-areas, where both men and women perform differently. Men in the North-

West, North-East and Centre, with 253, 259 and 256 points respectively, exceed the average for Italian men and achieve results consistent with the OECD average (259 points). Women in the North-West (258 points) and North-East (264 points) perform statistically higher than the average for Italian women and are consistent with the OECD average; in the Centre (249 points), meanwhile, the performance of women is consistent with the Italian average, but below the OECD average (261 points).
The analysis of differences between men and women in average literacy scores, i.e. the gender gap, shows no significant differences across the macro-areas either.
The adjusted gender gap in average literacy scores (Figure 1.10), which takes the adults' main socio-demographic characteristics into account, confirms the results obtained based on the simple difference in scores between men and women: as in the majority of the other countries participating in the survey, no gender differences are evident in Italy. In contrast, women have an advantage in Croatia, Estonia, Germany, New Zealand and Hungary, while the gender gap favours men in the Flemish Region (BE), Portugal and Spain.

Figure 1.10 Average score in the literacy domain by gender and average score difference between men and women by country and Italian macro-area

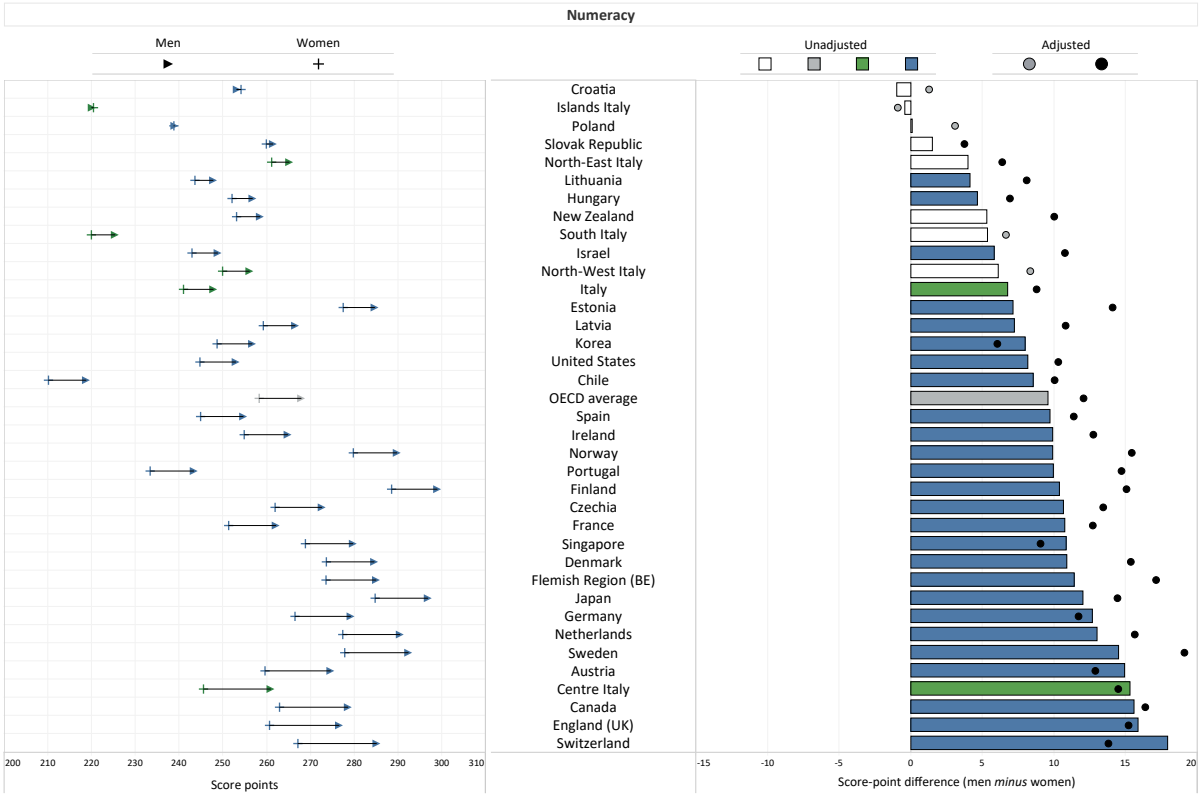


Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In the numeracy domain (Figure 1.11), the average score for men resident in Italy is 248 points; this is significantly lower than the OECD average (268 points) and all other countries and economies participating in PIAAC, with the exception of Chile and Poland. Performances similar to those in Italy were recorded for men in Israel, Lithuania, Portugal and the United States.
The average numeracy score for women in Italy is 241 points, not statistically dissimilar to women in Israel, Lithuania, Poland, Spain and the United States. This result is significantly higher than for women in Chile and Portugal but below the OECD average (258 points) and all other participating countries.
Once again in the case of numeracy, an analysis of the Italian data broken down by geographical area shows good performances by men in the North-East (265 points, consistent with the OECD average), Centre (261 points) and North-West (256 points) and very positive performance by women in the North-East, scoring 261 points, consistent with the OECD average and above the national average not only for Italy but also Chile, Korea, France, Israel, Lithuania, Poland, Portugal, Spain, the United States and Hungary.
The Italian macro-areas with the lowest scores by gender are once again the Islands and the South: 220

points for both men and women from the Islands and 225 and 220 points respectively for men and women from the South.
The advantage of men over women is a global trend across all OECD countries, including Italy (7-point difference) and its central regions (15 point difference); exceptions to this trend are the other Italian macro-areas, Croatia, New Zealand, Poland and the Slovak Republic where no gender differences are observed.
When the main background characteristics are taken into account, the adjusted gender gap in average numeracy scores widens to 12 points on average across all OECD countries, and to 9 points in Italy (almost 2 points higher than the unadjusted gender gap). One possible factor that may explain this increase in the size of the adjusted coefficient could be educational attainment which, as we shall see, shows differences in proficiency between men and women specifically in the numeracy domain. As regards the Italian macro-areas, with the same characteristics included in the multivariate analysis, the differences remain statistically significant in favour of men in the Centre, and become significant, again in favour of men, in the North-East, where an increase of more than 2 points is observed (from 4 to 6), thus indicating that the gender difference in this macro-area may be dependent on several different factors jointly correlated with proficiency.

Figure 1.11 Average score in the numeracy domain by gender and average score difference between men and women by country and Italian macro-area

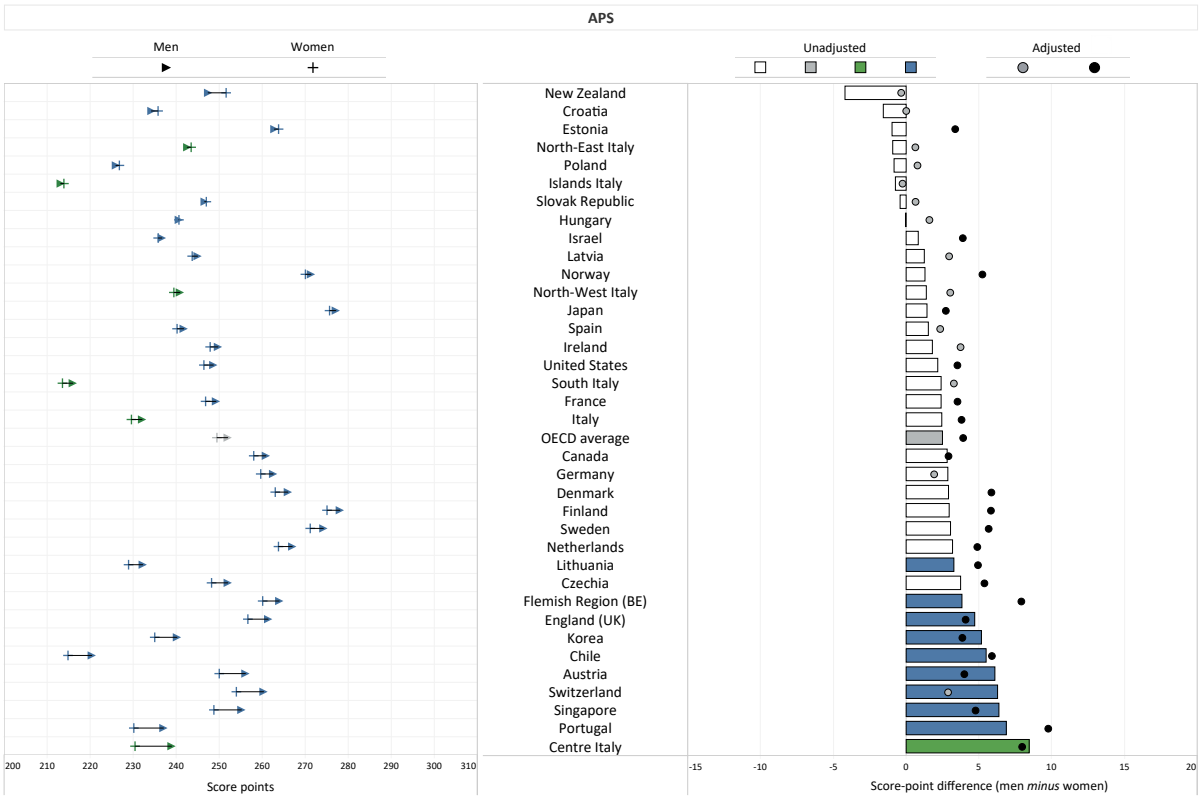


Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In adaptive problem solving (Figure 1.12), men and women score below the OECD average both in Italy and in all its macro-areas. On average, Italian men score 232 points (OECD average: 252), while women score 230 points (OECD average: 249), only outperforming men in Poland and Chile and women in Chile, respectively. As observed for the overall performance of adults aged 16-65 years in this domain, and in contrast to the literacy and numeracy domains, the performance in the North-East is below the OECD average in all cases, including when broken down by gender. Both men and women in the North-East, and in the North-West, however, outperform the national average, while the men and women in the South and Island regions rank at the very bottom in terms of performance, even behind Chile.
In this domain, in Italy, men have no advantage over women, in contrast to the OECD average, where the gender gap is just over 2 points. Only in the Centre of Italy is the gap between men and women notably high, even in comparison with other countries: men score 239 points and women 230 points.

As in the case of numeracy, when the main background characteristics are taken into account, the adjusted gender gap widens: in Italy it goes from a non-statistically significant gap of just over 2 points to a statistically significant difference of 4 points (in favour of men), while in the macro-areas the situation remains unchanged, confirming the significant difference only in the Centre.

Figure 1.12 Average score in the adaptive problem solving domain by gender and average score difference between men and women by country and Italian macro-area



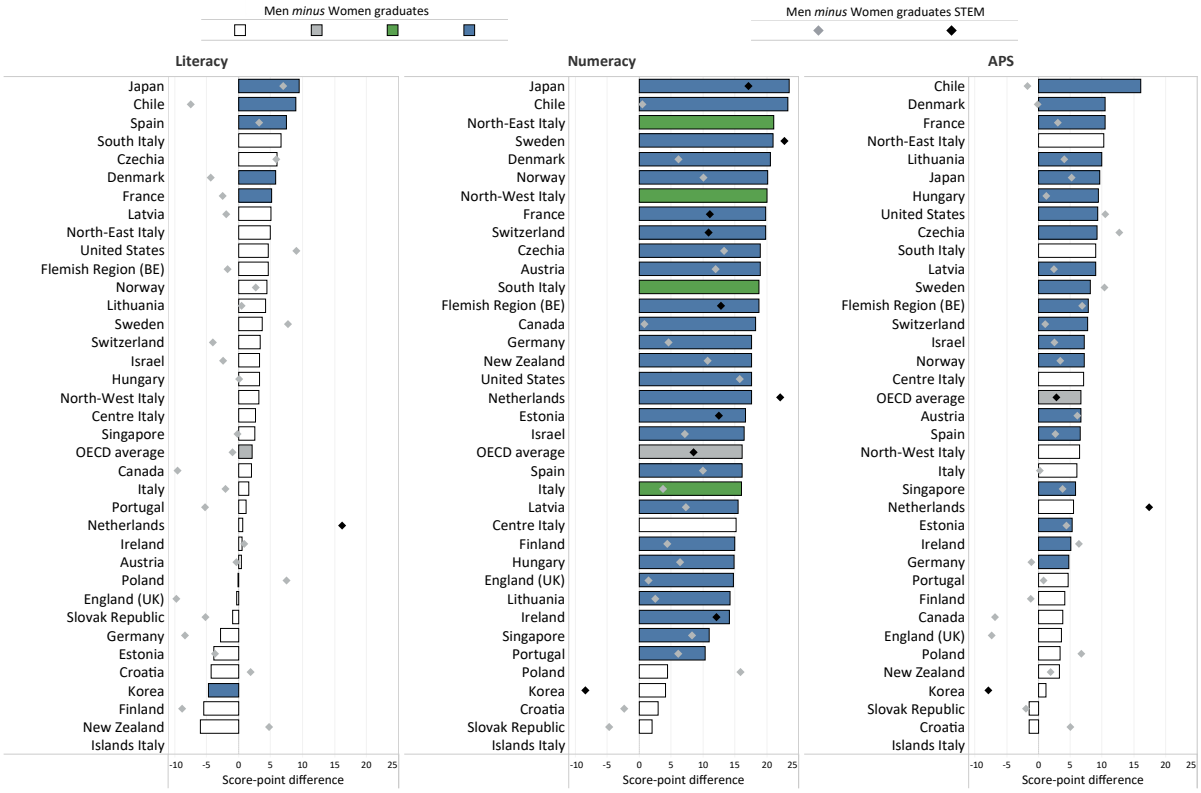
Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In general, then, there are no gender differences in Italy in the APS and literacy domains; as regards the latter, the advantage for men (Gallina 2000) that emerged as a finding from the first OECD-IALS Skills Survey (1998), already no longer evident in subsequent surveys, ALL (2003) and Cycle 1 (2012), can now be considered definitively overcome. The same cannot be said for the numeracy domain, where a gender gap emerges in favour of men. The gender gap is evident in the Centre in both literacy and numeracy domains, while in the North-East it is evident in numeracy, taking only the adjusted analysis into account. Despite achieving the highest proficiency values nationally, the North-East has the widest variability in performance when analysed by socio-demographic characteristics, demonstrating that several factors (variables) may jointly contribute to determining the dynamics of proficiency.
An analysis of gender gap is presented below (Figure 1.13) as a function of educational qualification held and STEM schooling undertaken specifically for the purposes of verifying whether tertiary education, which, as we have seen, is a determinant of an increase in average proficiency, enables the gender gap to be reduced or eliminated, particularly on the basis of the type of field of study completed (STEM).
In this case, the estimates are limited to the sub-population aged 25-65 with tertiary education.
In the case of numeracy, there is a gender gap among this population in Italy of 6 points in favour of men (compared to a gap of 7 points, as we have seen, for the population aged 16-65); this gap widens to 16 points, however, if only university-educated men and women in this specific 25-65 age group are taken into account.
The increased gender gap in skills among individuals with tertiary education is also evident in the OECD average; while the gender gap for the population aged 25-65 is 10 points, it widens to 16 points in favour of men among graduates aged 25-65.
Still with reference to the numeracy domain, the gender gap is very wide in the Italian macro-areas and

statistically significant between graduates in the North-West, North-East and South, where the difference is around 20 points.
In the Centre, in contrast, the definitely wide gender gap of 15 points recorded in favour of men aged 16-65, which increases by 3 points for the sub-population aged 25-65, disappears completely when considering the differences among graduates[14].
In recent years, the historical gender gaps in education in favour of men have narrowed and, in some cases, even reversed. For instance, the percentage of women aged 25-34 with tertiary education has steadily increased in recent decades, surpassing that of men; in 2023, the average gap across OECD countries is 13 percentage points in favour of women, and growing (OECD 2021a and 2024a; Lee and Lee 2016). Men and women, however, make different educational choices. Women are less likely than men to choose courses in the fields of science, technology, engineering and mathematics (STEM) (OECD 2023c; 2022) and are also less likely to successfully complete such courses (OECD 2022).
The percentage of women with a STEM degree remains low: in participating OECD countries, women account for just 26.6% of adults with tertiary education in STEM fields (versus 73.4% of male STEM graduates). In Italy, women account for 31.5% of adults with tertiary education in STEM fields (versus 68.5% of male STEM graduates); this figure is higher than the OECD average, but should be considered in the context of women with STEM degrees accounting for 14.1% of all women with tertiary education, while men with STEM degrees account for 43.3% of all men with tertiary education.
Increasing women's participation in scientific fields is important not only to increase female employment, but also to reduce or overcome the gender skills gap among the highly educated. In fact, when the results of men and women university graduates in STEM fields in Italy are analysed, the numeracy gender gap disappears, which is not the case in other OECD countries such as Korea, Estonia, the Flemish Region (BE), France, Japan, Ireland, the Netherlands, Sweden and Switzerland, resulting in an average gender gap in the numeracy domain across OECD countries that remains significant at 8 points.
In the literacy domain, however, the field of study makes no difference, as expected, in the gender analysis for almost all participating countries and economies, as well as for Italy, its territorial areas and the OECD average. Gender differences remain statistically non-significant regardless of educational attainment or field of study. Exceptions to this finding are observed in Korea, where a difference is recorded in favour of women, and in the Netherlands where the opposite is the case.
A similar situation emerges in the APS domain, where the average gender gap in Italy, as in other OECD countries, does not differ significantly either among university graduates or based on fields of study undertaken.
In Italy, then, possessing a tertiary qualification not only raises the average proficiency level, but also seems to be a decisive factor in eliminating gender differences across all domains, with the exception of numeracy. In the latter domain, in contrast, holding a tertiary qualification seems to increase men's average skill level more than women's, mainly due to the greater propensity of women to take humanities-based pathways, to the extent that the numeracy gap disappears when comparing the results of STEM university graduates by gender. The Centre of Italy deviates from this Italian average trend as the gender gap in numeracy disappears completely among university graduates, regardless of their field of study, perhaps due to the higher concentration of 25-65 year-old university graduates in these regions of Italy.

[14] In the case of the Islands, the data cannot be analysed due to small sample size.

Figure 1.13 Average score difference in the literacy, numeracy and adaptive problem solving domains between male and female STEM university graduates by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. Darker colours denote differences that are statistically significant (at 5%). Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates. Countries and economies are ranked in descending order of scores among graduates in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

1.2.3 Adult skills and age

The PIAAC survey covers an age range spanning from the end of compulsory schooling (which in many countries ends around the age of 15 to 16) to the onset of retirement age (which in many countries is around 65). In the second cycle of the PIAAC, the survey population comprises adults born between 1957 and 2007. Due to the cross-sectional nature of the data, the survey provides a snapshot of the skills of different adults at different ages at a particular point in time. This means that differences in skills between adults of different ages may depend on age-, cohort- and period-related effects. While age effects concern changes due to ageing, cohort effects reflect the different experiences of people born at different times (such as, for example, the effects of significant reforms in the education system), and period effects capture influences that vary over time (such as, for example, a change in macro-economic conditions, or events like the Covid-19 pandemic). These three effects are interconnected and not easily distinguishable by observing data collected at a single point in time. This section will focus on the differences in proficiency observed between the different age groups, while Chapter 2 below compares the results of the 2023 survey with those from Cycle 1, in order to investigate the age and cohort effects separately[15].

A close relationship between cognitive skills and age was found in all countries analysed: average proficiency level tends to decrease as age increases.

Confirming what has been said, in the literacy domain, young people aged 16-24 in Italy and all its macro-areas achieve the highest proficiency scores in this domain, while the lowest score is achieved by individuals aged 55-65 (Figure 1.14). This finding is common to other countries also, such as Austria, Chile, Korea, Croatia, Germany, Ireland, Czechia, Lithuania, Poland, Portugal, Singapore, Spain and Switzerland.

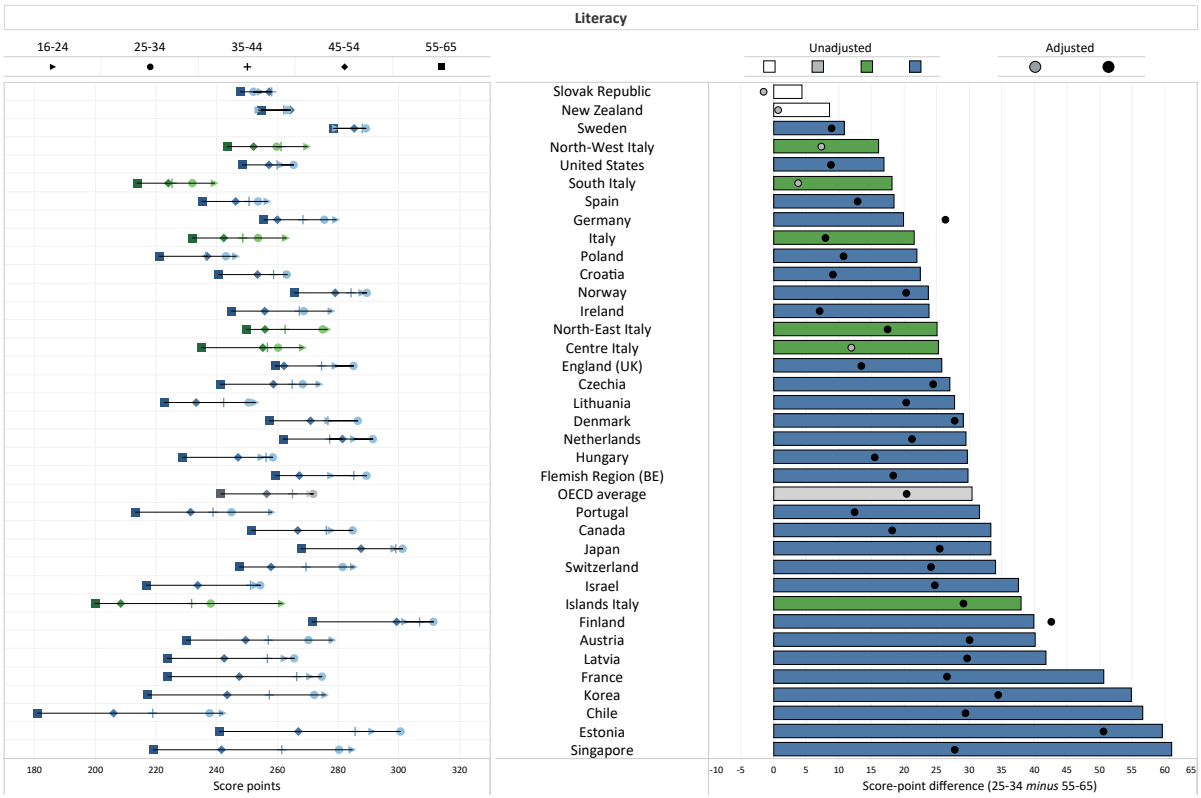
In the remainder of the countries participating in the survey (15 out of 31 countries), with the exception of New Zealand and the Slovak Republic, the 25-34 year age group have the highest literacy skills.

In Italy, the average literacy score achieved by 16-24 year-olds is 263 points, significantly lower than the OECD average (271 points); 55-65 year-olds score 232 points, also significantly lower than the OECD

[15] In this Report, period effects are not investigated.

average (241 points).
An advantage of younger cohorts over older cohorts with regard to average literacy by age group is also observed in the Italian macro-areas. Young people in the 16-24 age group score highest in all macro-areas, but with some disparities: North-East (276 points), North-West (270 points), Centre (268 points), Islands (261 points) and South (239 points). In particular, at 276 points, young people in the North-East score significantly above the average for Italian 16-24 year-olds, and are in line with the OECD average. Young people aged 16-24 in the South of Italy, meanwhile, rank lowest (239 points) in their age group of all countries in the PIAAC survey (OECD average 271 points). In this analysis, the results of 16-24 year-olds in the Islands differ significantly from those recorded in the South; at 261 points, their proficiency level is consistent with the Italian average and with the other macro-areas. This 16-24 year-old group achieve the only "positive" result for the Islands, given the very wide gap of 61 points with respect to 55-65 year-olds.
For the purposes of comparison with the other countries and economies, where, as already noted, the highest proficiency scores were generally achieved by 25-34 year-olds, the difference in proficiency between this age group and adults aged 55-65 will now be analysed (Figure 1.14).
Differences in proficiency between two age groups can be read differently: large gaps reflect a marked divide between the two groups (high skills for one and low skills for the other), whereas small gaps highlight a very narrow generational variance, which can either translate into good performance for both groups, in the case of both categories ranking highly, or into low skills for both groups when they appear towards the bottom of the ranking.
In Italy, the average gap is 22 points, while in the macro-areas the gap ranges from 38 points difference in the Islands to 25 points in the Centre and North-East, 18 in the South and 16 in the North-West. In the South, the small gap in scores between the two age groups under comparison is due to the low scores achieved by both categories, but particularly by young people (with 232 points, 25-34 year-olds in the South rank below all countries); in the North-East, in contrast, though the gap is wide (25 points), it highlights the good performance of both young people and older adults who rank in the top 14 and top 12 respectively for literacy proficiency.
Even when other socio-demographic characteristics are held constant, and although the gap narrows compared with the unadjusted estimates, significant differences remain in favour of 25-34 year-olds both in Italy and internationally, indicating a strong relationship between age and proficiency. In the North-West, Centre and South of Italy, however, the gap between the two age groups is not significant, indicating that, in these areas, the differences between the two generations may be entirely attributed to the other characteristics examined in the multivariate analysis.

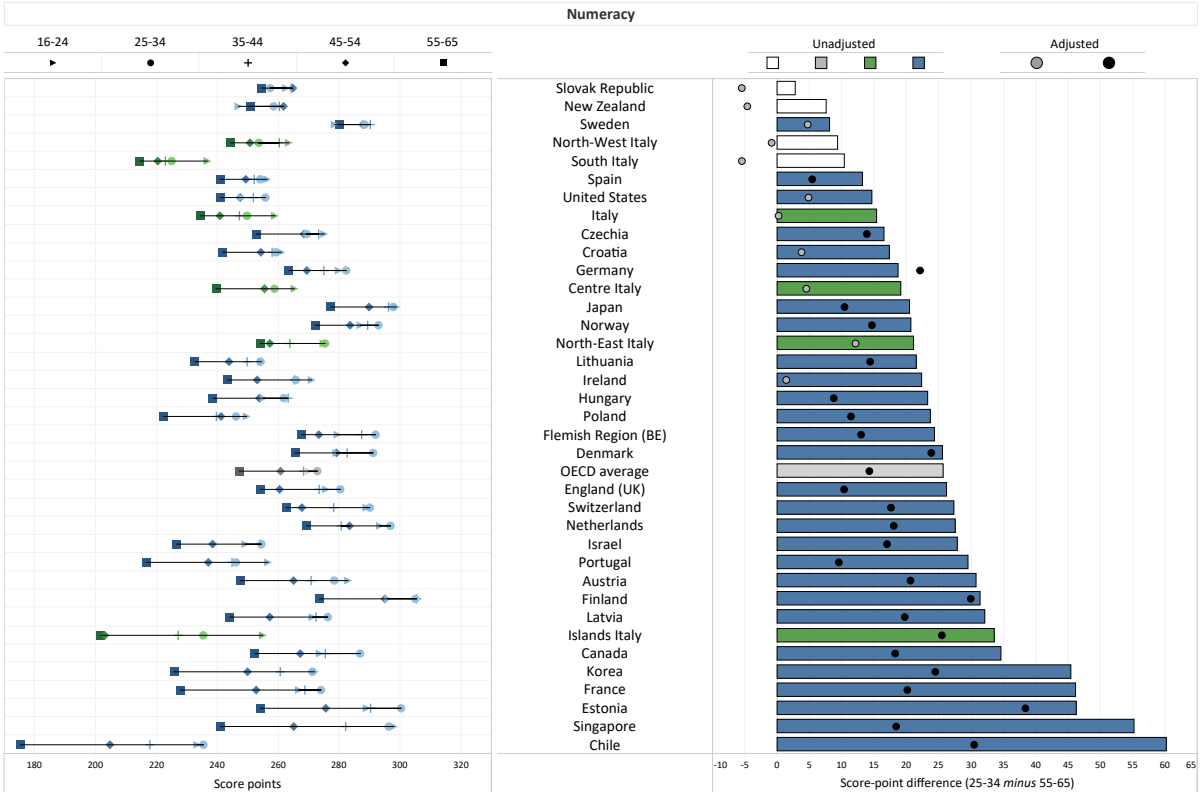
Figure 1.14 Average score in the literacy domain by age group and average score difference between 25-34 year-olds and 55-65 year-olds by country and Italian macro-area



Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The negative association between age and cognitive skills is also evident when analysing the results in the other two domains in the survey.
Indeed, in the numeracy domain (Figure 1.15) too, the highest proficiency levels are achieved by individuals aged 16-24, with an average of 259 points in Italy, a score that is, however, lower than the OECD average of 270 points. The results for the Italian macro-areas are: North-West 263, North-East 275, Centre 265, South 237 and Islands 255. The North-East score, which is the highest recorded, is significantly higher than the Italian average and in line with the OECD average.
As in the case of literacy, the Italian trend across age groups differs from the international picture, where the best proficiency is always recorded among 25-34 year-olds; the OECD average for this group is 273 points, statistically higher than Italians in the same age group who score 250 points.
With 275 points, young people aged 25-34 in the North-East, on the other hand, are in line with the OECD average (273 points), scoring above the other macro-areas but also above other countries, such as Chile, Croatia, Israel, Lithuania, New Zealand, Poland, Portugal, Slovak Republic, Spain, the United States and Hungary. The picture is decidedly less rosy for young people aged 25-34 from the Islands and the South who, scoring 235 and 225 points respectively, find themselves at the bottom of the international ranking.
The geographical heterogeneity in Italy is also reflected in the wide variation in numeracy proficiency between 25-34 year-olds and 55-65 year-olds, albeit with some differences: setting aside the 9- and 10-point differences in the North-West and South, which are not statistically significant, the gap between these two age groups spans from 19 points in the Centre to 34 points in the Islands, while the average Italian difference is 15 points, compared to an OECD average of 26 points. When considering the differences that emerge from the adjusted estimates, however, the disparities between these two cohorts disappear both in Italy and in its macro-areas, with the exception of the Islands where the gap is reduced from 34 to 25 points, remaining significant. This result suggests that, while in Italy other factors (including, for example, a given educational qualification or family background) may come into play to eliminate the gap between the two cohorts, potentially helping 55-65 year-olds to retain their skills or diminishing the performance of the younger cohort, this does not happen in the Islands where the performance of 55-65 year-olds evidently depends solely on the age effect.

Figure 1.15 Average score in the numeracy domain by age group and average score difference between 25-34 year-olds and 55-65 year-olds by country and Italian macro-area

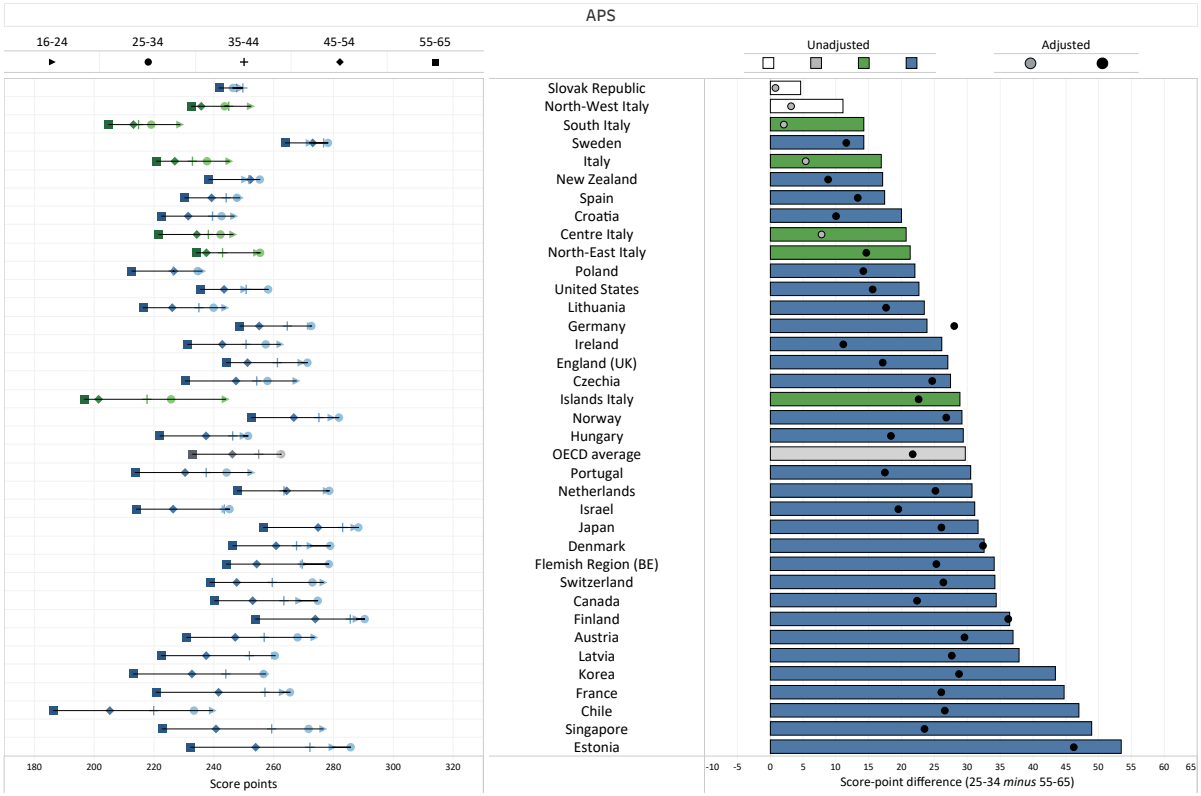


Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parental educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In the adaptive problem solving domain also (Figure 1.16), it is once again the 16-24 year-olds who achieve the highest proficiency levels in Italy, with an average score of 245 points. The results by macro-area confirm the advantage of young people in the North-East (254) over the same age group in the other geographical areas: North-West (252), Centre (246), Islands (244) and South (229).
That very young adults demonstrate higher proficiency in the APS domain may seem surprising, given the underlying cognitive process involved – namely, the ability to solve problems, including complex ones. However, it is also true that the environment in which 16-24 year-olds operate today is dynamic and often digitalised, as required by the assessments in this domain (see Appendix 1).
Internationally, in the APS domain, 16-24 year-olds and 25-34 year-olds demonstrate the same skill level with a score of 262 (OECD average); a similar result is evident in the North-East, where both age groups achieve a similar score (16-24 year-olds: 254; 25-34 year-olds: 255).
The North-East of Italy is confirmed as the macro-area where the proficiency of young adults aged 25-34 is, across all domains, in line with the OECD average, and even higher than in other countries, such as Chile, Croatia, Lithuania and Portugal.
A comparison of the 25-34 and 55-65 age groups reveals a significant gap of 17 points in Italy in favour of younger people; this gap is eliminated, however, when socio-demographic characteristics are controlled for (adjusted values). At a macro-area level and without adjusting for socio-demographic characteristics, the score differences range from 14 points in the South to 29 points in the Islands; only in the North-West are no statistically significant differences recorded.
In terms of adjusted estimates, on the other hand, the gap between the two age groups is not significant in the Centre and the South, but still significant in the North-East and the Islands, where the difference is 15 and 23 points respectively, and still not significant in the North-West.
The differences in proficiency observed between adults and young people in the North-East are similar to those in Poland and the United States, albeit determined by different factors: in the North-East, as in the United States, the difference is due to the positive performance of the 55-65 age group (234 points) in the international context, ranking just above the OECD average (233 points), while in Poland both age groups rank at the bottom.

In the Islands, on the other hand, the wider gap (23 points) between 25-34 year-olds and 55-65 year-olds is due to the lower proficiency scores achieved primarily by older adults compared to the international average; only in Chile do 55-65 year-olds achieve a lower score, widening the gap with 25-34 year-olds to 27 points.

Figure 1.16 Average score in the adaptive problem solving domain by age group and average score difference between 25-34 year-olds and 55-65 year-olds by country and Italian macro-area



Note: adults 16-65 years. Doorstep included. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in ascending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In Italy, the generational gap is evident between 25-34 year-olds and 55-65 year-olds (with differences of 22, 15 and 17 points recorded in the domains of literacy, numeracy and adaptive problem solving), demonstrating the strong relationship between age and proficiency and how skills are not static but can instead be acquired and developed throughout life, and also lose value and, as in the case of 55-65 year-olds, decline. In Italy, however, this gap between the two groups is not very marked compared to the other countries and economies, and, unfortunately, lower levels of performance are recorded for both groups; this is in contrast to many other OECD countries and to the North-East, where a wider difference is matched by good performance by adults aged 55-65.
The process of acquiring and maintaining skills over the course of a lifetime is complex, given the various factors that can influence them, such as family, school and work environment, cultural background and the effects of ageing itself. The North-East, however, is the macro-area that demonstrates that skills, perhaps developed and nurtured in a favourable social and economic context, or supported by specific actions and investments, can be maintained over time.

1.2.4 Adult skills and family background

Differences in the skill level demonstrated by individuals are strongly correlated with their family background (Kao and Thompson 2003; Paino and Renzulli 2013; Baker *et al.* 2002). This finding is well-established in the literature and has been confirmed, over time, in various surveys on the skills of both students and the adult population: people with low proficiency levels are predominantly from culturally disadvantaged families, where parents have low educational attainment (OECD 2023b; Grotlüschen *et al*. 2016; Mineo and Amendola 2018; INAPP 2022).
The variables most commonly used as proxies of family background are parents' educational qualification,

income and/or employment status. In this Report, as in the international report by the OECD, the highest educational qualification obtained by the respondents' parents will be used. In the analysis below, the indicator adopted to measure family background takes three forms: no parent who attained upper secondary education; at least one parent who attained upper secondary education; at least one parent who attained tertiary education.

International data from the second cycle of the PIAAC Survey confirm the trend described above, showing that adults who had at least one parent with tertiary education score better than those whose parents have at least upper secondary education (the OECD average advantage is 20 points in literacy, 21 in numeracy and 17 in APS); the latter, in turn, score better than adults from families where no parent has attained upper secondary education (the OECD average advantage is 30 points in literacy, 29 in numeracy and 25 in APS). This result is observed in all participating countries and across all three skill domains investigated, but with considerable differences between countries (Figures 1.17, 1.18 and 1.19). Except for Italy. Indeed, Italy and its macro-areas are the only areas among those analysed where adults with at least one parent with tertiary education do not achieve statistically different average scores from those of individuals whose parents did not attain more than secondary education, in either the numeracy or literacy domains. In contrast, this difference is positive and statistically significant with respect to APS skills both nationally and in the South of Italy. This figure further confirms the limited return on tertiary education in Italy, a finding already observed in the context of the analysis of the educational attainment by adults (cf. 1.2.1).

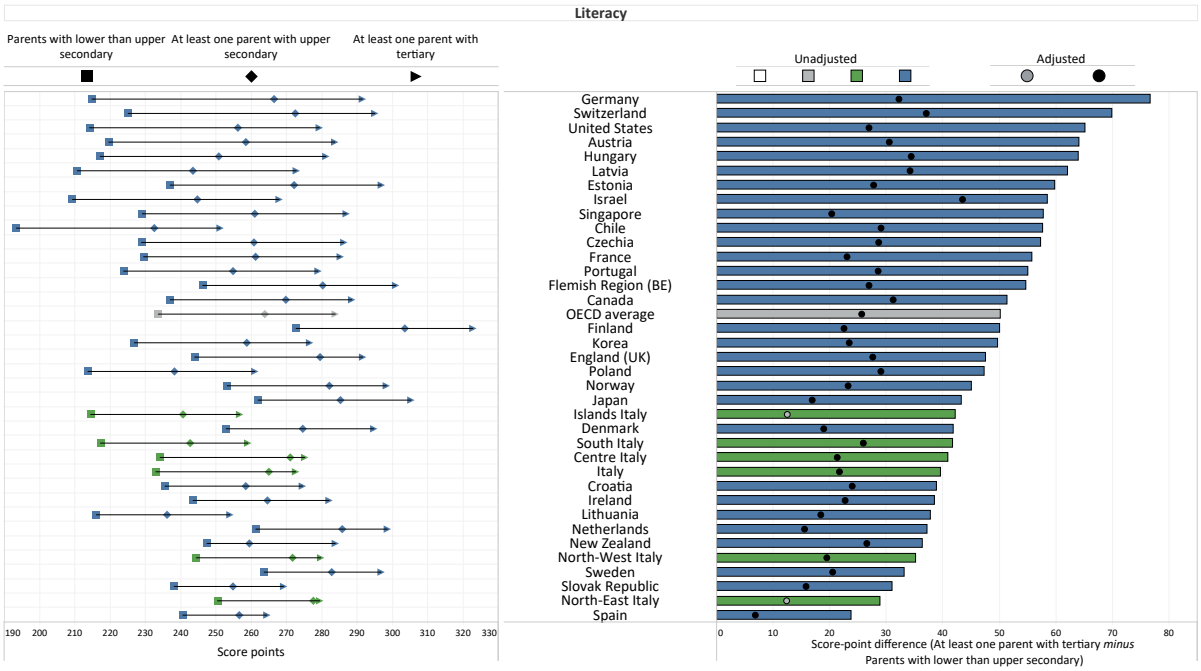
In Italy, people from a disadvantaged family background, i.e. where no parent has attained upper secondary education, score significantly lower than the national average across all domains in the survey. Specifically, this group achieves an average score of 233 in literacy (compared to a national average of 245), 232 in numeracy (compared to a national average of 244) and 221 in APS (compared to a national average of 231). In contrast, people from more advantaged family backgrounds, i.e. where at least one parent has attained tertiary education, achieve average scores of 272 in literacy and numeracy and 253 in APS. Individuals from an average family background (with at least one parent having attained upper secondary education) and from a high family background (with at least one parent having attained tertiary education) score above the national average in all domains surveyed. The average increase ranges from around 15 to 20 points – depending on the domain – for those with at least one parent who completed upper secondary education, and from 23 to 27 points for those with at least one parent with tertiary education. All these differences are statistically significant.

Figures 1.17, 1.18 and 1.19, in the box to the right, show the differences (unadjusted and adjusted) in average scores in literacy, numeracy and adaptive problem solving between adults from families with at least one parent holding a tertiary education qualification and adults from families where no parent has completed upper secondary education. The difference between these two groups, always in favour of the former, is significant in all countries participating in the PIAAC survey across all three skill domains analysed and remains so even after controlling for differences between the two groups due to other socio-demographic variables (adjusted values), further confirming the decisive role of family background with regard to the proficiency level attained by individuals.

In Italy, the gap between adults with at least one parent who attained tertiary education and those with no parent who completed upper secondary education amounts to 40 points in literacy and numeracy, and 33 points in APS. These gaps are smaller, but remain significant even when controlling for the main socio-demographic variables (adjusted values): 22 points in literacy, 24 points in numeracy and 19 points in APS. Across all macro-areas, family background emerges as a key factor in explaining the different average scores obtained by adults. This relationship is consistently evident throughout the country, with no geographical area deviating significantly from the national average in terms of the magnitude of the effect, just as no significant differences are observed in the effects between geographical areas. This highlights that the influence of family background extends throughout the country and is observed consistently across all OECD countries and economies. In all three domains, the North-East, in line with Spain, is the area with the lowest difference in scores between individuals with parents who attained at least one tertiary qualification and those with no parents who completed upper secondary education: in the literacy and numeracy domains, the difference is 29 and 28 points, respectively. Particularly noteworthy is the observation concerning the phenomenon controlled for socio-demographic characteristics (adjusted values): in both the literacy and numeracy domains, the gap arising from a possible disadvantaged family background persists across the national and international landscape. Only in the North-East and the Islands is this gap not evident, indicating that there is presumably greater heterogeneity of skills in these areas among groups of individuals from similar family backgrounds, heterogeneity linked to individual socio-demographic characteristics. In the adaptive problem solving domain, differences emerge in all macro-areas; after controlling for potential factors at play such as gender, immigrant background and language spoken at home (adjusted), such

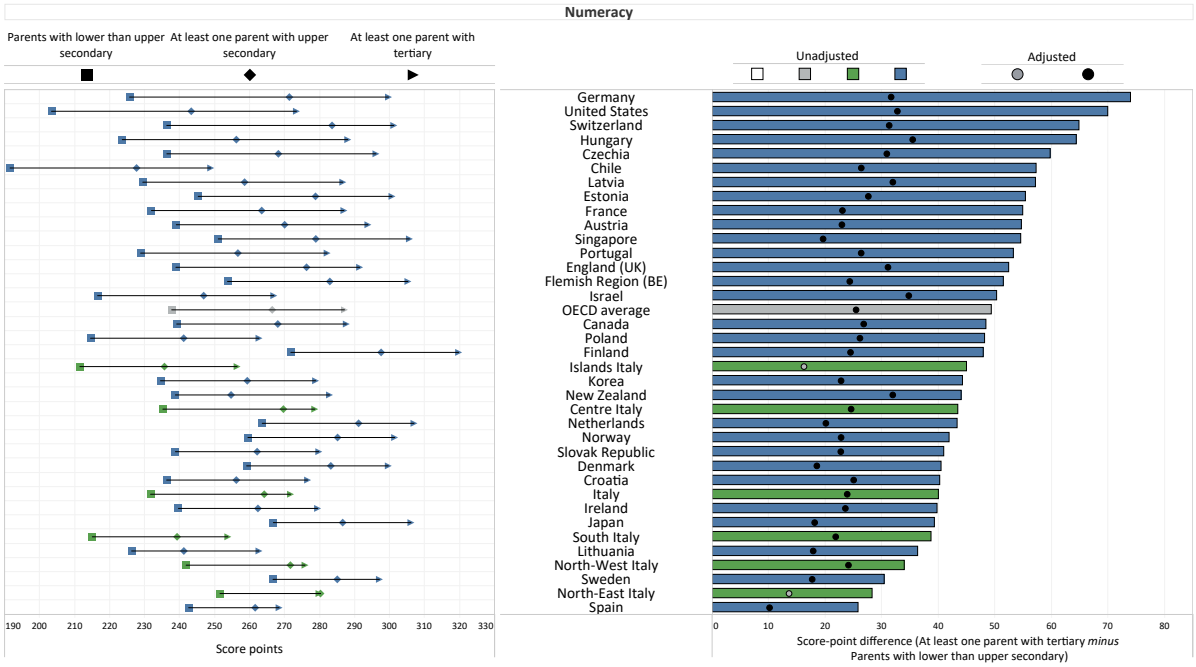
differences are only eliminated for the Islands, thus confirming that the low performance observed in this area in Italy is very much linked to less favourable structural conditions.
At an international level, once the main socio-demographic variables are controlled for (adjusted values), it is Spain that sees the smallest difference in scores between adults with at least one parent who attained tertiary education and adults with no parent who completed upper secondary education, across all skill domains in the survey (7 points in literacy, 10 points in numeracy and 7 points in APS, adjusted values). Next in the international rankings are countries such as Denmark, Japan, Lithuania, the Netherlands and the Slovak Republic, recording differences (adjusted) of between 15 and 19 points in the literacy domain. The largest differences are seen in Israel in the literacy and APS domains (43 and 33 points, respectively, adjusted values) and in Hungary in the numeracy domain (35 points, adjusted value).
A very varied picture once again emerges from the international rankings, with certain countries characterised by strong social differences in which family background determines a major gap in the proficiency level demonstrated by individuals, and other countries where social differences seem less profound and manifest to a lesser extent. It remains the case that statistically significant differences are found in all countries participating in the second cycle of the PIAAC, even after controlling for the impact of other socio-demographic variables. This once again confirms the crucial role of family background – independent of gender, age and educational choices – in determining individuals' skill outcomes and, consequently, in shaping employment, economic and social outcomes.

Figure 1.17 Average score in the literacy domain by family background and average score difference between adults with at least one parent who attained tertiary education and adults with no parent who completed upper secondary education by country and Italian macro-area



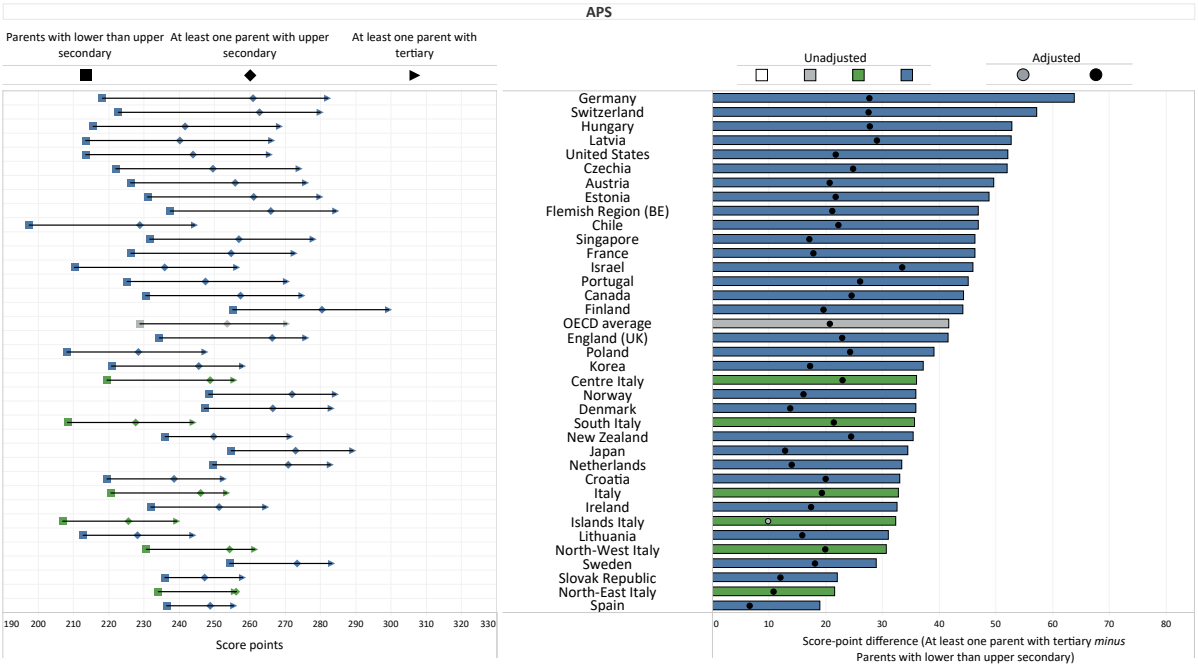
Note: adults 16-65 years. Doorstep excluded. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Figure 1.18 Average score in the numeracy domain by family background and average score difference between adults with at least one parent who attained tertiary education and adults with no parent who completed upper secondary education by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Figure 1.19 Average score in the adaptive problem solving domain by family background and average score difference between adults with at least one parent who attained tertiary education and adults with no parent who completed upper secondary education by country and Italian macro-area



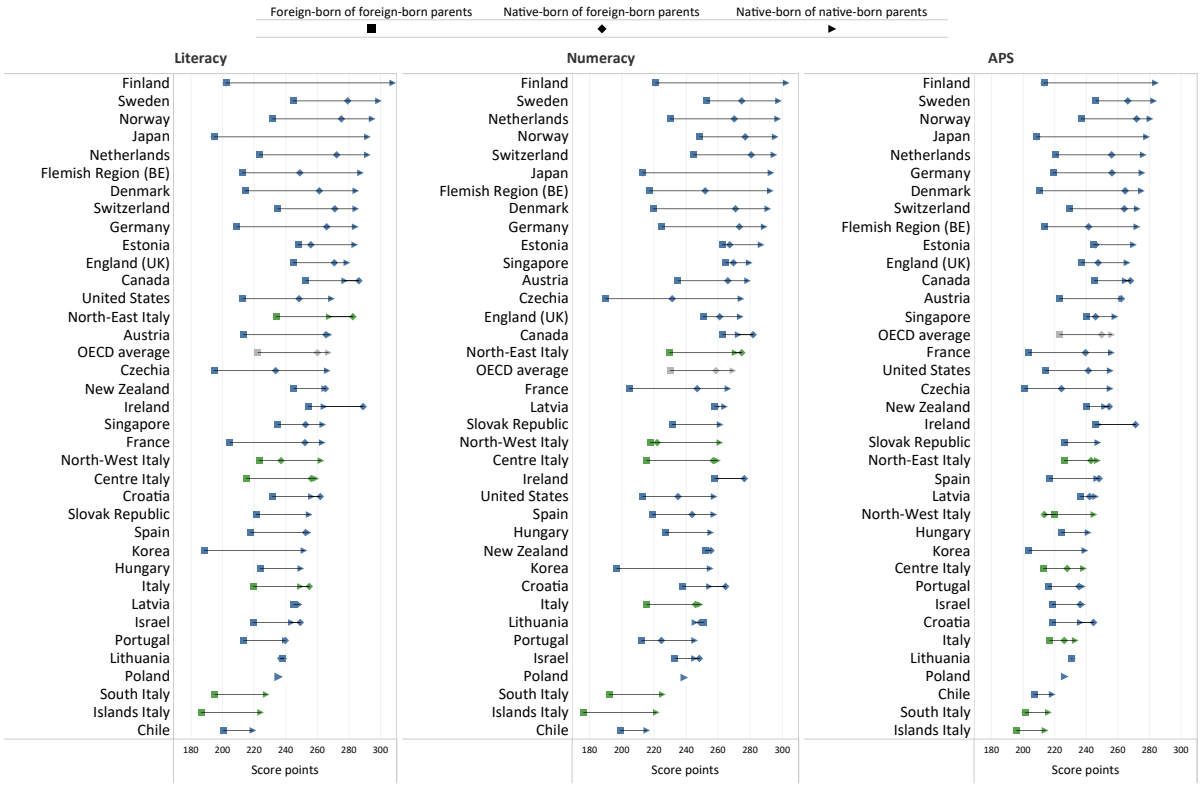
Note: adults 16-65 years. Doorstep excluded. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of the change in the unadjusted average score.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

1.2.5 Adult skills and immigrant background

Migration flows in OECD countries have reached an unprecedented level in recent years, with more than 6 million new permanent immigrants in 2022 (OECD 2023a). In addition, approximately 5 million Ukrainian refugees fleeing the war must be considered as of mid-2023 (OECD 2024b). In this socio-political context, discussions regarding measures to support and facilitate the migrants' integration into host countries' education and training systems, labour market and societies are high on the political agenda (OECD 2024c).
The following section focuses, albeit partially and specifically, on an analysis of the migration phenomenon, examining cognitive skills in the three domains analysed (literacy, numeracy and adaptive problem solving). The analysis subdivides the population in question based on place of birth of the respondents to the PIAAC Survey and place of birth of their parents, identifying three main groups: foreign-born adults of foreign-born parents, native-born adults of foreign-born parents and native-born adults of native-born parents[16].
It should be noted that, in Italy as in other participating countries, the foreign population included in the PIAAC Survey comprises people who are resident in the country; as such, people in the country who are not resident or who are irregular are excluded from the analysis.
Figure 1.20 shows the average literacy, numeracy and adaptive problem solving scores of adults aged 16-65 based on migration status for all countries participating in the second cycle of the Adult Skills Survey and for the Italian macro-areas.
Across all domains in the survey, consistent differences emerge in adult scores based on immigrant background. At the international level (OECD average), native-born adults of native-born parents record higher scores (267 in literacy, 269 in numeracy, 256 in APS) than the overall average for all adults residing in the country. Their scores are also higher than those of native-born adults of foreign-born parents (260 in literacy, 258 in numeracy, 249 in APS) and significantly higher than those of foreign-born adults of foreign-born parents (222 in literacy, 230 in numeracy, 223 in APS). The latter group are most disadvantaged in terms of skills demonstrated across all domains and in all participating countries; marked differences are recorded from country to country ranging, in literacy, for example, from 188 points in Korea to 254 in Ireland.
In Italy, foreign-born adults of foreign-born parents achieved an average score of 219 in literacy (compared to a national average of 245), 215 in numeracy (compared to a national average of 244) and 217 in APS (compared to a national average of 231). Adults born in Italy to foreign-born parents, on the other hand, scored 255 in literacy, 246 in numeracy and 226 in APS. Adults born in Italy to parents born in Italy, on the other hand, achieved an average score of 249 in literacy, 249 in numeracy and 233 in APS.
Marked differences emerge from the data on average skills possessed by the adult population based on immigrant background when analysed in relation to the geographical areas of Italy. In areas where the average score of the population aged 16-65 is higher than in the other macro-areas, higher average scores are also recorded for foreign-born adults of foreign-born parents. In the North-East, for example, foreign-born adults of foreign-born parents scored an average of 234 in literacy, 229 in numeracy and 226 in APS, placing them at Level 2, the same level as the average for the Italian population. In the South and the Islands[17], on the other hand, foreign-born adults of foreign-born parents achieved very low average scores (Figure 1.20), all at the lower half of Level 1 in the PIAAC, and certainly not sufficient to guarantee adequate labour and social integration. It should also be noted that the results achieved by foreign-born adults of foreign-born parents resident in the regions of the South and the Islands are significantly lower than those of the same category of the population resident in the North-East, with differences ranging between 25 and almost 40 points in the South and 30 and 53 points in the Islands[18]. The results for this population subgroup in the Centre of Italy (215 in literacy, 215 in numeracy, 213 in APS) and North-West of Italy (223 in literacy, 218 in numeracy, 220 in APS) do not differ in statistically significant terms from those in the North-East.
This points to profound and deep-rooted economic, organisational and social differences that characterise Italy's different geographical areas and that inevitably also, and perhaps to a greater extent, affect people arriving from other countries.
The average score for individuals born in Italy to foreign-born parents in the literacy domain is 282 points in the North-East, corresponding to Level 3, while intermediate scores, at Level 2, are recorded in the Centre (256) and the North-West (237). The figure for the South and Islands is not reported due to insufficient sample size, which would lead to unreliable estimates.

[16] The other categories are: foreign-born adults of native-born parents and adults (native- or foreign-born) with just one foreign-born parent.
[17] Score for the South (195 literacy, 192 numeracy, 201 APS) and the Islands (186 literacy, 176 numeracy, 196 APS).
[18] The difference in scores is 39 in literacy, 38 in numeracy and 25 in APS for the South, 47 in literacy, 53 in numeracy and 30 in APS for the Islands.

Figure 1.20 Average score in the literacy, numeracy and adaptive problem solving domains by immigrant background by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates. Countries and economies are ranked in descending order of average score of native-born adults of native-born parents in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Figure 1.21 shows the differences (unadjusted and adjusted) in average scores in literacy, numeracy and APS between different groups based on immigrant background and, specifically, allows for a more analytical comparison, for each domain, of the results of native-born adults of native-born parents with those of foreign-born adults of foreign-born parents.

As shown in Figure 1.21, the differences between native-born adults of native-born parents and foreign-born adults of foreign-born parents are significant in almost all countries participating in the PIAAC 2023 in favour of native-born adults of native-born parents. When the adjusted data are taken into account, three countries (Latvia, Lithuania and the Slovak Republic) deviate from the general trend in the literacy domain, four countries (Croatia, Latvia, Lithuania and the Slovak Republic) in the numeracy domain, and six countries (those listed for numeracy, as well as Ireland and Hungary) in the APS domain. These data suggest that – based on a small number of countries where differences in adults' proficiency appear to be linked to other socio-demographic variables rather than immigrant background – in countries where such differences remain significant even when adjusted, foreign-born adults of foreign-born parents are generally at a disadvantage in terms of skills compared to native-born adults, primarily attributable to their country of origin.

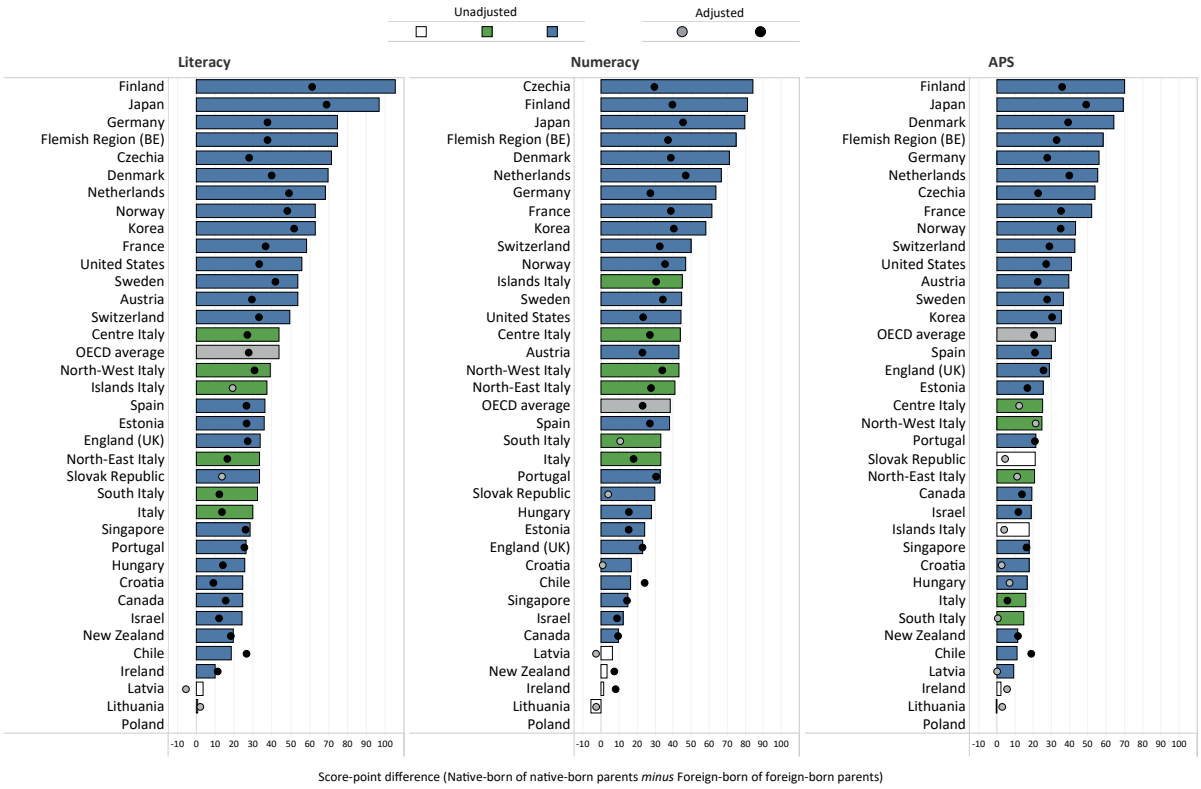
In Italy, the average score difference between native-born adults of native-born parents and foreign-born adults of foreign-born parents is 30 points in literacy, 33 points in numeracy and 16 points in APS, in all cases to the disadvantage of the foreign-born group.

An analysis of these differences across the Italian macro-areas reveals consistently significant differences in the literacy domain, even when controlled for the main socio-demographic characteristics (adjusted estimates), across all macro-areas except the Islands. The (adjusted) differences range from a maximum of 31 points in the North-West, to 12 points in the South, the lowest value, encompassing 27 points in the Centre and 16 points in the North-East, the latter being slightly higher than the national average of 13 points. The situation is almost the same for numeracy; in the latter case, however, the adjusted estimates are significant in all macro-areas except the South. The (adjusted) differences in this case are 34 points in the North-West, 28 points in the North-East, 27 in the Centre and 30 in the Islands. In the adaptive problem

solving domain, the adjusted differences between native-born adults of native-born parents and foreign-born adults of foreign-born parents remain significant but are smaller than those recorded in the literacy and numeracy domains: specifically, a difference of 21 points in the North-West, 11 in the North-East and 12 in the Centre.

As regards Italian macro-areas, the above data generally confirm the extent to which immigrant background can be regarded as a determinant when considering the different proficiency levels of native-born adults and foreign-born adults of foreign-born parents. This is particularly the case in literacy, a domain closely linked to mastery of the language in which the assessments are administered, but also in the numeracy and adaptive problem solving domains, in any case closely tied to literacy. It should be noted, for example, that all assessments, independent of the specific skill required, are accompanied by instructions and texts of varying length and complexity that, in any case, require the ability to access, understand and use an Italian language text in order to respond.

Figure 1.21 Average score difference in the literacy, numeracy and adaptive problem solving domains between native-born adults of native-born parents and foreign-born adults of foreign-born parents by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%). Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates. Countries and economies are ranked in descending order of the change in the unadjusted average score in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

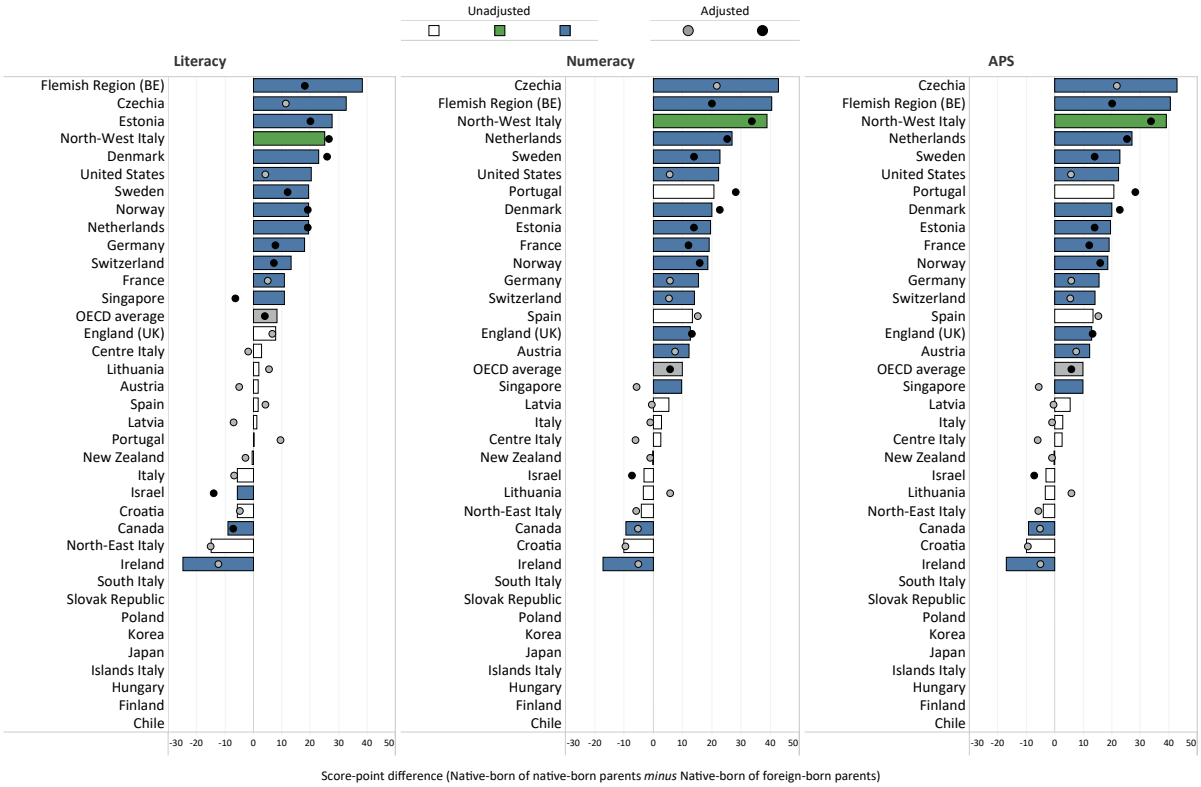
A very different situation emerges when comparing native-born adults of native-born parents to native-born adults of foreign-born parents, as shown in Figure 1.22. In this case, as already evident from the international average, the differences (8 points in literacy, 10 in numeracy and 6 in APS) are significantly reduced across all skill domains analysed, and are even eliminated in many countries.

In Italy, these differences are not statistically significant either at a national level or at a macro-area level for any of the domains analysed, except in the North-West. Here, adjusted differences of 27 points in literacy, 34 points in numeracy and 35 points in APS are recorded between native-born residents of native-born parents and native-born residents of foreign-born parents, in favour of the former. As both groups comprise native-born adults, and controlling for other socio-demographic variables, it appears that in this macro-area, the mere fact of whether adults' parents were born in Italy or abroad gives rise to a significant difference in skill outcomes.

In contrast, national average data and results for the other macro-areas show that being born in Italy, even

to parents born abroad, represents an advantage in terms of skills over those born abroad to parents also born abroad. This advantage enables such adults to achieve and demonstrate skills comparable to those of adults born in Italy to Italian-born parents.
This finding suggests that the context in which an individual is raised, characterised by access to the education system and culture of the country of residence, plays a determining role in the development of cognitive skills, regardless of one's family's country of origin.

Figure 1.22 Average score difference in the literacy, numeracy and adaptive problem solving domains between native-born adults of native-born parents and native-born adults of foreign-born parents by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The adjusted differences are estimated through a linear regression model using age, educational attainment, gender, immigrant background, language spoken at home and parents' educational attainment as predictors (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%). Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates. Countries and economies are ranked in descending order of the change in the unadjusted average score in the individual domains.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

2 The evolution of skills over time

Introduction

The PIAAC Survey was designed to provide a solid information base for analysing adults' skills internationally and over time, including in comparative terms, by means of surveys administered in periodic cycles.
Indeed, the PIAAC Cycle 1 Survey (conducted between 2011 and 2018) builds on the first international surveys developed by the OECD, specifically the International Adult Literacy Survey (IALS) carried out between 1994 and 1998 and the Adult Literacy and Life Skills Survey (ALL), conducted between 2003 and 2007. As such, Cycle 2 (2022-2023) is positioned within a comparative framework spanning almost 30 years. A detailed analysis of the relationship between PIAAC and the IALS and ALL surveys is provided in the INAPP and OECD reports on the theoretical frameworks of the second cycle (INAPP 2021a and 2021b; OECD 2021). A comparative overview of these surveys with the two PIAAC cycles is presented, at the international level, in the OECD Report (OECD 2024a), and will be further explored in forthcoming INAPP publications.
This chapter describes the changes in proficiency, in the literacy and numeracy domains, of adults aged 16-65 in the countries and economies that participated in both the first (2011-2018) and second (2022-2023) cycles of PIAAC. Changes in the distribution of proficiency will be examined for the adult population as a whole, as well as for specific groups defined by age, gender, educational qualification, immigrant background and family background.
Changing economies – along with social and demographic developments, including ageing population, increased participation in formal and non-formal learning pathways and migration flows – continue to reshape the supply of skills. PIAAC provides a wide range of information on adults' skills, thus also enabling analyses to be performed over time to verify the dynamics and measure the stocks. The methodology and tools used in Cycle 2 of the PIAAC Survey are largely similar to those used in Cycle 1, but they have been updated to take into account the increasing ways in which individuals interact with information management in contemporary society. Box 2.1 provides an overview of the methodological and technological changes between the two survey cycles, expanding on the information already set out in the Reader's Guide to this Report. As regards problem solving, the data from Cycle 1 and Cycle 2 of the Survey are not comparable, specifically due to the differences in the underlying constructs: in Cycle 1, the skill domain was defined as problem solving in technology-rich environments, while in Cycle 2 the domain assesses adaptive problem solving. As such, this domain will not be analysed in this chapter.

A total of 27 countries and economies participated in both cycles of the survey. The second cycle was conducted in 2022/23, while the first was carried out in three rounds: the first in 2011/12, the second in 2014/15 and the third in 2017/18. As different countries and economies participated in Cycle 1 in different years, the amount of time that has elapsed between the two data collections is not the same for all. Most countries and economies (21 out of 27) participated in Round 1 of Cycle 1, 11 years before Cycle 2; therefore, for ease of exposition, this chapter often refers to changes that occurred "over the past decade". Five countries participated in Round 2 of Cycle 1, eight years before Cycle 2. Hungary is the only country that participated in Round 3 of Cycle 1, only six years before the second cycle. Due to these differences, the size of the change in competences between the survey cycles is not comparable across the participants in the different rounds of the first cycle. The rounds will be highlighted for all figures in this chapter, indicating the year that each individual country and economy participated in the survey and, for these reasons, no results are given for the average across OECD countries.

Box 2.1 Methodological changes between Cycle 1 and Cycle 2 of PIAAC

In designing the second cycle of the Adult Skills Survey, great care was taken to ensure the comparability of the results with those of the first cycle; for this reason, the survey methodology has remained almost unchanged, as have the tools, namely the Background Questionnaire and Assessments.
The questionnaire was administered, in both cycles, in CAPI mode by trained interviewers who then supervise while the adult respondents were completing independently the assessments. The sections and questions of the questionnaire remained largely similar to those administered in Cycle 1; also, in order to ensure the comparability of the assessments, parts of the literacy and numeracy items from Cycle 1 were retained and administered in Cycle 2 as well.
The use of identical items (both in terms of questions in the BQ and assessments) in the first and second cycles offers the advantage of allowing the analysis of trends between the two cycles, e.g. monitoring and examining changes in skills over time and their impact on labour market outcomes.
At the same time, however, some innovations were introduced to improve the content, design and administration of the survey itself. As a supplement to the information already highlighted in the Reader's Guide of this Report, further specifications on the methodological differences between the two cycles are set out below (OECD 2024b).

Framework updates
The questionnaire framework was subject to critical evaluation and careful revision by a group of academic experts and, again with the aim of ensuring comparability with Cycle 1, some important innovations were implemented: several items were updated and improved, and new constructs were added to capture, in particular, educational pathways and social and emotional skills.
Specifically, the revisions to the BQ in the PIAAC focused on:

- Adapting to new international standards
- Adapting to changes in technology
- Additional information on work environment and the use of high-performance work practices to make the most of workers' skills
- More detailed information on the pathways taken by respondents in their education and training careers
- A self-assessment of social and emotional skills.

The theoretical frameworks of literacy and numeracy have both been updated, in particular to account for the increasing use of digital devices in both professional and personal life and the consequent evolution of skills in complex digital environments. The literacy assessment in the second cycle encompasses a broader spectrum of digital texts, including texts from multiple sources, and places greater emphasis on the cognitive process of assessing the accuracy and credibility of information, underlying the reading task (see Appendix 1 of this Report). The numeracy assessment has also been updated, with more emphasis on the interpretation of mathematical information presented in dynamic forms (as on interactive websites) or structured forms (e.g. infographics) and making judgements based on a critical evaluation of mathematical information.
As a result, adult skill assessments in both PIAAC cycles are comparable, although not identical. In general, the new framework refers to a broader set of items, thus improving measurement through better coverage of so-called alphabetic and mathematical constructs. The so-called trend items (common to both cycles) provide the psychometric basis for linking the results of the two surveys, thus yielding a single measurement scale. The "residual" uncertainty, associated with changes between the two cycles, can and should be estimated, by analysing trends in skills, through use of the linking error, incorporated in all analyses in this chapter (OECD 2024b).
Furthermore, the assessment of literacy and numeracy proficiency, in this Cycle 2, was supplemented by the results of the reading component for literacy and the numeracy component for numeracy. While the reading components were already present in Cycle 1, they were not integrated as measurement elements for estimating the literacy levels of the adults who completed them. The numeracy components, on the other hand, were introduced with this new cycle of PIAAC. More details on the components can be found in Appendices 1 and 2 of this Report.

A tablet-based assessment
Cycle 1 of the PIAAC was designed to administer the assessments primarily using computers (CBA,

Computer-Based Assessment). For those found to be unfamiliar with the use of computers (determined via a special test) or reluctant to use them, the assessments were administered on paper (PBA, Paper-Based Assessment).
In the second cycle, tablet devices were introduced to fully reap the benefits of a CBA and this was the sole mode of administering the assessments. The CBA enables use of items that resemble the sort of digital information now commonly found in everyday life (e.g. reading digital texts or interacting with mathematical information on digital devices). It also allows for automatic scoring, without the subjectivity of "human" correction. The graphic layout of the assessments, designed with a user-friendly interface, are introduced in a Tutorial demonstrating the main basic functions of the tablet (tapping, using drag and drop, highlighting text, etc.) and is designed to familiarise the user with the tablet. To ensure comparability of the CBA used in Cycle 2 with the mixed mode (CBA and PBA) used in Cycle 1, the main PIAAC survey was preceded by a Field Test, which supported the validity of the decision to administer the assessments using CBA only.

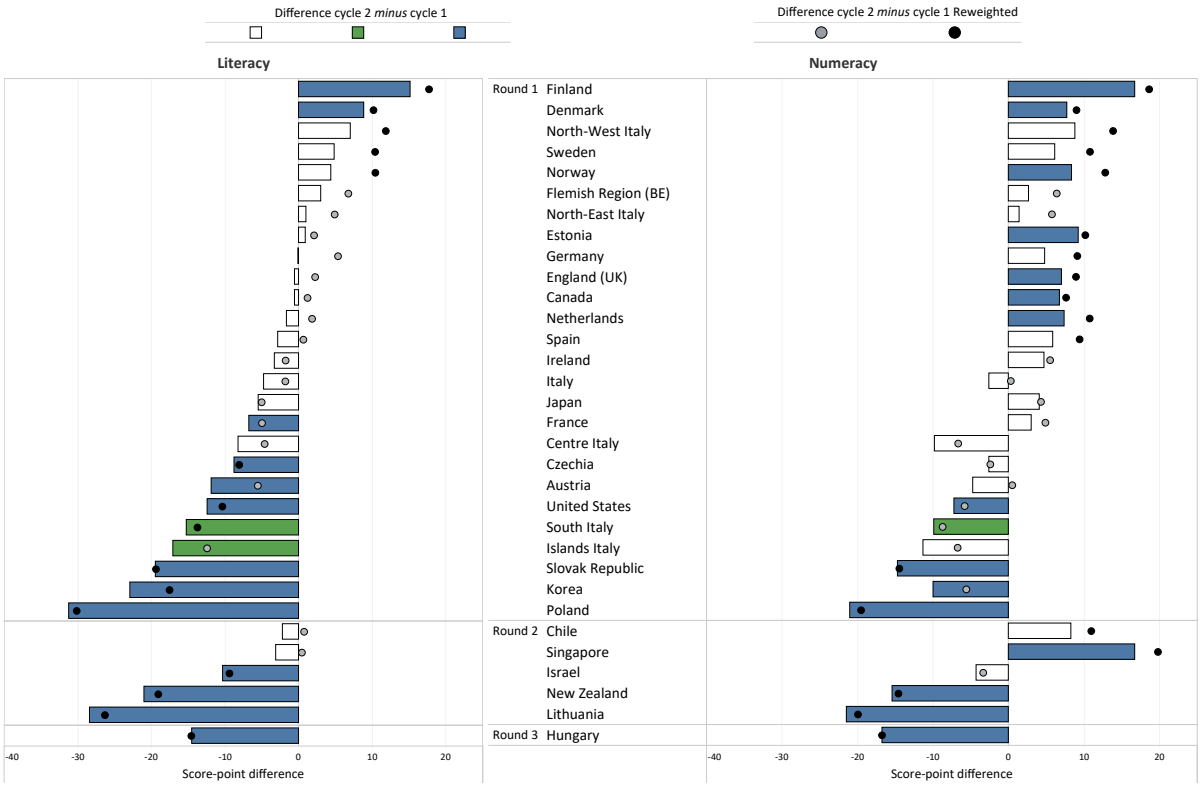
2.1 Changes in proficiency between the first and second cycle of PIAAC

Over the past decade, the literacy and numeracy proficiency of adults in Italy has remained stable. Figure 2.1 shows the differences between Cycle 1 and Cycle 2 in the literacy and numeracy domains for the countries and economies participating in both cycles.
In the literacy domain, a decline in the proficiency of adults between the two survey cycles was observed in 11 countries and economies, while an increase was only recorded in Finland and Denmark (by 15 and 9 points respectively); across the remaining 14 countries, including Italy[19], the situation was found to be stable.
A varied picture emerged across the Italian macro-areas: in the North-West, North-East and Centre, the difference between the two cycles is not statistically significant, while in the South and the Islands, the average literacy score declined by 15 and 17 points respectively. On the basis of this decline, adults in the regions of the South of Italy achieved the same results as those in Chile, a country characterised by deep economic and social inequalities, whose proficiency levels have remained unchanged over time.
Over the past decade, the demographic composition of the adult population has changed across most countries and economies participating in the Adult Skills Survey. Factors such as larger migration flows and an ageing population may have contributed to a lack of skills growth at a national level, as immigrants and older adults often display lower proficiency levels. In order to isolate the impact of these demographic changes, data from the 2023 Survey were reweighted to match the demographic distribution of the population (in terms of age, gender and immigrant background) in the first cycle[20]. This approach provides an estimation of the proficiency scores that would have been observed in 2023, had the composition of the population remained the same as in the previous cycle.
In addition to estimated average proficiency, Figure 2.1 also reports the reweighted values for Cycle 2, to determine whether the demographic changes over the past decade have had an impact on the evolution of proficiency.
As regards literacy, the reweighted estimates show that in Italy, even with the same demographic composition, no evolution is evident, confirming the stability of the average proficiency level over the decade.
An analysis of the data for the Italian macro-areas, however, reveals two contrasting changes for the South and North-West. In the North-West of Italy, as in Finland, Norway, Sweden and Denmark, had the demographic profile of the adult population in Cycle 2 remained the same as in Cycle 1, proficiency scores would have increased by as much as 12 points; in contrast, in the South, as in Korea, Israel, Lithuania, New Zealand, Poland, Czechia, Slovak Republic, the United States and Hungary, the decline indicated by the not weighted figure would have been confirmed, albeit to a slightly lesser extent, going from -15 points to -14.
A different picture emerges with regard to numeracy proficiency dynamics: 8 countries recorded significant increases in mathematical skills, with the largest increases observed in Singapore (17 points), Finland (17 points) and Estonia (9 points). In 12 countries, including Italy, the situation appears stable, while numeracy skills declined significantly in 7 countries.
As for the Italian macro-areas, the trend in numeracy skills mirrors that observed for Italy as a whole, with proficiency levels remaining stable over the years across all territorial areas. The sole exception is the South, which recorded a decline of 10 points, on a par with Korea and less than the Slovak Republic and New

[19] The 5-point difference observed between Cycle 1 and Cycle 2 is not statistically significant.
[20] See the Reader's Guide for more details on the reweighting procedure.

Zealand (15 points difference), Hungary (17 points difference), Poland (21 points difference) and Lithuania (22 points difference). It should be noted, however, that despite the decline, the aforementioned countries remain at Level 2 on the proficiency scale, while average proficiency in the South dropped from Level 2 (233 points) to Level 1 (223 points).
Accounting for demographic changes that occurred over the past decade, i.e. looking at reweighted results, numeracy skills would have improved in the North-West of Italy, with an increase of almost 14 points, and also in some countries, such as Chile, Germany, Spain and Sweden. In Italy and its remaining macro-areas, the situation would have remained unchanged, with the decline observed in the South being cancelled out. Overall, a similar pattern of evolution over time has been observed in relation to literacy and numeracy in the participating countries and economies. An exception to this pattern is Singapore, where a considerable increase in numeracy proficiency (17 points) was accompanied by stable literacy proficiency. Similar trends are seen in Canada, England (UK), Estonia, the Netherlands and Norway, albeit with much smaller changes in numeracy. In contrast, in Austria, Czechia, France and Israel, numeracy skills have remained stable, while literacy skills have declined.
In Italy, as noted, no changes were seen in either literacy or numeracy, but a deeper territorial analysis shows a decline in both skill domains in the regions of the South of the country, and a decline in literacy for the Islands. Changes over the past decade in the country's demographic structure have, however, influenced skill dynamics; indeed, had the demographic composition remained the same as ten years ago, the North-West would have seen an increase in skills, while the only decline would have been observed in the South, and only in the literacy domain.

Figure 2.1 **Change in average literacy and numeracy proficiency between Cycle 1 and Cycle 2 by country and Italian macro-area**

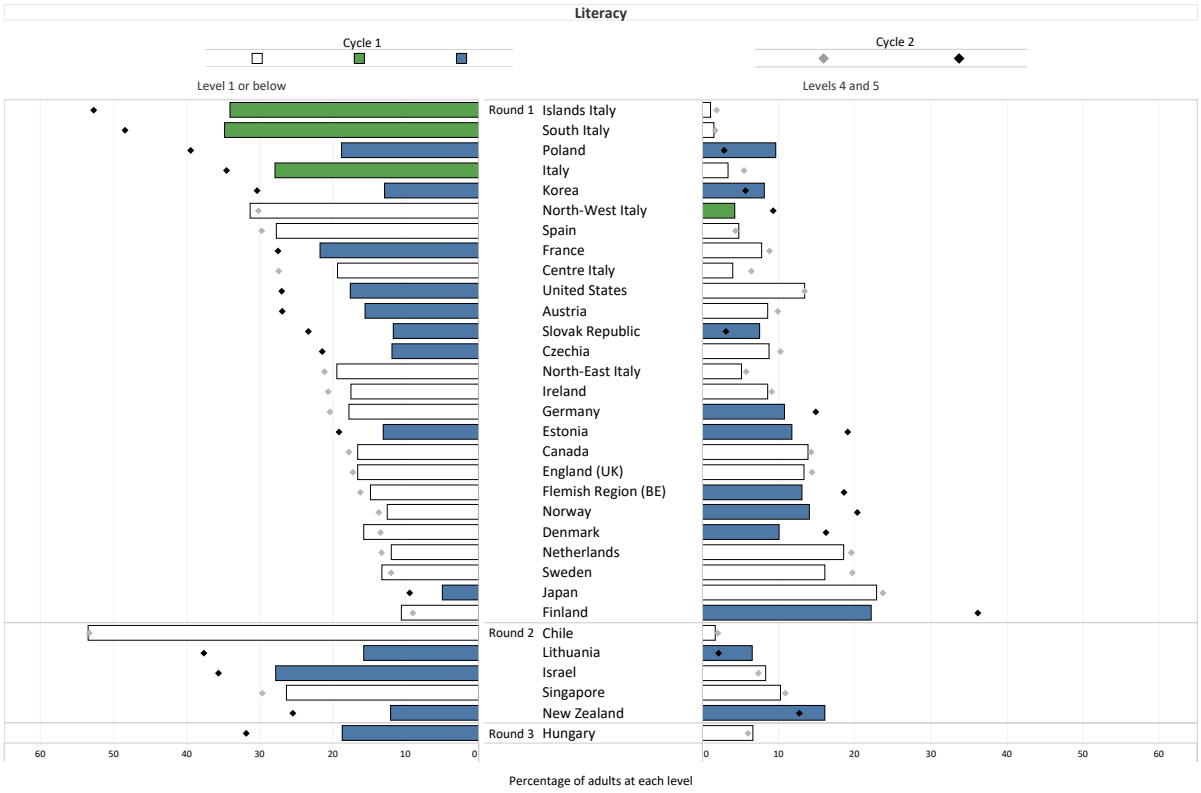


Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of change in literacy scores.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

An analysis of changes in proficiency levels — that is, in the share of adults at each predefined level — shows that Italy does not display a true polarisation of skills. Unlike in other countries, there is no increase in the share of the population at both ends of the scale (the lowest and highest levels).
As regards the literacy domain in Italy, the decrease in the proportion of adults at levels 2 and 3 gives rise to a significant increase only in the share of adults at the lowest proficiency levels (Level 1 and below), while the share of adults at the highest levels (4 and 5) remains substantially unchanged. In fact, the proportion of

so-called low performers (Level 1 and below) rose from 27.9% in Cycle 1 to 34.6% in Cycle 2, an increase of almost 7 percentage points; the proportion of high performers (Level 4 and 5), meanwhile, remained stable, with a slight increase that was not statistically significant (Figure 2.2).
With regard to the macro-areas, an exception is seen in the North-West, where, like Denmark, Finland, the Flemish Region (BE), Germany and Norway, the percentage of adults with scores at Level 1 and below in literacy has remained stable, while the percentage of adults with scores at Level 4 and above has increased. Specifically, the percentage of high performers increased by 5%, from 4.2% to 9.2%.
In the North-East and Centre, the distribution of low and high performers has remained stable, while in the South and the Islands, a stable situation at the top end of the proficiency scale is accompanied by a clear – though expected – increase in the share of low performers, rising by almost 14 percentage points in the South and by 19 percentage points in the Islands.
At an international level, an increase in the share of low performers was observed even where no decline in average proficiency level was recorded: this is the case in Italy where, as shown previously, the average proficiency level is stable, as is also the case in Estonia and Japan.

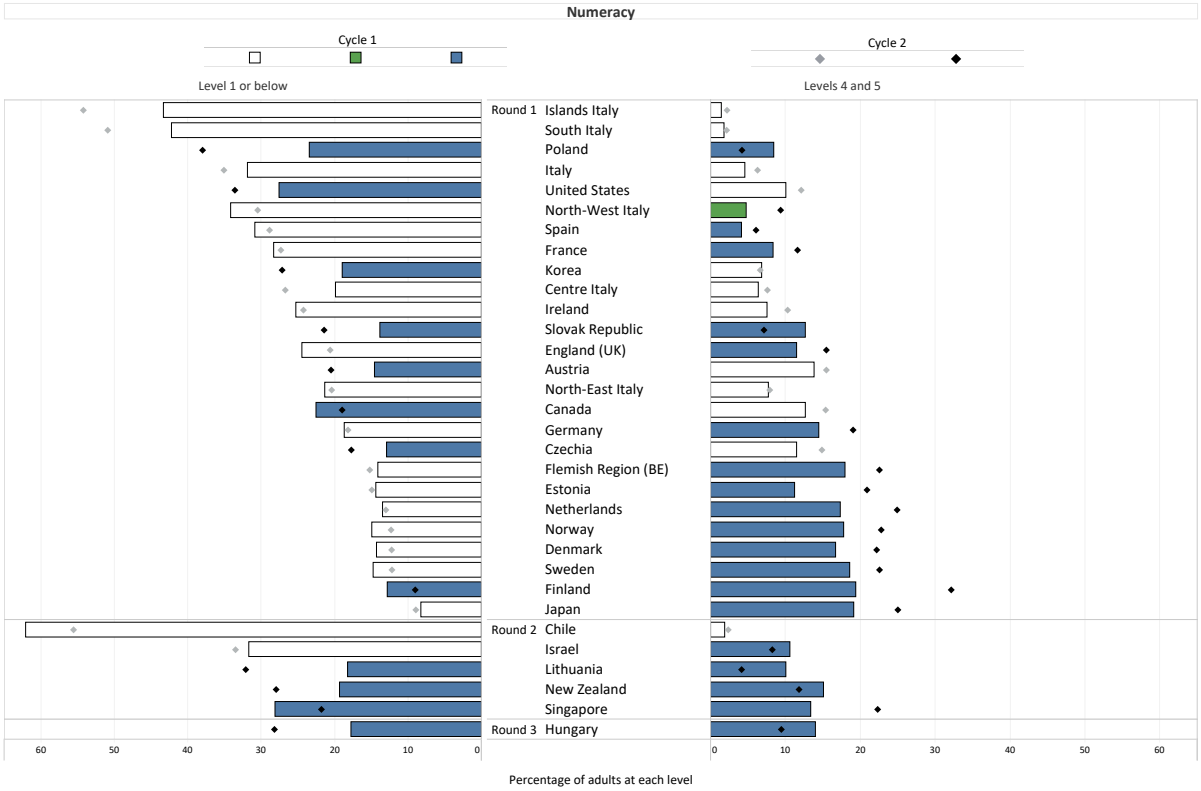
Figure 2.2 Percentages of adults at Level 1 and below and Level 4 and above in literacy in Cycle 1 and Cycle 2 by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of percentage of adults at Level 1 and below in Cycle 2.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

Across the OECD countries, the percentage distributions of low and high performers in numeracy follow a similar pattern to that of literacy, albeit with larger increases in the percentage of high-skilled adults (Figure 2.3). In Italy, as in Chile and Israel, no significant changes were seen in either group.
As regards the Italian macro-areas, the only significant change was once again recorded in the North-West, where, as in the literacy domain, the share of low performers remained stable while that of high performers rose by just over 4 percentage points, from 4.8% to 9.3%.

Figure 2.3 Percentages of adults at Level 1 and below and Level 4 and above in numeracy in Cycle 1 and Cycle 2 by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of percentage of adults at Level 1 and below in Cycle 2.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

2.2 Changes between the two PIAAC cycles by socio-demographic characteristics

2.2.1 Changes in skills by educational attainment

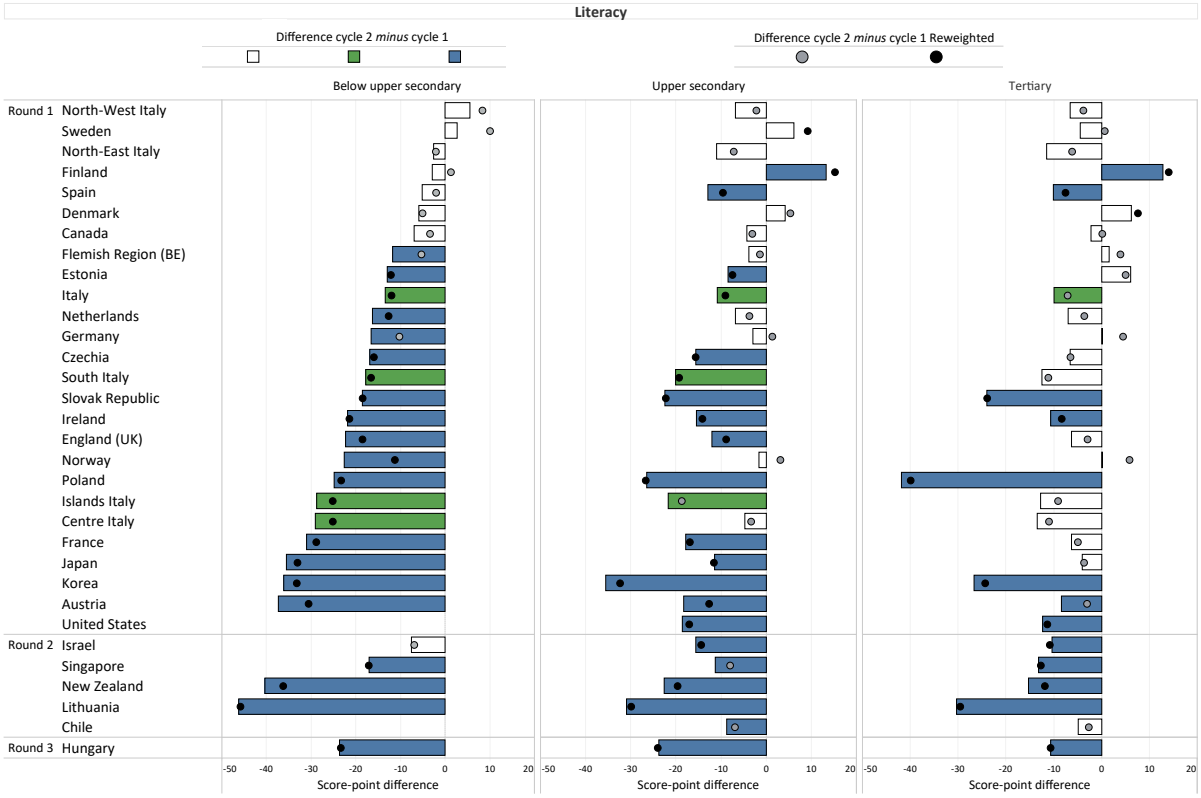
As previously noted in Chapter 1 of this Report, educational attainment plays a crucial role in the analysis of adults' skills and how they change over time, due to the twofold effect of educational qualification on proficiency. Indeed, if on the one hand high educational qualifications correspond to higher skills (direct effect), it is also the case that higher educational attainment is associated with higher-level occupations, with higher salaries, enabling the attainment of expertise and better skills through on-the-job learning (indirect effect).

Figure 2.4 below shows the differences for adults aged 25-65 with different educational attainment with regard to average score in the literacy domain, for all participating countries and economies in both cycles of the PIAAC Survey.

In Italy, statistically significant declines are noted between the two cycles across all three educational attainment levels (-13 points for adults with less than secondary education, -11 points for adults with upper secondary education and -10 points for those with tertiary education). This finding may appear to contradict that presented above as an overall result, but it should be noted that the sub-population aged 16-24 is being excluded from the analysis in this case. Looking at the reweighted scores, the difference remains statistically significant in the first two cases, meaning that even when controlling for the impact of demographic changes on the population, the average literary proficiency of people with low-to-average educational attainment levels has declined over time. In the case of tertiary education, on the other hand, when considering reweighted estimates, the difference in scores between the two survey cycles is no longer statistically significant: average literacy levels of people with high educational attainment remained the same between the two survey cycles, when taking account of the influence of demographic factors on skills. Looking at the Italian macro-areas, a general decline is evident in literacy performance between the two surveys for adults with lower secondary education or below (-29 points for the Centre and Islands, -18 for regions of the South) and for adults with upper secondary education in the regions of the South (-20) and

the Islands (-22). An analysis of the reweighted differences shows that the decline in skills in the Islands is not significant in the case of adults with upper secondary education.
The sharp decline in skills seen in Italy among adults with low educational attainment, i.e. those with lower secondary education or below, was common to almost all other OECD countries participating in the survey, to a very heterogeneous extent (from -12 points in the Flemish Region in Belgium to -46 points in Lithuania). As regards adults with upper secondary education, the decline in skills recorded in the Italian macro-areas was further exceeded by some countries (Korea -35, Lithuania -31, New Zealand -23 points, Poland -26, Hungary -24).

Figure 2.4 Average score difference in the literacy domain between Cycle 1 and Cycle 2 by educational attainment by country and Italian macro-area

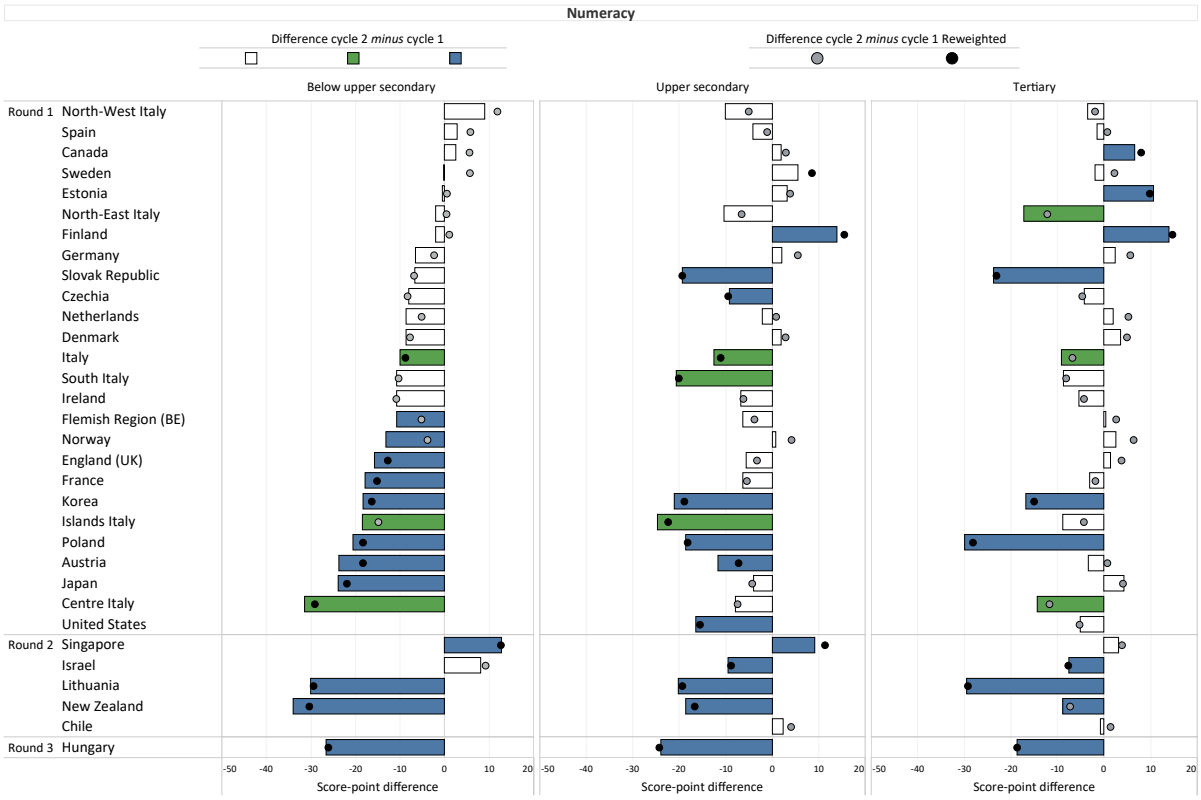


Note: adults 25-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). In Chile and the United States, more than 20% of the subsample of adults with below upper secondary education only completed the assessment of reading and numeracy components in the second cycle, which is why the average score difference for this group is not reported. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of change in average score of adults with educational attainment of lower secondary education or below.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

As previously noted for the literacy domain, statistically significant declines in numeracy skills were recorded in Italy between the two cycles among the population aged 25–65 across all three educational attainment levels (-10 points for adults with lower secondary education or below, -13 points for adults with upper secondary education and -9 points for those with tertiary education) (Figure 2.5). This finding, which is certainly not reassuring, demands further investigation to determine what factors have led Italian adults across all educational attainment levels to fall behind in skills over the past decade.
As with literacy, the average score difference between the two cycles for adults with tertiary education loses statistical significance when reweighted estimates are considered.
The strongest declines in average score between the two surveys are recorded among individuals with low education qualifications in the regions of the Centre, at -31 points; only in New Zealand do adults at that education qualification level record a worse performance (-34); the performance decline in the Islands is also marked (-18 points), although the reweighted difference is not statistically significant. Among adults with upper secondary education, significant skill losses were observed in the South (-21) and the Islands (-25), similar to performances recorded in Hungary (-24), Korea (-21) and Lithuania (-20). Among adults with tertiary education, finally, the decline in skills between the two cycles is significant in the North-East (-17

points) and Centre (-14), although this decline is no longer evident and loses significance in both macro-areas when controlled for the impact of demographic change. There are not many countries and economies in which declines over time were observed in average numeracy proficiency levels among the highly educated sub-population (Korea -17, Israel -8, Lithuania -30, New Zealand -9, Poland -30, Slovak Republic -24 and Hungary -19).
An analysis of reweighted estimates shows that low average educational qualifications are more likely to be associated with a decline in average skills over time; when analysing differences over time among those with high educational qualifications, however, the decline is less pronounced, or often absent, as the composition of the population mitigates the decline in skills.

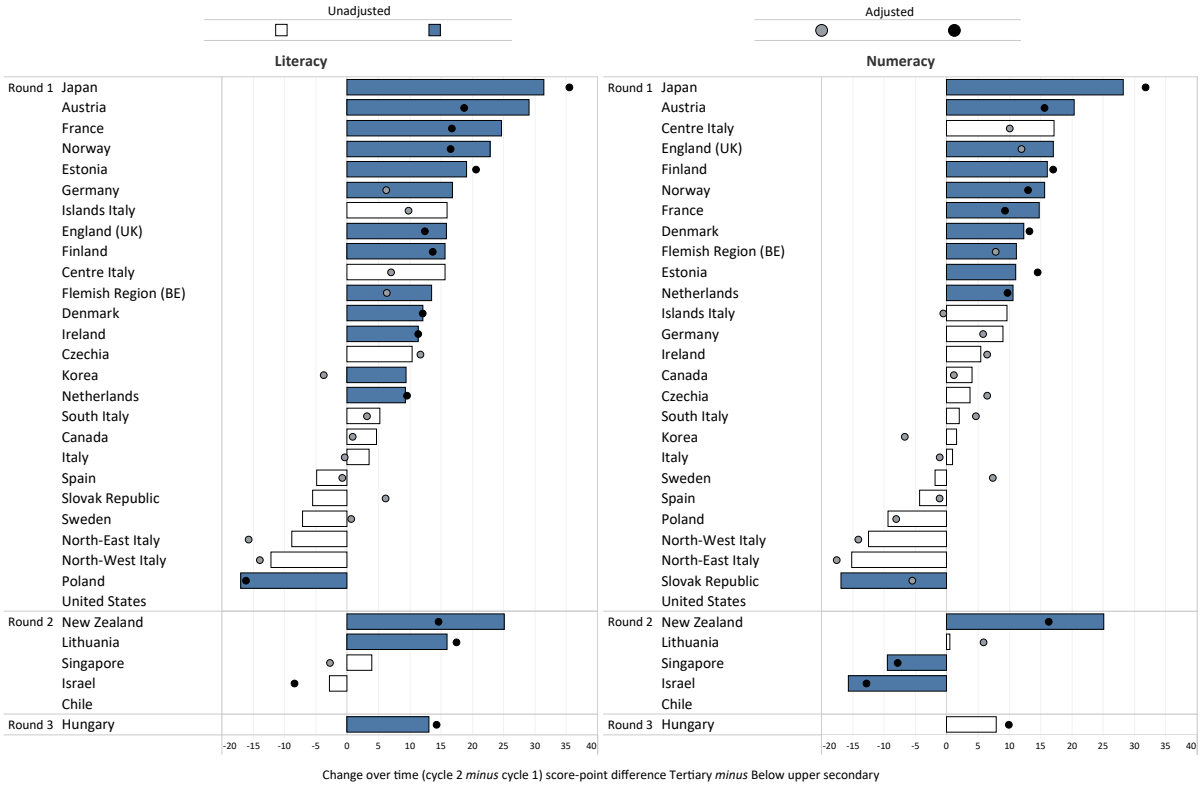
Figure 2.5 Average score difference in the literacy domain between Cycle 1 and Cycle 2 by educational attainment by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). In Chile and the United States, more than 20% of the subsample of adults with below upper secondary education only completed the assessment of reading and numeracy components in the second cycle, which is why the average score difference for this group is not reported. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of change in average score of adults with educational attainment of lower secondary education or below.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

The widespread decline in skills among adults with a low educational attainment has led, in most participating countries, to an increased gap in literacy skills (Figure 2.6) between adults with lower secondary education or below and adults with tertiary education. However, given the generalised decline across all educational levels considered, in Italy the gap among educational qualification levels in the literacy domain did not change significantly between the two cycles, either at a national level or in the macro-areas.
The situation is more or less the same in the numeracy domain: the skills gap between qualification levels has not changed significantly either at a national level or in the regional macro-areas.

Figure 2.6 Changes between Cycle 1 and Cycle 2 in the average score difference in the literacy and numeracy domains between adults with tertiary education and adults with lower secondary education or below by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Adjusted changes are obtained by subtracting the coefficients of linear regression models that use age, education, gender, immigrant background, language spoken at home and parental education as predictors. The models are estimated separately for the two cycles (see Reader's Guide). In Chile and the United States, more than 20% of the subsample of adults with below upper secondary education only completed the assessment of reading and numeracy components in the second cycle, which is why the average score difference for this group is not reported. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of unadjusted gap.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

2.2.2 Changes in skills by gender

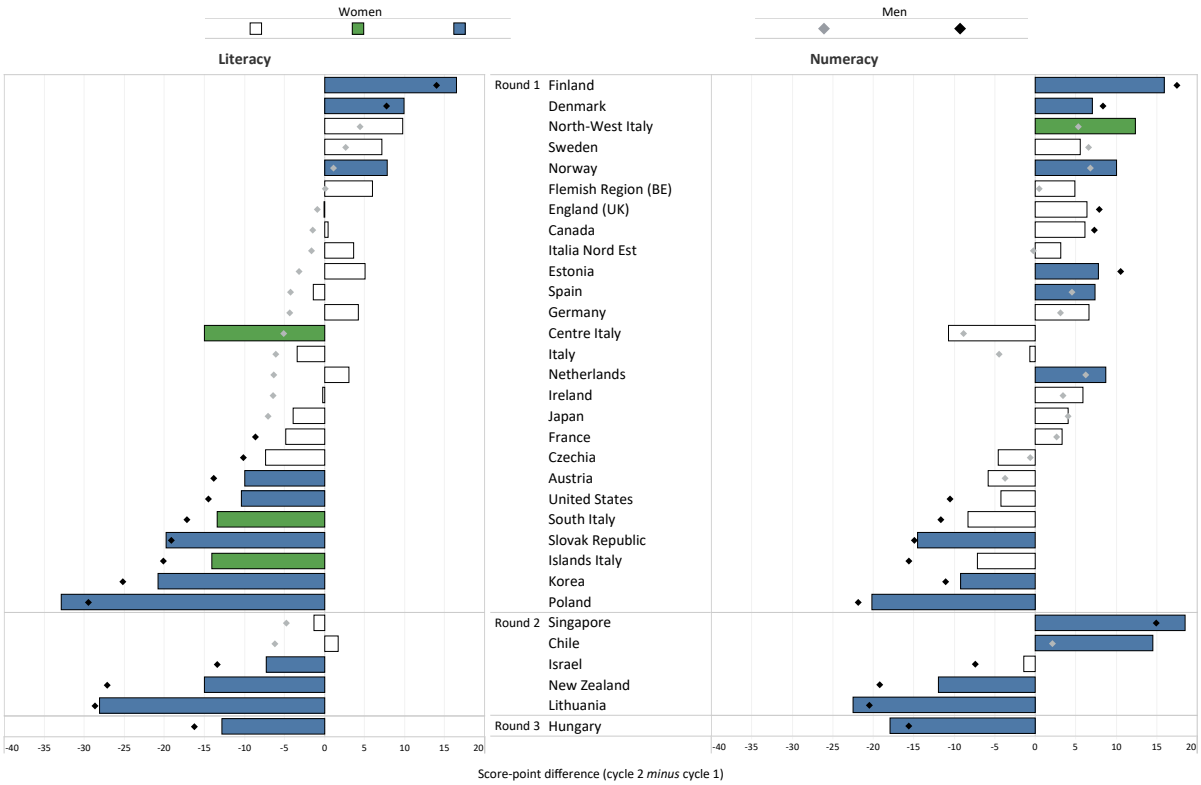
Figure 2.7 illustrates the difference between the two cycles of the PIAAC Survey in men's and women's scores in the literacy and numeracy domains. From this figure, it is therefore possible to observe whether men and women, analysed separately, have improved their skills over the past decade.

As regards literacy, there were no significant changes between the two surveys in the average score of either men or women in this domain. Looking at the macro-areas, however, a decline in skills over the decade is noted for both sexes in the South and Islands, albeit less marked for women than for men (in the South -17 points for men and -13 for women, in the Islands -20 for men and -14 for women). This pattern, which recognises a slight advantage for women in literacy scores, even in the context of a decline in performance over time, is also observed in other OECD countries participating in the survey, namely Austria (-14 points for men, -10 points for women), Korea (-25 for men, -21 for women), Israel (-13 for men, -7 for women), Lithuania (-29 for men, -28 for women), New Zealand (-27 for men, -15 for women), the United States (-15 for men, -10 for women) and Hungary (-16 for men, -13 for women).

An unusual trend is evident in the regions of the Centre of Italy, where the gender situation is reversed: women lost as much as 15 points in Cycle 2, while there were no significant differences for men between the two surveys.

In the numeracy domain also, no statistically significant differences are observed between the two surveys in Italy; in the regions of the South and the Islands, however, statistically significant declines were recorded for men only (-12 and -16 points), while a 12-point increase in mathematical skills was recorded for women in the North-West.

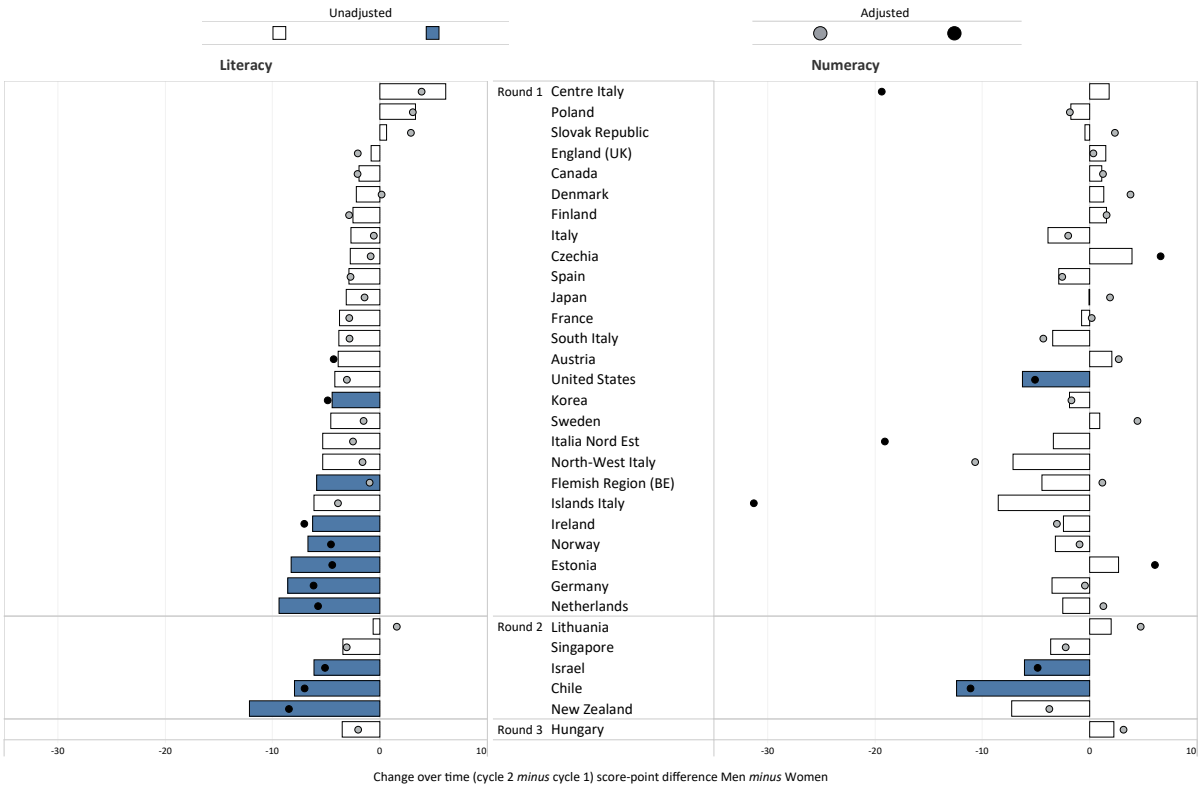
Figure 2.7 Average score difference in the literacy and numeracy domains between Cycle 1 and Cycle 2 by gender by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of changes in average literacy score for men.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

The following figure (Figure 2.8) shows the changes between the first and second PIAAC cycles in the gender gap in the literacy and numeracy domains.
In Italy, as in many participating OECD countries, no statistically significant differences are evident in the skills gap between men and women in either cognitive domain between the first and second cycles.
As already noted in Chapter 1, the gender gap in the literacy domain has closed: initially identified in the IALS Survey in 1998, it was no longer evident in either ALL or Cycle 1, therefore giving rise to no change between the two cycles, either at a national or regional macro-area level.
In the numeracy domain, meanwhile, the significant skills gap in favour of men, identified in the first cycle (+11 points) (ISFOL and Di Francesco 2014), is confirmed in the second cycle (+7 points). Thus, in the decade between the two surveys, there have been no significant changes in the gender gap, either at a national or regional macro-area level. Indeed, similar trends are observed in the regional macro-areas, indicating that the numeracy skills gap between men and women is a constant feature both over time and across the country. However, when the gender gap is adjusted by macro-area – i.e. after adjusting the estimated gender gap in proficiency differences to account for the effects of other socio-demographic characteristics – notable deteriorations in the numeracy skills gap emerge to the disadvantage of women, at 19 points in the regions of the North-East and the Centre and as much as 31 points in the Islands. This finding confirms that significant gender disparities in numeracy skills persist in Italy, presumably due to different education and training choices, but also, and more profoundly, dictated by social context rather than cultural stereotypes. These data therefore highlight the need for careful reflection on the influence of gender on educational choices.

Figure 2.8 Changes between Cycle 1 and Cycle 2 in the average score difference in the literacy and numeracy domains between men and women by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Adjusted changes are obtained by subtracting the coefficients of linear regression models that use age, education, gender, immigrant background, language spoken at home and parental education as predictors. The models are estimated separately for the two cycles (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of the change in the unadjusted literacy gap.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

2.2.3 Changes in skills by age group

Figure 2.9 shows the "cohort effect", i.e. the result of differences in average literacy proficiency among adults of the same age across the first and second cycle of the survey, taking into account the five 10-year age groups (16-24, 25-34, 35-44, 45-54, 55-65) in all participating OECD countries and economies, as well as the five Italian macro-areas. It can be assumed that the changes in proficiency observed in the youngest age group (16-24 years) reflect changes in the education system in many countries following recent government reforms aimed at, for example, broadening young adults' participation in the education system or improving and enhancing the quality of education. Conversely, the changes observed between the two cycles in skill levels for the oldest age group may be the result of phenomena that occurred well before the period covered by the survey, for example in the 1950s and 1960s, when the cohort aged 55-65 was in compulsory schooling, while also being influenced by the considerable changes that have occurred in the world of work in recent decades.

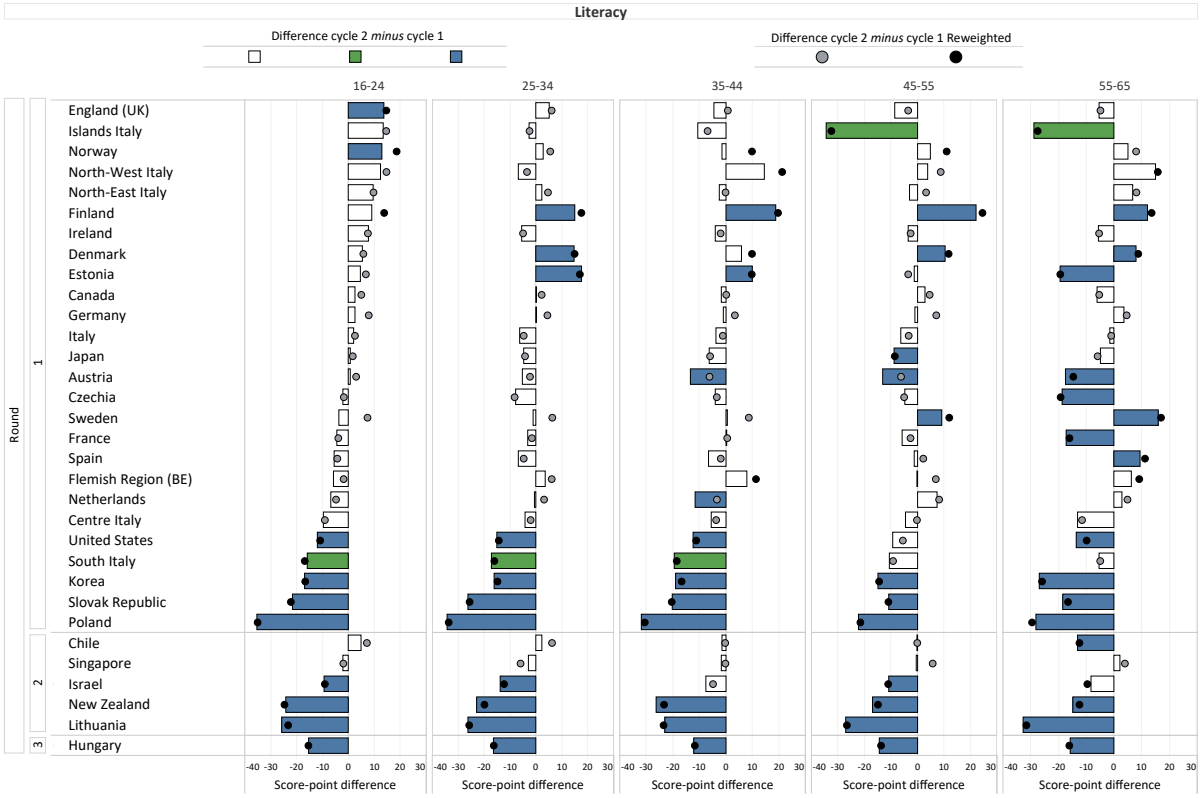
As regards the literacy domain, no statistically significant changes have been identified between the two cycles in Italy across all age groups considered; at a macro-area level, however, statistically significant negative differences are found in the regions of the South and the Islands. In the South, declines in proficiency were recorded among the youngest age group (16-24 years, with a loss of just under 16 points compared to their peers in the previous cycle), among those aged 25-34 (-17 points) and those aged 35-44 (-20 points). By contrast, in the Islands, significant declines in average score between the first and second cycle are observed among the older groups, with a loss of 35 points among adults aged 45-54 and 29 points among those aged 55-65.

Such conspicuous declines in literacy performance among the older age groups represent a rather isolated case among participating OECD countries; indeed, a comparably notable decline among the oldest age group is only observed in Korea (-27), Lithuania (-33) and Poland (-28), while Lithuania (-27 points) is the country that comes closest to the negative record of the Islands as regards the 45-54 year-old cohort.

Based on reweighted estimates, i.e. if the demographic profile of the adult population had remained the same over time, the North-West would have seen an increase in proficiency among those aged 35-44 and

55-65 – age groups that are crucial for career consolidation in the former case and for reskilling or upskilling in the latter. These changes over time, likewise, would have confirmed the decline reported above for the South and the Islands.

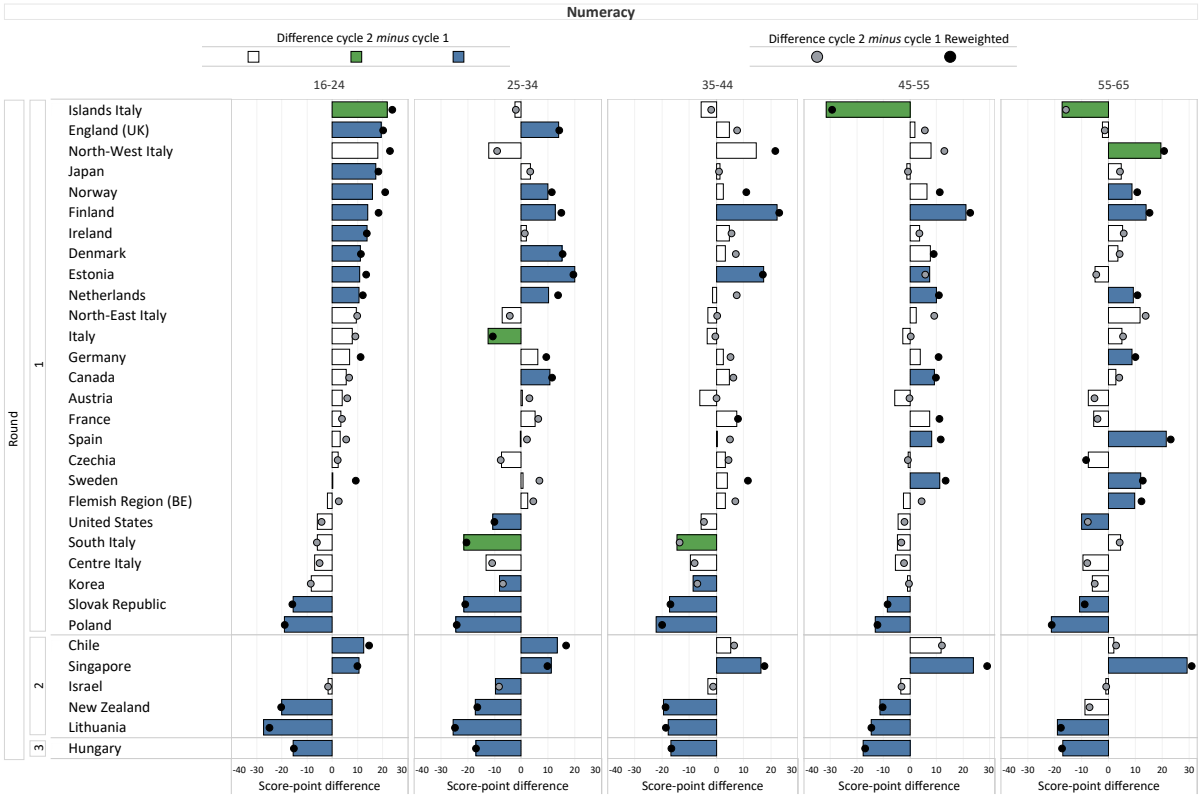
Figure 2.9 Average score difference in the literacy domain between Cycle 1 and Cycle 2 by age group by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of difference in the average score of 16-24 year-olds.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

In the numeracy domain (Figure 2.10), statistically significant changes between the two cycles are only observed in Italy among the 25-34 age group, which recorded a 12-point drop compared to the first cycle, albeit less marked than in other countries (Lithuania -26, New Zealand -17, Poland -24, Slovak Republic -21, Hungary -17). In Italy, this decline is entirely explained by the performance of the regions of the South, which lost 21 points between the first and second cycles, similar to the countries seen above.
A decline in proficiency is also seen in the regions of the South (-15 points) for adults aged 35-44. When controlling for demographic changes, however, this decline is no longer statistically significant; this is not the case for the 25-34 age group, where the decline would persist even if the demographic composition had remained the same. These data highlight the need to improve structural conditions in the South in order to curb the persistent decline in skills.
An unusual situation is found in the Islands, where a significant increase in proficiency (approximately +22 points) is recorded among the youngest age group (aged 16-24), while a sharp decline (-17 points) is seen among the oldest age group (aged 55-65), which loses significance if the difference in average scores between the two cycles is controlled for the effect of demographic changes; finally, the decline almost doubles among the 45-54 age group (-32 points), a singular situation in the context of the countries analysed.

Figure 2.10 Average score difference in the numeracy domain between Cycle 1 and Cycle 2 by age group by country and Italian macro-area



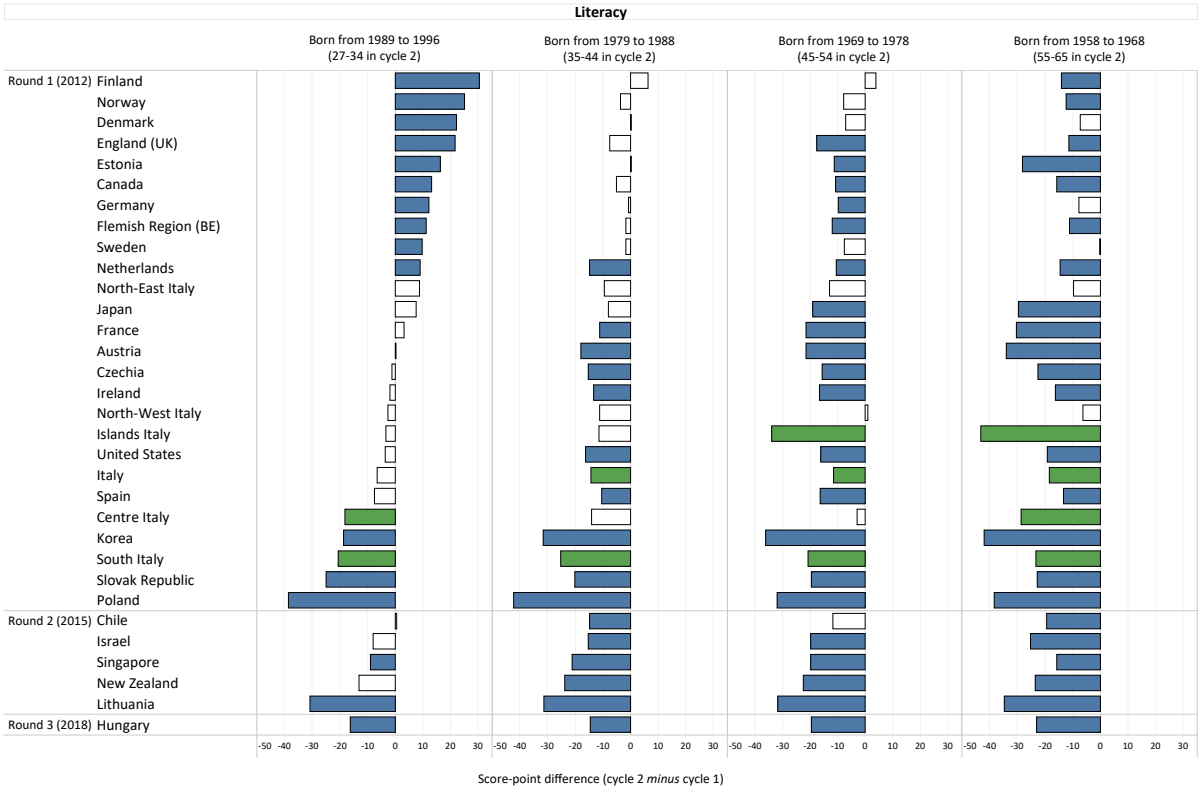
Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of difference in the average score of 16-24 year-olds.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

An analysis of the effects of ageing provides further insights into the evolution of skills over time in relation to birth cohort. For each participating country and Italian macro-area, Figure 2.11 compares the average literacy proficiency of population groups based on year of birth (again in ten-year categories) in the second cycle of the survey with the average proficiency of the corresponding population group in the first cycle[21]. This means, for example, that in order to analyse the changes over time among the oldest adults (aged 55-65) in Cycle 2 – born in 1958-68 – reference is made to the age group to which they belonged at the time Cycle 1 of the PIAAC was administered. This makes it possible to analyse how the proficiency of adults aged 44-54 in Cycle 1 (born in 1958-68) has evolved over time.

As regards the results of the analyses for the literacy domain in Italy, a significant decline in proficiency was observed in the second cycle across all birth cohorts (-14 points for those born in 1979-1988, -11 points for those born in 1969-1978, -18 points for those born in 1958-1968), with the exception of the youngest cohort (aged 27-34). At a geographical level, the greatest skill losses are observed in the regions of the South (-21 points for the youngest cohort, -25 points for those born in 1979-1988). As regards the two oldest cohorts, those born in 1969-1978 lost 21 points in the South in the second cycle and a significant 34 points in the Islands; those born in 1958-1968, meanwhile, are confirmed as the birth cohort with the greatest decline in literacy proficiency throughout the Centre and South of Italy (-29 points in the Centre regions, -23 in the South, -43 points in the Islands).

[21] In this specific analysis, foreign-born adults who have lived in the survey country for less than 10 years are excluded. This decision is designed to isolate the impact of migration on the composition of birth cohorts. For ease of exposition, we refer to "10 years younger", but based on the *round of participation in the first cycle of the PIAAC, the value should be adjusted.* The PIAAC is not based on a panel of individuals; therefore, there is no way to track exactly the same respondents over time. However, it is possible, at least ideally, to trace the trend in skills of a random sample of individuals drawn from the same population.

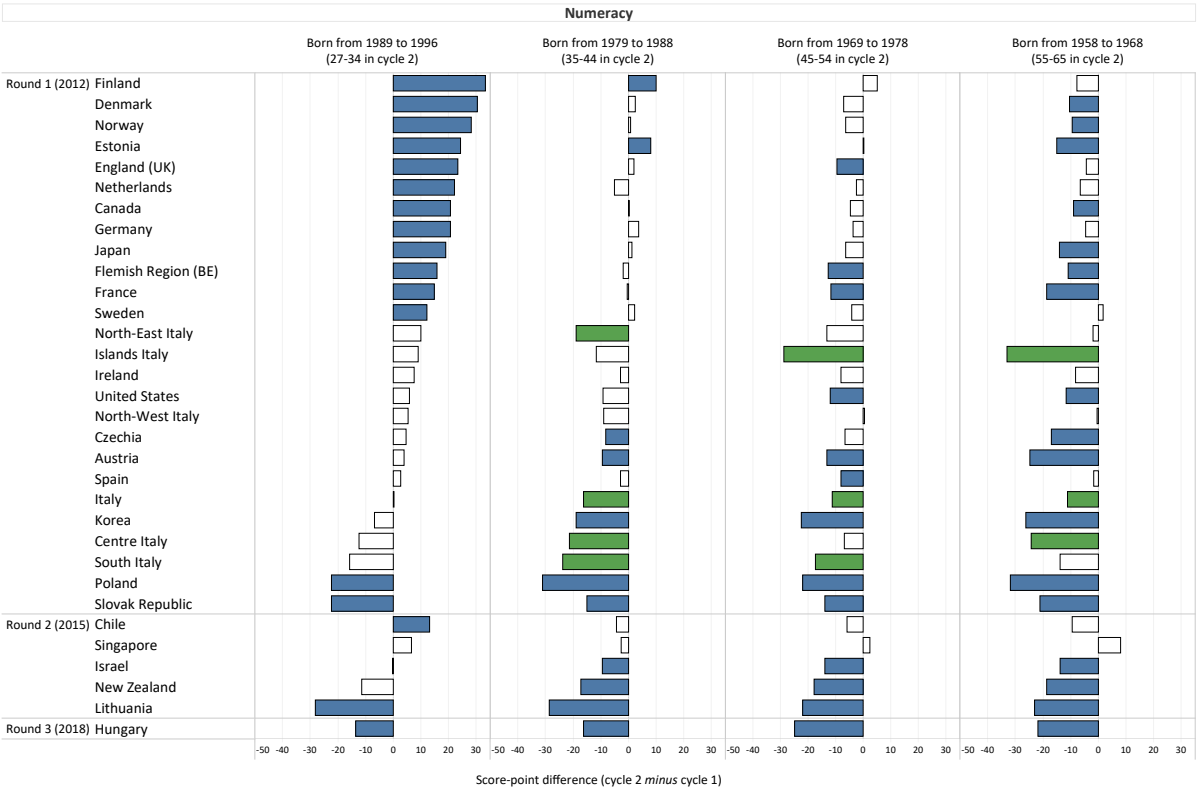
Figure 2.11 Trend in average score in the literacy domain among birth cohorts (effect of ageing) by country and Italian macro-area



Note: adults aged 16-65, excluding foreign-born adults who have lived in the country less than 10 years. Doorstep excluded. Analyses start from the 27-34 age group in Cycle 2, as this is the youngest birth cohort included in Round 1 of Cycle 1 (aged 16-23 at the time). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of average score of the 27-34 year old cohort in Cycle 2.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

In the numeracy domain also (Figure 2.12), the trend in Italy is the same as observed in literacy, with a significant decline in proficiency in the second cycle across all birth cohorts (-16 points for those born in 1979-1988, -11 points for those born in 1969-1978, -11 points for those born between in 1958-1968), with the exception of the youngest cohort. Looking at the geographical areas in more detail, a significant decline in proficiency was observed among those born between 1979 and 1988 in the North-East (-19 points), Centre (-21) and South (-24); for the cohort born between 1969 and 1978, the South and Islands are the macro-areas with a significant drop in performance (-17 and -29 points), while for the oldest cohort, born between 1958 and 1968, the worst decline is observed in the Islands (-33 points) followed by the regions in the Centre (-24 points).

Figure 2.12 Trend in average score in the numeracy domain among birth cohorts (effect of ageing) by country and Italian macro-area



Note: adults aged 16-65, excluding foreign-born adults who have lived in the country less than 10 years. Doorstep excluded. Analyses start from the 27-34 age group in Cycle 2, as this is the youngest birth cohort included in Round 1 of Cycle 1 (aged 16-23 at the time). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of average score of the 27-34 year old cohort in Cycle 2.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

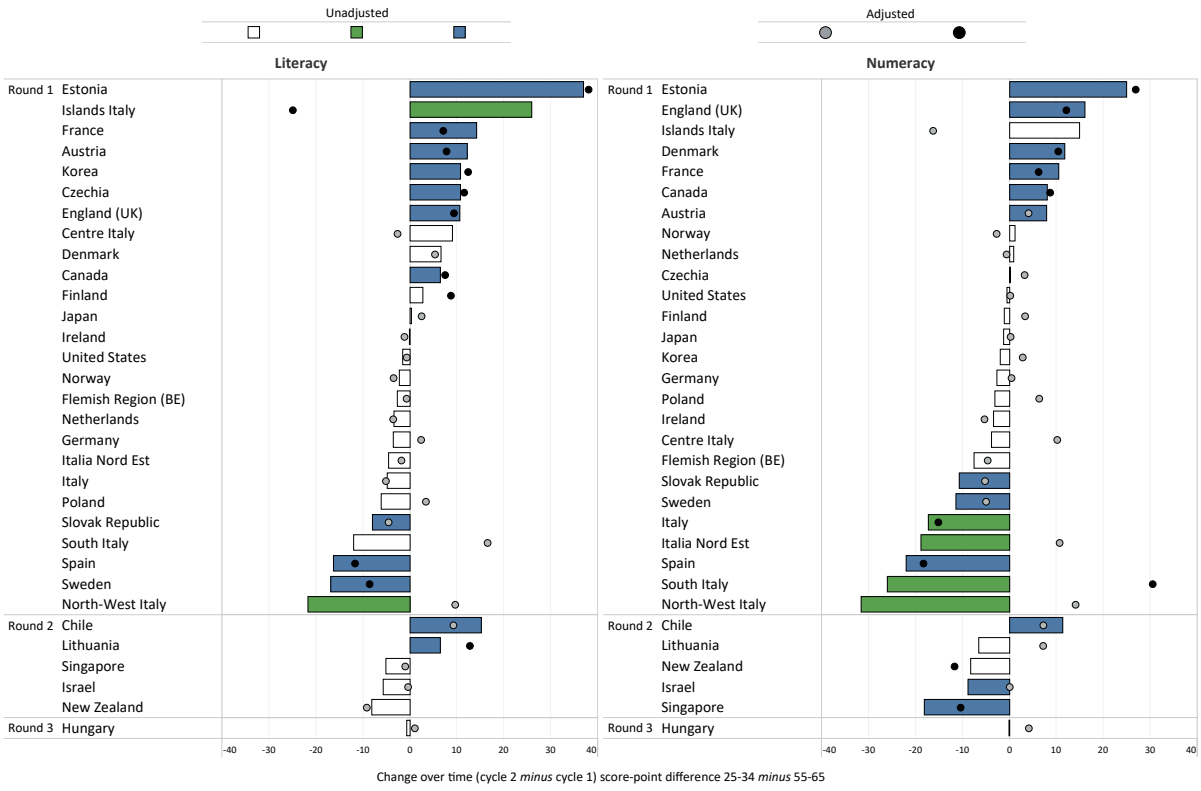
Findings from the data on birth cohorts point to a general age-related decline in proficiency over the past decade, which may be considered an erosion or obsolescence of skills, resulting from a number of factors: constant technological innovations that make previously acquired skills easily outdated or ineffective, the absence of a continuous process of acquiring knowledge and skills throughout the individual's lifetime (lifelong learning), and resistance to change, to which older individuals are undoubtedly more prone. This would suggest the need to reflect on the adaptation and upgrading of expertise, which may potentially be achieved by promoting a culture of training and sharing of skills and knowledge.
The cohorts aged 25-34 and 55-65 play a strategic role in interpreting the skills of the adult population, representing two crucial cohorts for the labour market and for the process of adapting to social and economic transformations. As such, an examination of how the skills gap between these two cohorts has changed between the two cycles in the countries and economies participating in PIAAC is presented below. Figure 2.13 shows the changes between the first and second cycle in the average score difference between young adults (25-34 years old) and older adults (55-65 years old) in the literacy and numeracy domains for the countries and economies participating in the survey and the Italian macro-areas. Three types of scenarios can be distinguished for both domains in the various countries. In the first case, the changes in the gap between younger and older adults result from an overall improvement in the proficiency of these age groups between the two cycles, with one group improving more than the other; the second scenario involves an overall decline in proficiency, with one of the two groups declining more; the final scenario, meanwhile, involves a clear divergence between the two groups, with the proficiency of one group increasing and the other decreasing.
In Italy, no statistically significant differences were observed in the gap between younger and older adults in the literacy domain between the first and second cycles. The geographical differences across the country, however, are very marked, albeit attributable to the same scenario (the third): significant progress has been made toward bridging the generational gap in literacy in the North-West regions (-22 points), due to an improvement in the average score for the older age group over the decade, while a considerable increase in the intergenerational gap is observed in the Islands (+26 points), due to a very marked decline

in proficiency among older adults between the two cycles, coupled with a net improvement among the younger generation. Taking the main background characteristics into account, the adjusted gap between generations in the Islands remains statistically significant but the sign is reversed (-25 points), demonstrating the presence of numerous factors, in this particular area, that influence disparities between generations, such as educational qualifications. In the North-West, meanwhile, the adjusted gap is no longer significant, eliminating the gap between younger and older adults.

In the numeracy domain also, the generational gap in Italy is attributable to the third scenario; the significant decline of -17 points is the result of a net decline in proficiency among those aged 25-34 between the first and second cycle, and a modest increase among those aged 55-65. In the North-West macro-area, the generational gap declined by 32 points and by 19 points in the North-East; in both cases, the change is attributable to a notable improvement in proficiency among the oldest group. In the regions of the South, on the other hand, the marked decline in the gap between younger and older adults (-26 points) is the result of modest improvement in the average score for the 55-65 age group combined with a severe decline in the average score of those aged 25-34. When considering the adjusted gap between younger and older adults, it is only in the South that the differences between the first and second cycle remain significant, albeit with a reversal of the trend (+30 points). This confirms that when effects of certain socio-demographic factors (such as educational qualification, gender, immigrant background) are controlled for, the generational gap can change direction, exacerbating disparities.

With regard to other participating countries, the reduction in the generational gap in numeracy observed in Singapore and Spain is similar to that in Italy, amounting to more than 15 points (-18 and -22 respectively), due to increased proficiency among the older age groups. Other countries, such as Estonia (+25) and England (UK) (+16), recorded improvements among those aged 25-34 and no change among those aged 55-65, leading to a widening of the intergenerational skills gap.

Figure 2.13 Changes between Cycle 1 and Cycle 2 in the average score difference in the literacy and numeracy domains between those aged 25-34 and those aged 55-65 by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Adjusted changes are obtained by subtracting the coefficients of linear regression models that use age, education, gender, immigrant background, language spoken at home and parental education as predictors. The models are estimated separately for the two cycles (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of the unadjusted gap in the literacy domain.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

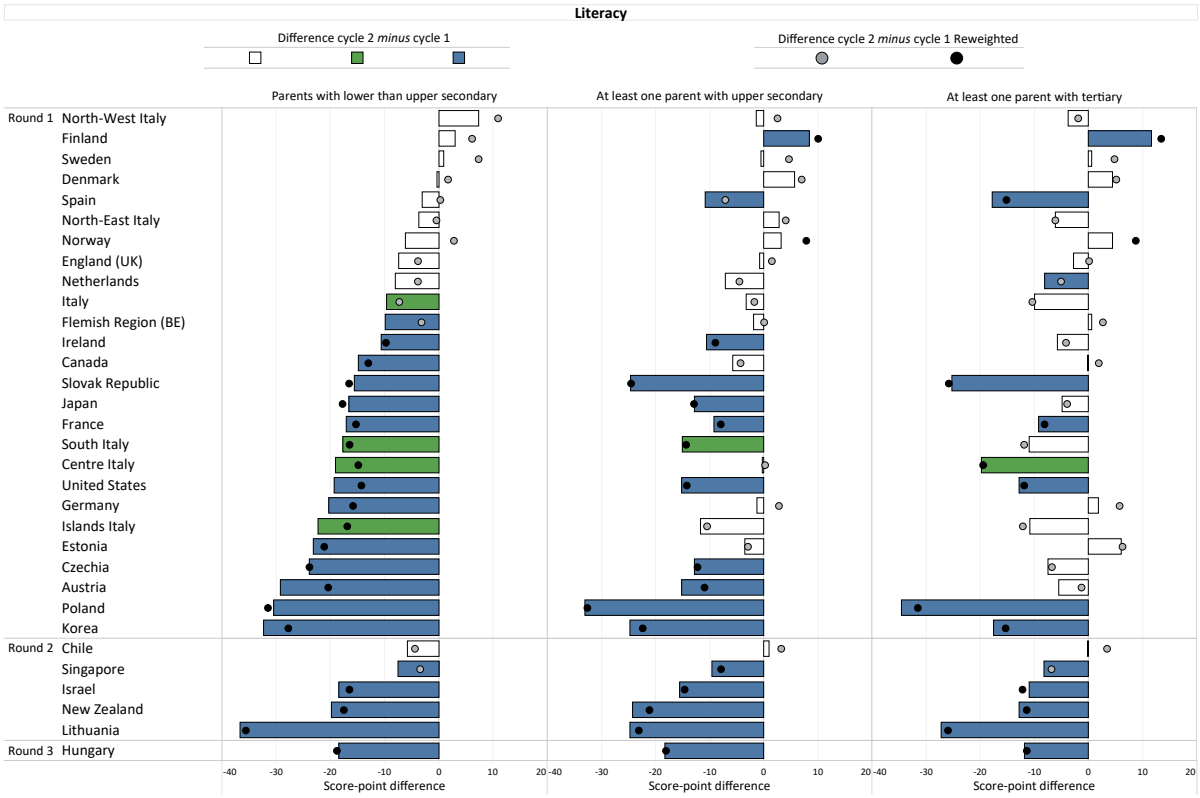
2.2.4 Changes in skills by family background

It is also relevant to consider whether the relationship between family background and key skills has changed between the two survey cycles in Italy and across all participating OECD countries. Parents' educational attainment, an indicator of the cultural capital of one's family of origin, is strongly correlated with other measures of social position such as income and employment status, and thus with individuals' family socio-economic background. As such, it is frequently used as a proxy for the socio-economic background in which an individual is born, grows up, attends school and undertakes the activities that will enable him or her to learn and develop his or her abilities and skills[22].

As regards the literacy domain, Figure 2.14 presents the changes in skills over time among the three categories of parents' educational attainment across the entire adult population of all participating OECD countries and economies. Over the past decade, Italy has seen a significant decline in performance only among adults with parents with a low educational qualification (-10 points); this is most notable in the Islands, where the decline reaches -22 points, followed by the regions of the Centre (-19) and the South (-18). More broadly, this decline in skills over the past decade among adults from the most disadvantaged family backgrounds is evident across more than two-thirds of the countries participating in PIAAC, to a drastically more pronounced extent than in Italy. Lithuania, for instance, recorded a decline of 37 points, Korea 32 points, Poland 31 points and Austria 29 points.

In the Italian regions of the South, a decline in proficiency is also evident among adults with at least one parent who completed upper secondary education (-15 points), a trend also seen in many other OECD countries (among the highest are Poland -33 points, Korea, Lithuania and the Slovak Republic -25, and New Zealand -24). In the regions of the Centre, on the other hand, a decline is noted among adults with at least one parent who attained tertiary education (-20 points): in this case, only 3 OECD countries record worse results (Poland -35 points, Lithuania -27, Slovak Republic -25).

Figure 2.14 Average score difference in the literacy domain between Cycle 1 and Cycle 2 by parents' educational attainment by country and Italian macro-area

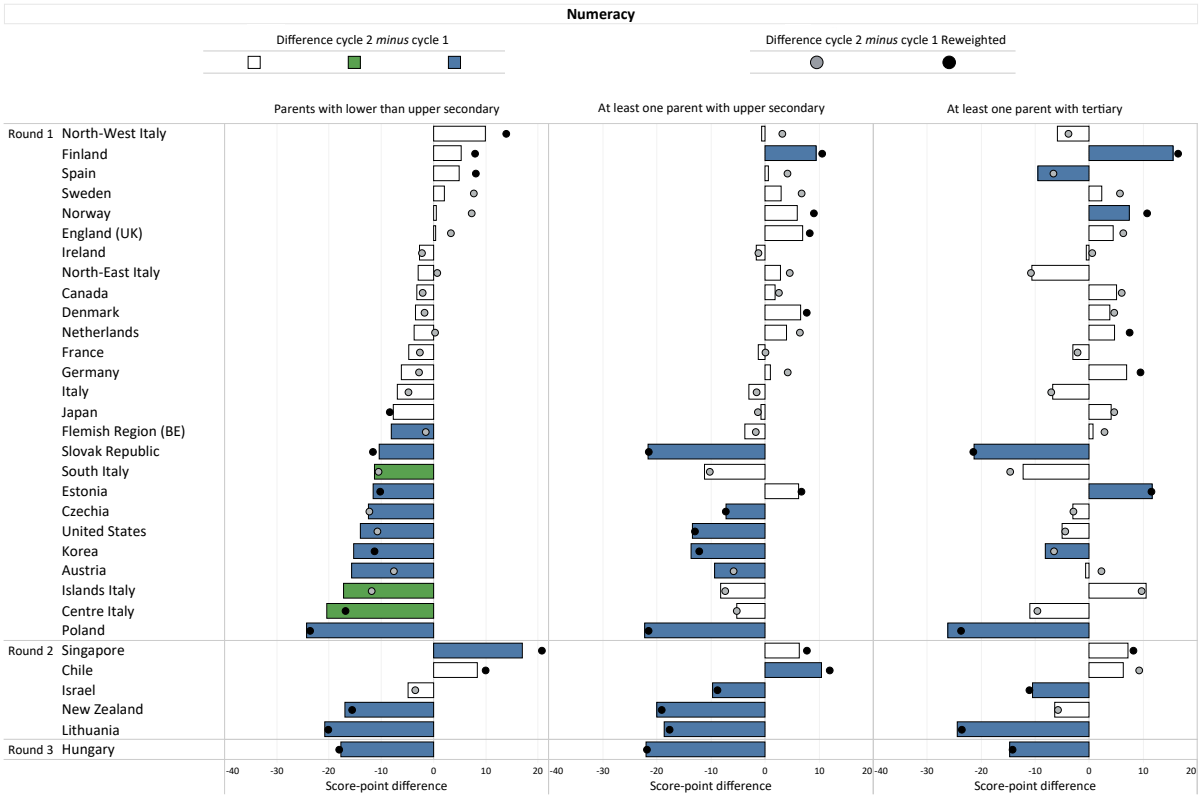


Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of changes in the average score of adults with no parent who attained upper secondary education.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

[22] In the analysis below, the indicator adopted to measure family background takes three forms: no parent who attained upper secondary education; at least one parent who attained upper secondary education; at least one parent who attained tertiary education.

As regards the numeracy domain, there were no statistically significant differences between the two cycles in Italy across any of the three groups considered (Figure 2.15). An analysis of the data at a geographical level shows, however, that the most intense decline in mathematical skills is seen among adults whose parents did not complete upper secondary education in the Centre regions (-20 points), followed by the Islands (-17) and the South (-11). Internationally, similar performances are observed in several countries (Poland -24 points, Lithuania -21, Hungary -18, New Zealand -17).

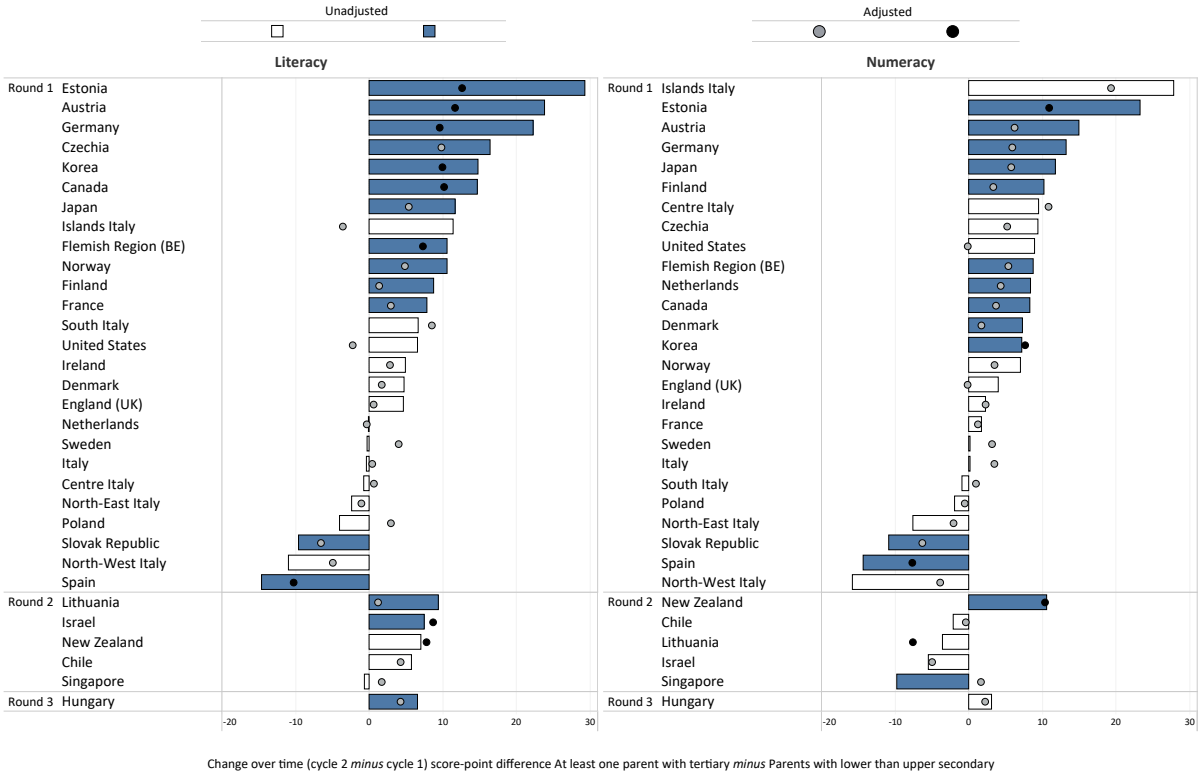
Figure 2.15 Average score difference in the numeracy domain between Cycle 1 and Cycle 2 by parents' educational attainment by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age, gender and immigrant background (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of changes in the average score of adults with no parent who attained upper secondary education.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

In order to observe the clear disadvantage of individuals from families with lower educational levels and the extent to which this affects them over time, Figure 2.16 shows the change over time (between Cycle 1 and Cycle 2) in the literacy skills gap between adults with both parents with low educational qualifications, i.e. lower secondary education or below, and those with at least one parent who attained tertiary education. While this gap has increased significantly in 14 of the participating OECD countries (including, for example, Estonia, Austria, Germany, Japan, Korea and Canada), it has remained stable in Italy (a constant gap of around 40 points in both cycles), in both the literacy and numeracy domains, with no particular scenarios discernible in the geographical analysis either. This finding reaffirms the persistence of inequality in educational opportunities in Italy, stemming from social disadvantage and a less educated family background. These factors may represent a constraint that extends beyond the cultural sphere and play a decisive role in shaping educational choices and, even more so, school regular attendance, school dropout and early educational disengagement, as well as the likelihood of continuing on to university or post-secondary studies and subsequently entering the labour market.

Figure 2.16 Changes between Cycle 1 and Cycle 2 in the average score difference in the literacy and numeracy domains between adults with no parent who attained tertiary education and adults with at least one parent who attained upper secondary education by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Adjusted changes are obtained by subtracting the coefficients of linear regression models that use age, education, gender, immigrant background, language spoken at home and parental education as predictors. The models are estimated separately for the two cycles (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of unadjusted literacy gap.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

2.2.5 Changes in skills by immigrant background

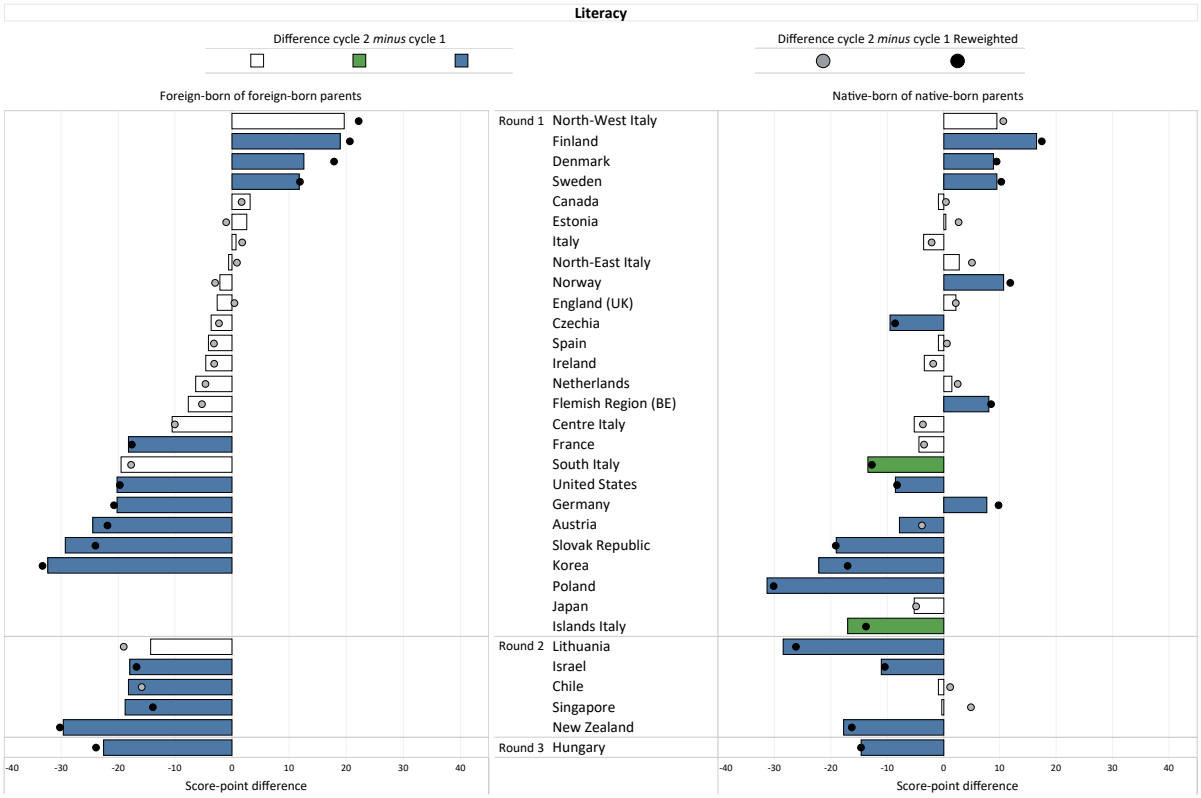
As already noted in the previous chapter, OECD countries and economies have seen a considerable surge in migration flows over the past decade to the extent that, given the significance of the issue at an international level, it is now crucial to analyse the findings from the PIAAC data on the proficiency of adults from an immigrant background and how these have evolved over time.

In this regard, as already highlighted in the previous chapter of this Report, it must be noted that individuals from an immigrant background who participated in the PIAAC survey in Italy are understood to be "integrated migrants", as they are citizens with a permanent residential address who duly engage with the institutions. As such, the group is a subset of the foreign population, which is not representative of the irregular migrant population or those who are not permanently resident in the country; these considerations must be taken into account when interpreting the data below.

As regards literacy, Figure 2.17 shows the evolution of the relevant skills among the two groups: foreign-born adults of foreign-born parents and native-born adults of native-born parents.

In Italy, the average literacy score for foreign-born adults of foreign-born parents hardly changed between the first and second cycle, as is seen for native-born adults of native-born parents. In the Italian macro-areas, no significant differences emerge between the two cycles for first-generation immigrants, while a significant decline in skills is seen among native Italians, both in the South regions (-13 points) and the Islands (-17 points). The only changes resulting from the reweighted analysis are found in the North-West, where the gap over time for foreign-born adults of foreign-born parents becomes significant at 22 points, confirming once again how the demographic composition of the adult population has changed in this geographical area: in several respects, an increase in proficiency would have been recorded.

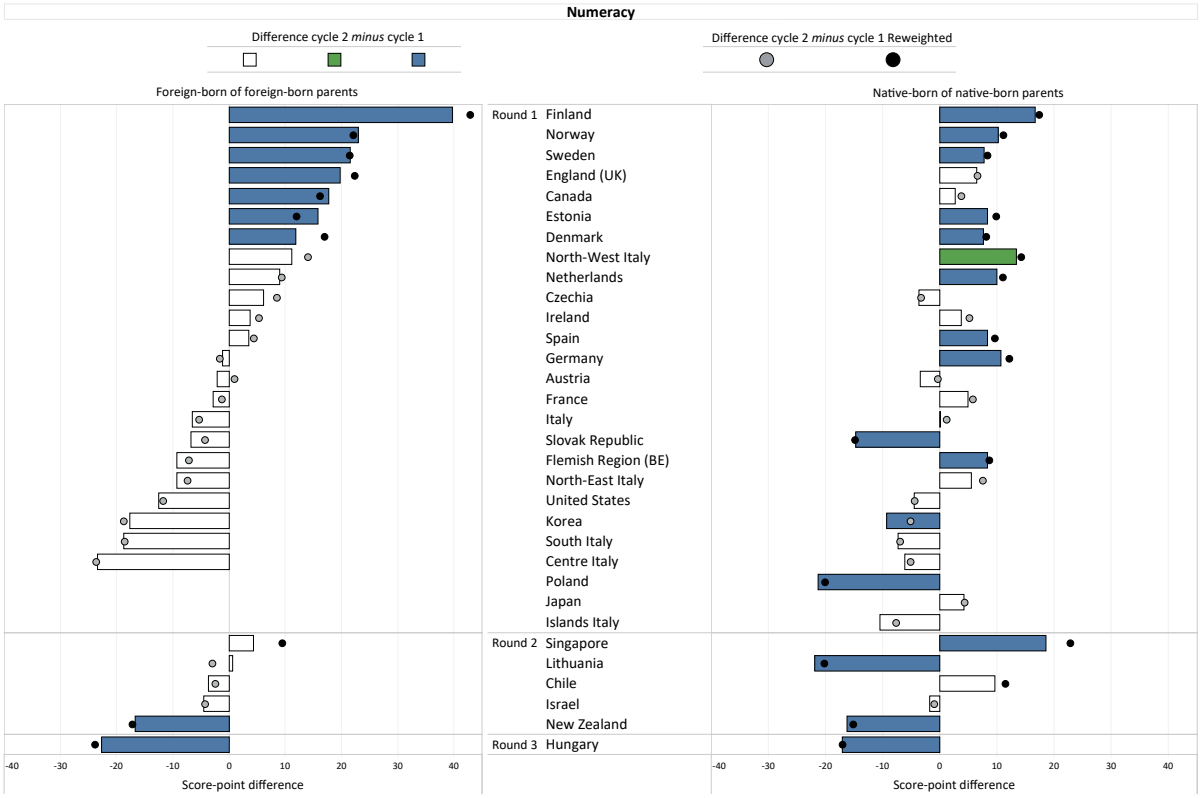
Figure 2.17 Average score difference in the literacy domain between Cycle 1 and Cycle 2 by immigrant background by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age and gender (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of changes in the average score of foreign-born adults of foreign-born parents. Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

As regards the numeracy domain (Figure 2.18), once again no significant changes in performance between the two survey cycles are evident in Italy for either first-generation immigrant adults or native-born adults. An analysis by macro-areas, however, highlights a significant improvement in proficiency among native-born adults in the North-West regions (+13 points); this trend was also seen in some of the largest participating OECD countries (Finland +17, Germany +11, Norway and the Netherlands +10 points).

Figure 2.18 Average score difference in the numeracy domain between Cycle 1 and Cycle 2 by immigrant background by country and Italian macro-area

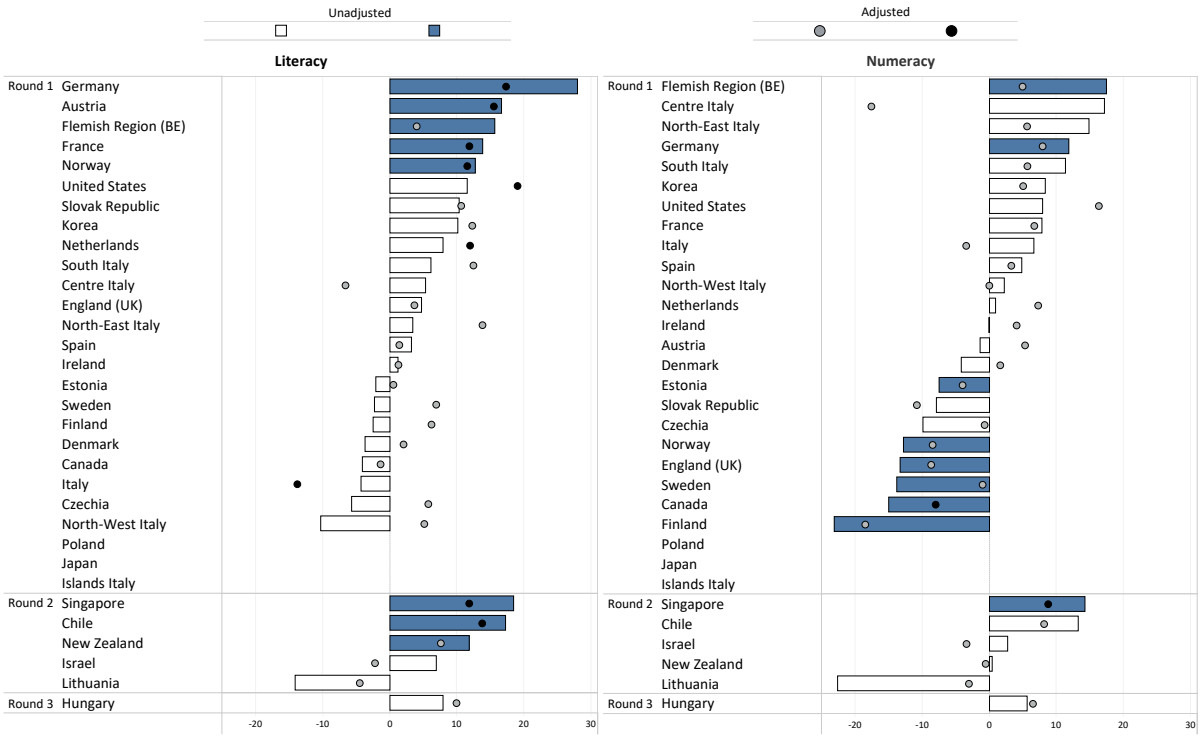


Note: adults 16-65 years. Doorstep excluded. The reweighted differences are calculated using a reweighting procedure that highlights how the skills in Cycle 2 would have changed over time had the composition of the population remained the same as for PIAAC Cycle 1 in terms of age and gender (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of changes in the average score of foreign-born adults of foreign-born parents. Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

In Italy, the skills gap between migrants and natives (Figure 2.19) has not changed significantly over the past decade in either the literacy domain – where the gap between the two average scores has remained largely stable between the first and second cycles (33 points in 2012, 29 points in 2023) – or in the numeracy domain – where the gap between the average scores of native-born and foreign-born adults increased from around 25 points in 2012 to 32 points in 2023. The adjusted gap in literacy, however, is statistically significant, confirming that if the effect of certain socio-demographic variables on adult skills is controlled for – which tends to mitigate the gaps between immigrants and natives – and only the effect of immigrant background on the proficiency gap between immigrants and natives is taken into account, the gap between the two cycles widens.

These results invite reflection on how disadvantage has become entrenched in Italy for adults from an immigrant background over the past decade, and on how much remains to be done to improve the conditions for the integration and inclusion of foreign-born individuals in the country – particularly at the regional level – in order to create more and better opportunities for language learning and, consequently, for the development of key skills. This remains the only pathway to genuine integration and a better quality of life, as well as access to the labour market, which is often highly dependent on language proficiency. Without good knowledge of the language of the host country, individuals from an immigrant background may be forced to accept low quality jobs, which do not reflect their actual skills or qualifications and do not allow for the potential development of new skills.

Figure 2.19 Changes between Cycle 1 and Cycle 2 in the average score difference in the literacy and numeracy domains between foreign-born adults of foreign-born parents and native-born adults of native-born parents by country and Italian macro-area



Note: adults 16-65 years. Doorstep excluded. Adjusted changes are obtained by subtracting the coefficients of linear regression models that use age, education, gender, immigrant background, language spoken at home and parental education as predictors. The models are estimated separately for the two cycles (see Reader's Guide). Darker colours denote changes that are statistically significant (at 5%) between Cycle 1 and Cycle 2. Countries and economies are ranked in descending order of unadjusted literacy gap. Data are not presented in the event of insufficient sample size, as this would lead to unreliable estimates.
Source: INAPP elaborations based on PIAAC-OECD, Cycle 1 and Cycle 2 data

3 Skills, work, social and civic well-being

Introduction

The previous chapters examined the cognitive skills of the adult population, looking at distribution, time and space dynamics, factors that can influence the level of skills possessed, and the variability of these skills based on belonging to particular population groups defined according to socio-demographic characteristics. This chapter takes a step further, moving toward an analysis of how different proficiency levels can influence people's career and life choices. More generally, it addresses the issue of return on human capital investment (measured in terms of cognitive skills possessed and education attained), both with reference to results achievable at a professional level, given certain levels of human capital, and in relation to important social outcomes.

Skills can have a significant impact on individuals' life opportunities, influencing their position in the labour market, determining wage levels, but also shaping lifestyles, participation in political and social life, as well as access to services (healthcare, social services, etc.).

This chapter first examines how the information processing capacities resulting from investment in education and skills have an effect on labour-market participation and wages. It then further explores the relationship between the labour market, on the one hand, and investment in education and skills, on the other, by focusing on the issue of mismatch, considering both qualification mismatch and skill mismatch. The chapter subsequently focuses on the relationship between skills and individual well-being and civic and social engagement. In particular, with regard to the first area, individual perceptions are observed in relation to the degree of life satisfaction and self-reported health, while the second area focuses on the degree of individual trust, both in terms of political efficacy (such as confidence in one's ability to influence politics or political decision-makers) and trust in others. In keeping with the previous chapters, the main focus of analysis concerns the (average) data for Italy and its macro-areas, from the perspective of both internal comparison at a national level, and international comparison with the other countries participating in the second cycle of the PIAAC. The chapter also includes specific boxes offering detailed information on the Italian situation, both as regards proficiency levels in relation to the main characteristics of employed adults, and in terms of mismatch.

As previously mentioned in the Reader's Guide to this Report, the data discussed in this text only refer to statistically significant estimates, with the significance level set at 5%. Additionally, given the topics and phenomena studied, the youngest adults are excluded from the analyses presented in this chapter. Unless otherwise specified, then, the reference population is comprised of people aged 25-65.

3.1 Skills, education, employment status and earnings

Skills enable adults to perform tasks more efficiently, leading to improved employability and higher wages (Hanushek *et al.* 2015; Paccagnella 2015). This relationship between skills, productivity and economic outcomes is well established in economic theory, according to which wages generally reflect workers' productivity; therefore, individuals with higher skills, who tend to be more productive, are expected to earn higher wages. According to this logic, it can also be hypothesised that higher skills correspond to a higher likelihood of participation in the labour market due to the greater benefits, including in wage terms, generally associated with these skills. However, while high skills are often associated with higher wages, their actual value is conditioned by various structural factors (geographical differences, generational or gender wage gaps, economic sectors, etc.) that may limit the full realisation of this general assumption. The results of the first cycle of the Adult Skills Survey confirmed that literacy and numeracy skills play a key role in terms of labour market performance (OECD 2013).

In Italy, the relationship between skills, employment status and wages is a key issue, particularly given the geographical disparities and characteristics of the labour market. Proficiency, understood as the set of knowledge, skills and abilities possessed, is one of the factors that influence performance in the labour market, but the link is not always direct or linear. In particular, higher proficiency tends to be associated with higher wages, especially in sectors that require specialised or technical training, such as engineering, financial economics and the information and technology (ICT) sector (Winters 2014). In Italy, however, this dynamic is not always represented linearly in the labour market (Franzini and Raitano 2011; Even *et al.* 2023).

Likewise, higher educational attainment is generally associated with better wage prospects, but the labour-market reward for education is lower in Italy than in other European countries (Ascoli and Pavolini 2015). This could be due to a lack of appreciation and understanding of generalist skills by companies, as well as greater labour market rigidity. In particular, STEM degrees (science, technology, engineering and mathematics), which, as noted in the first chapter of this Report, guarantee higher proficiency levels, are associated with higher salaries than humanities degrees, though this difference diminishes as work experience is acquired (Croce and Ghignoni 2019).
Geographical variability also plays a significant role in Italy, with earnings tending to be higher in the North than in the South for the same jobs and the same proficiency or qualification levels. This is attributable to a more dynamic economy and higher density of innovative companies in the northern regions, as well as better infrastructure and more investment in training and research.
The economic activity sector and contract type significantly influence the relationship between skills and wages. Sectors such as advanced manufacturing, ICT and financial services reward technical skills with higher wages, while other sectors, such as agriculture and tourism, tend to offer lower wages even in the presence of specific skills.
The following paragraphs examine the results in terms of employment and wage performance, which can be observed from a variety of perspectives, by looking at the effect associated with individual proficiency level and considered in relation to the effect of investment in formal education.

3.1.1 Skills, education and employment status

In Italy, the link between skills, investment in education and employment status is complex and influenced by various factors, including the specific structure of the labour market (often rigid) and of the production system, the socio-demographic characteristics of individuals, and geographical inequalities. Examining the relationship between these elements is key to understanding employment challenges, especially for weaker groups such as younger people, women and immigrants, and to analysing differences across geographical macro-areas.
Individuals' acquired skills are linked in a significant way to their employability and working conditions. Educational attainment is a decisive factor in determining employment prospects, although the correlation between education and employability is not as strong in Italy as in other European countries (OECD 2024a). Italian graduates struggle more than their European counterparts to find suitable employment and, in general, employment status is greatly affected by precariousness and geographical disparity.
In general terms, this picture emerges clearly from the results presented in Table 3.1, which presents estimates of average proficiency by employment status in the three domains analysed by the PIAAC survey. Among employed adults residing in Italy, the average proficiency score in literacy is 251 points, while in numeracy it is 253 points; the average proficiency score in the APS domain, meanwhile, is 236 points. Jobseekers recorded lower average scores across the three skill domains compared to employed adults, at 228 and 223 points in literacy and numeracy, respectively, and 218 points in the APS domain. In keeping with what has been noted previously, the inactive population, i.e. those neither seeking employment nor employed, recorded the lowest average proficiency scores among the three employment status groups considered. In fact, the gap between the average proficiency scores of the employed and inactive populations is nearly 29 points in the literacy domain, and 33 points in the numeracy domain, dropping to 25 points in the APS domain.
The heterogeneity of the Italian situation emerges clearly from the data on the macro-areas. Compared to the national average figure for the employed category, different and statistically significant average values emerge across three macro-areas: the North-East, where average values are higher, and the South and Islands where the reverse is true. Among employed adults in the North-East, average scores for literacy, numeracy and APS stand at 262, 265 and 244 points respectively, while the scores recorded for the South and the Islands are significantly lower (235 in literacy, 236 in numeracy and 224 in APS in the South, and 218 in literacy, 219 in numeracy and 212 in APS in the Islands). Among jobseekers, significant differences compared to the national average only emerge in the North-East across all three domains, and in the South in the literacy domain. In the North-East, the average proficiency level of adult jobseekers is significantly higher than the national average, with differences of more than 30 points in the literacy and numeracy domains, and 29 points in the APS domain. In contrast, the negative gap in the literacy domain in the South is 19 points. As regards the inactive population, significant differences compared to the national average figure are observed across all geographical areas except for the Centre and the Islands, with the exception of the literacy domain in the latter area. Average proficiency levels observed in the North-West and North-East significantly exceed the national results, with gaps of between 15 and 25 points. In this case too, however, the South recorded lower proficiency levels with scores of 207 in the literacy domain, 201 in the

numeracy domain and 198 in the APS domain.
In international terms, the average proficiency level in Italy remains significantly below the average of the countries participating in PIAAC, even when considering the sub-population of 25-65 year-olds not enrolled in formal education, regardless of their employment status or the domain considered.
The negative difference presented by Italy's employed population compared to the OECD average ranges from around 14 points in the literacy domain, 17 in numeracy and 18 points in the APS domain. Among jobseekers, the differences are even greater, at around 17 points in the literacy domain, 24 points in the numeracy domain and around 21 points in the APS domain. The smallest difference between the Italian figure and the OECD average is seen among the inactive population. Here, the gap in the literacy domain is less than 10 points, and between 14 and 15 points in the remaining two domains. This last finding, which can be read in multiple ways, including in view of the sub-population to which it refers, suggests, in comparative terms, that the average skill level of inactive Italians is higher than the corresponding positioning of employed adults and jobseekers.

Table 3.1 Average score in the literacy, numeracy and adaptive problem solving domains by employment status by country and Italian macro-area

	Literacy			Numeracy			APS		
	Employed	Seeking employment	Inactive	Employed	Seeking employment	Inactive	Employed	Seeking employment	Inactive
Austria	260	248	219	274	256	234	257	243	223
Flemish Region (BE)	285	264	243	290	267	248	269	257	232
Canada	278	262	244	278	255	239	264	249	237
Chile	212	208	195	211	202	189	214	210	196
Korea	248	236	237	253	236	241	236	228	229
Croatia	259	249	235	259	249	233	238	226	218
Denmark	282	280	249	290	293	255	271	270	241
Estonia	278	249	233	285	259	242	264	244	226
Finland	307	278	261	304	280	258	282	262	246
France	261	249	215	266	252	215	253	238	215
Germany	274	239	231	283	244	237	268	238	230
Japan	291	275	279	294	282	278	278	262	267
Ireland	266	257	230	265	252	221	250	249	220
Israel	247	237	210	251	237	214	239	233	209
Italy	251	228	223	253	223	220	236	218	211
Centre of Italy	258	246	225	259	239	225	240	225	210
Islands	218	216	212	219	211	207	212	210	201
North-East of Italy	262	261	242	265	254	244	244	247	226
North-West of Italy	257	241	241	257	233	238	241	228	229
South of Italy	235	210	207	236	207	201	224	205	198
Latvia	251	230	221	267	249	236	246	230	221
Lithuania	242	224	213	250	230	222	233	221	210
OECD average	265	246	232	270	247	234	254	238	226
Norway	287	253	246	293	251	248	275	243	241
New Zealand	267	240	222	265	226	215	254	227	217
The Netherlands	287	268	244	291	276	249	270	257	236
Poland	238	225	217	243	225	215	229	220	210
Portugal	238	229	209	244	230	210	238	225	208
England (UK)	277	242	240	276	241	230	263	236	230
Czechia	267	252	243	277	252	246	255	235	232
Slovak Republic	258	235	239	265	241	245	249	243	239
Singapore	252	218	229	273	233	248	250	225	230
Spain	252	233	226	257	231	230	246	230	224
The United States	268	246	229	261	231	217	256	236	222
Sweden	288	254	263	291	254	258	276	252	254
Switzerland	271	240	236	282	247	245	261	228	225
Hungary	251	243	221	259	243	223	242	235	214

Note: adults aged 25-65 not enrolled in formal education. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

A comparison of the proficiency scores recorded for the Italian geographical areas in relation to the results obtained by other countries participating in the PIAAC survey further quantifies the strong heterogeneity of the Italian context. Across the three domains considered, the average proficiency scores among employed adults in the South are higher only than those recorded for Chile and the Italian Islands macro-area, both of which record the lowest scores of all countries and economies observed. In contrast, the average literacy and numeracy proficiency scores of employed adults in the North-East and Centre are not statistically different from the respective OECD averages, while the scores recorded by both geographical areas in the APS domain are lower than the OECD average (by 11 and 14 points respectively). The significant gap within Italy is most evident in the results of the job-seeking population. In the numeracy and APS domains, the average proficiency scores of this population in the North-East are significantly lower only than those in Denmark.

A similar situation emerges with respect to the average skills of the inactive population. Results for this group across the three domains in the North-East and North-West are in all cases consistent the OECD average, as they are not statistically different. In contrast, low average proficiency scores are again recorded in the South and the Islands for the inactive population, higher only than Chile in the literacy domain alone, while in the remaining domains the differences are not statistically significant, with the exception of the lower ranking of the Islands in the numeracy domain. These results seem to indicate that the smaller gap observed for the inactive population between the OECD average and the previously presented Italian figure is mainly the result of the high skill scores recorded in the northern regions of Italy.

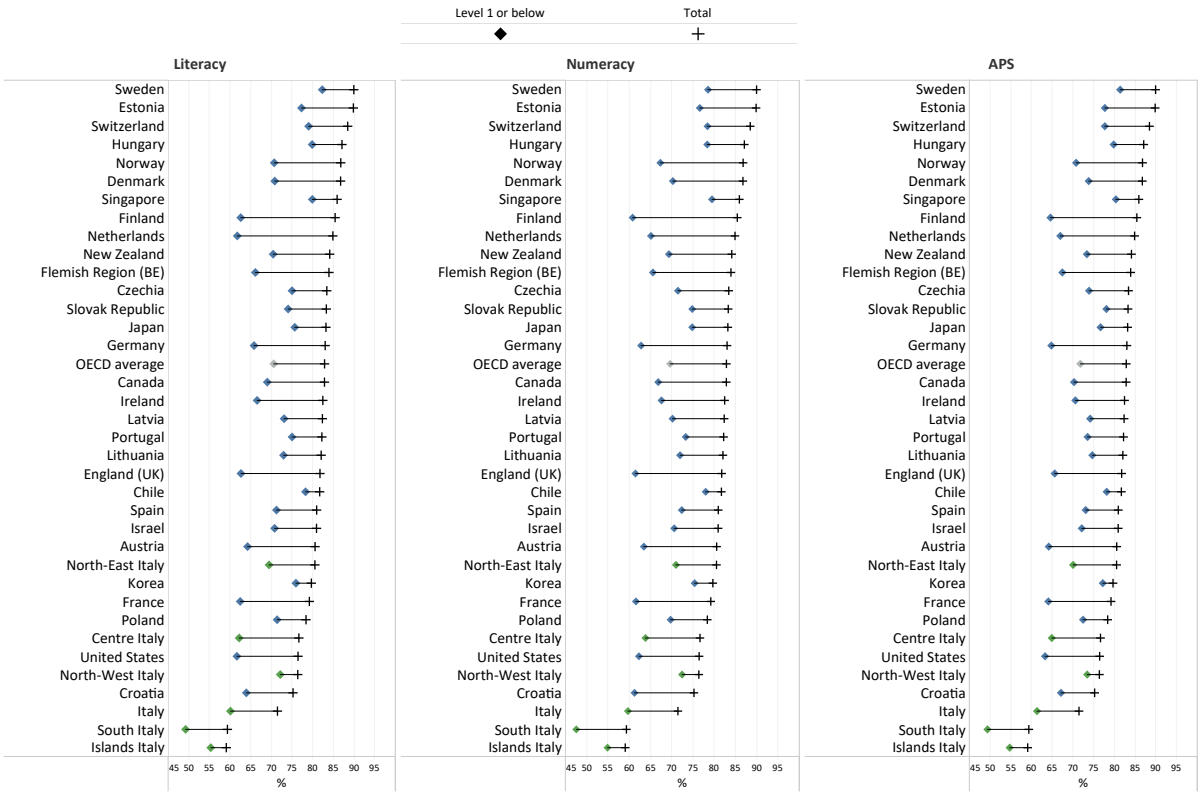
To further investigate the relationship between skills and employment status, Figures 3.1 and 3.2 present, in relation to the three domains analysed, how activity rate and employment to labour force ratio varies among the overall population and among individuals with a low level of skills (Level 1 and below, previously defined as low performers), in order to further characterise – at an aggregate level – the role played by skills with respect to the labour market.

The activity rate (Figure 3.1) represents the share of individuals of working age – in this case, people aged 25-65 who are not enrolled in formal education – who are in employment or seeking employment. The activity rate among 25-65 year-olds in Italy is 71.4%. This share drops significantly, to values close to 60% (specifically: literacy 60%, numeracy 59.6%, APS 61.3%) when only the low performer population is considered.

In the South of Italy and the Islands, only 59% of individuals of working age (aged 25-65 and not enrolled in formal education) are in the labour force. Moreover, in the South, this share drops to 49.1% among individuals with limited proficiency levels in literacy and APS, and to 47.5% if the numeracy domain is taken into account. In the Islands, meanwhile, although the share is lower than the national average, the decline is much smaller, with rates close to 55% in all domains. In contrast, in the regions in the North and Centre of Italy, the activity rate of adults aged 25-65 not enrolled in formal education exceeds the national average at 76% in the North-West and the Centre and 80.5% in the North-East. The major difference between these three geographical areas emerges in relation to the population with low proficiency levels. While the activity rate in the North of Italy is just over 70%, the rate in the Centre does not differ from the national average at between 62% and 64%.

The results for the macro-areas also indicate that the reduction in the share of the labour force with low skills is not a general feature across the areas. Indeed, in the South, North-East and Centre, the difference in the activity rate recorded between the total population of adults aged 25-65 not enrolled in formal education and low performers across the three domains observed is significant and notable, averaging around ten percentage points, and exceeding 12 points in the Centre in the literacy and numeracy domains. In contrast, however, this situation is not seen in the Islands and North-West, as the difference is not statistically significant in any of the domains analysed. Meanwhile, the data reinforce the findings already presented regarding geographical heterogeneity. Taking low performers as a reference point, it is noted that the activity rate in the South of Italy is lower and statistically significant compared to all macro-areas except the Islands, with negative differences of 20 percentage points and beyond across all three domains analysed compared to the North-West and North-East. The Centre occupies an intermediate position, as it shows labour force shares lower than those of the northern regions of Italy, but does not differ significantly from the figure for the Islands, except in the APS domain, where it shows a positive gap of 10 percentage points. Finally, no significant differences are identified across any of the three domains analysed in the North-East and North-West, which perform best in relation to this indicator.

Figure 3.1 Activity rate of the overall population and low performers in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults aged 25-65 not enrolled in formal education. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

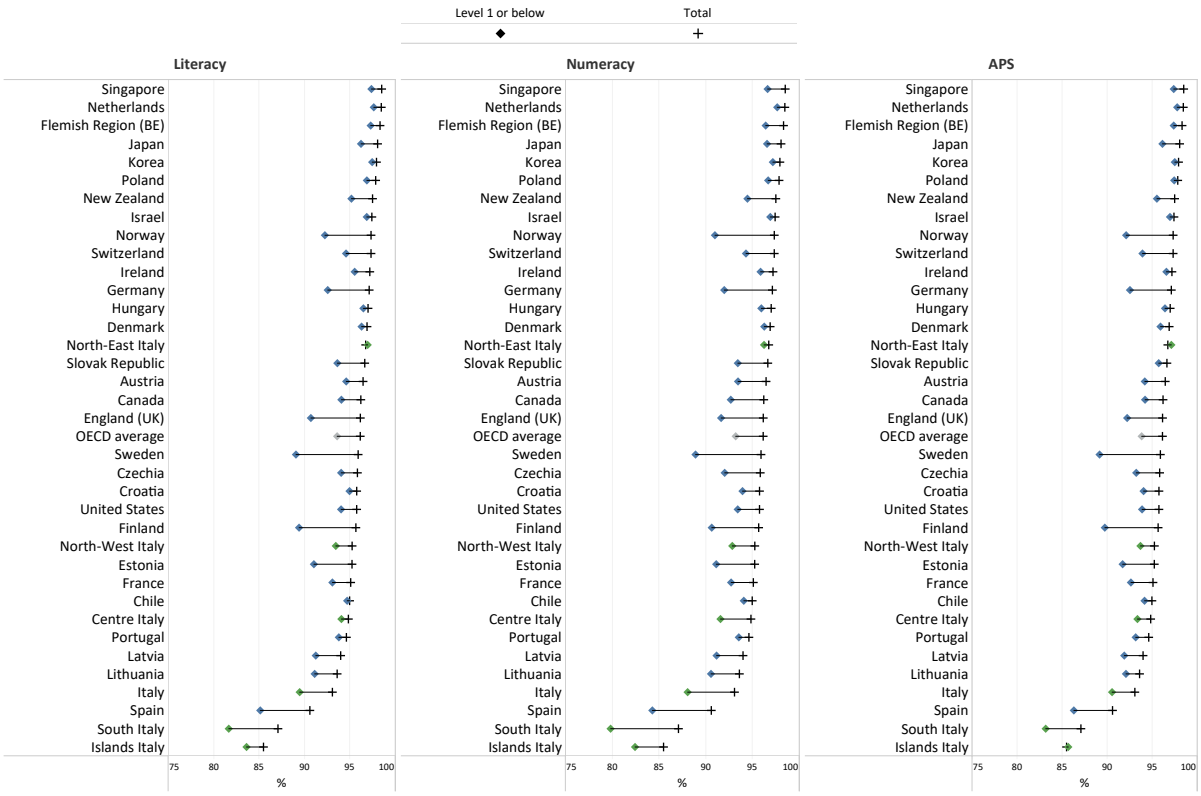
The comparison highlights a situation of disadvantage in Italy, both at a national and a geographical macro-area level, with respect to the international context, with reference both to the activity rate of low performers and the population observed here as a whole. In fact, data on the latter indicate that Italy has a lower activity rate than all other countries and economies analysed. In particular, the gap between Italy and the OECD average is around 11 percentage points, but this difference approaches 20 percentage points or above if countries such as Sweden, Singapore, Switzerland and Hungary are taken as points of reference. With regard to low performers also, the gap in the activity rate between Italy and the OECD average is around 10 percentage points. The activity rate for low performers in the North-West and North-East, however, is close to the OECD average.

In general, Figure 3.1 confirms the employment returns associated with skills. In Italy, as in all the countries and economies considered, people with lower skill levels participate in the labour market to a lesser extent than the overall population. Figure 3.2 focuses on the employment to labour force ratio, that is, considering all individuals who are employed or seeking employment, it shows the share who are actually employed. In other words, this ratio represents the complement to 100 of the standard unemployment rate[23].

In general, the data indicate that 93% of the labour force aged 25-65 and not enrolled in formal education are employed; this share drops to lower percentages among individuals with low proficiency levels. In particular, among low performers in the numeracy domain, 88% were employed, while slightly higher shares were recorded in the literacy and APS domains, at 89.4% and 90.5% respectively.

[23] The decision to use this indicator, rather than the more traditional unemployment rate, stems from a methodological constraint dictated by sample sizes and the need to produce reliable estimates, particularly in relation to Italian geographical areas. Indeed, with the same standard error, considering this ratio rather than its complement allows for a more detailed interpretation of the estimates produced.

Figure 3.2 Employment to labour force ratio for the overall population and low performers in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults aged 25-65 who are employed or seeking employment and not enrolled in formal education. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The picture that emerges from the data for the Italian geographical areas is partly consistent with the findings above as regards the activity rate. Again, the regions of the South have the lowest shares in relation to both populations observed: in the South, 87.1% of the labour force is employed, while in the Islands this share is 85.5%. The North-West, North-East and Centre are characterised by similar and higher employment shares than the Italian average, including in the case of low performers. In particular, among the labour force aged 25-65 not enrolled in formal education, those in employment range between 94.8% in the Centre and 96.7% in the North-East. The differences in employment shares between individuals with limited proficiency levels and the overall population, calculated for each macro-area, are statistically significant, with the exception of the national figure for the literacy and APS domains.

A macro-area level comparison of the population with limited skill levels finds, in keeping with the data on activity rate, that the lowest shares of employed adults across all macro-areas are in the South and the Islands, with the lowest rate again observed in the South. In contrast, the highest shares of employed adults are found in the regions in the North of Italy, with the North-East recording the highest rates across the domains considered.

At an international level, the share of employed adults in the labour force in Italy is higher only than in Spain, and in line with Latvia and Lithuania. The figure for Italy is 3.1 percentage points behind the OECD average and more than 5 points behind countries and economies such as the Flemish Region (BE), the Netherlands and Singapore. When considering the population with limited skill levels, the situation changes only with reference to similarly positioned countries. Indeed, Italy again has a higher share only than Spain in the literacy and APS domains (with a difference compared to the OECD average of between 3 and 5 percentage points depending on the domain), but does not deviate in statistical terms from a large number of countries and economies, including Finland and Sweden but also Germany, England (UK) and Norway. An entirely different situation emerges, meanwhile, in the North-East where values exceed the OECD average for both populations analysed.

The lower likelihood of individuals with limited skill levels to be employed compared to the population as a whole is particularly evident across the geographical areas in Italy. At a national level in Italy, significant differences only emerge in the numeracy domain, whereas in the macro-areas, all differences recorded are statistically significant. These results, when compared with those relating to the activity rate (Figure

3.1), seem to indicate that skills — or, in negative terms, the possession of limited skill levels — represent a disadvantage both in the transition from inactivity[24] to activity and in the transition from unemployment to employment.

Box 3.1 Skills and main job characteristics in Italy and its macro-areas

Below is an in-depth study of the employed population in Italy aimed at a more detailed analysis of the variability of proficiency scores in the three domains considered by the PIAAC survey in relation to the main job characteristics.

Permanent employees show higher average proficiency scores than temporary employees, but not higher than self-employed workers, with whom the differences are not statistically significant (Table B.3.1). For permanent workers, the numeracy and literacy scores are close to 255 (256 and 254 respectively), while in APS the score is 239 points. The differences with respect to temporary employees amount to 26, 22, and 17 points respectively. The self-employed record scores of 253, 252 and 233 in numeracy, literacy and APS.

In terms of occupations,[1] a clear, positive, and expected, relationship emerges between these and proficiency scores: as the inherent complexity of the former increases, the latter also increases. Italian residents employed in occupations requiring no qualifications record average proficiency scores of around 220 points in literacy and numeracy and 213 in the APS domain, with negative differences increasing as the complexity of the reference occupation increases (e.g., a difference of 54 points in the numeracy domain compared to those employed in highly skilled or technical occupations). Moreover, the differences in average scores among occupations are always significant across all domains considered, indicating that occupation type and associated qualification level is a good differentiating factor among the employed population with respect to skills. Indeed, on average, a difference of 15 points is seen between individuals in intermediate manual occupations and those in intermediate clerical occupations, in favour of the latter. Not surprisingly, those in highly skilled or technical occupations score highest in each domain, averaging 271 and 273 points in literacy and numeracy, respectively, and 250 points in the APS domain.

As regards sectors of economic activity[2], aggregated into three categories (primary sector, secondary sector, tertiary sector[3]), the average proficiency scores suggest partial polarisation among employed adults: across all domains considered, workers employed in the tertiary sector are, on average, more competent than those employed in the primary and secondary sectors, with no statistically significant differences seen between the latter two sectors. In particular, tertiary sector workers achieve average proficiency scores of 256 in numeracy and literacy and 240 in APS, with positive differences of between 15 and 21 points compared to those employed in the primary sector, and between 9 and 14 points compared to those employed in the secondary sector. Partial polarisation also emerges with respect to company size, measured in terms of number of workers and observed in four size categories (1-10 workers; 11-49 workers; 50-249 workers; more than 250 workers); this, however, is influenced by the reference domain. As regards numeracy, adults employed in small enterprises, i.e. with no more than ten workers, are found to have the lowest numeracy scores, on average, among the observed categories. Such differentiation does not emerge with the same clarity in the literacy domain: those working in small firms are found to be less competent, on average, than those in small-to-medium-sized firms (11-49 workers) or large firms (more than 250 workers), but not than those in medium-sized production firms (50-249 workers). This polarisation is even less pronounced in the APS domain, as employees working in small firms show significantly lower average proficiency only compared to those employed in large enterprises. Similarly, no significant differences emerge among the remaining firm size categories observed.

[1] The classification of occupations used was constructed from the ISCO classification – *International Standard Classification of Occupations*.
[2] The sectors of economic activity are based on the International ISIC classification – *International Standard Industrial Classification of all Economic Activities*.
[3] The primary sector includes agriculture, forestry, animal production and mining; the secondary sector includes processing industries in a broad sense; while the tertiary sector includes trade, credit granting, insurance, transport and communications and other service activities.

[24] Where inactivity is defined as non-participation in the labour force and activity as being in employment or seeking employment.

Table B.3.1 Average score in the literacy, numeracy and adaptive problem solving domains according to the main job characteristics in Italy

		Literacy	Numeracy	APS
Contract type	Permanent	254	256	239
	Temporary	232	230	222
	Self-employed	252	253	233
Occupations	Requiring no qualifications	221	219	213
	Intermediate manual	235	235	223
	Intermediate clerical	250	252	237
	Highly qualified or technical	271	273	250
Economic activity	Primary sector	235	236	224
	Secondary sector	242	246	230
	Tertiary sector	256	256	240
Firm size	1-10 workers	243	243	231
	11-49 workers	255	255	236
	50-249 workers	253	256	241
	More than 250 workers	258	264	244

Note: adults aged 25-65 residing in Italy, employed and not enrolled in formal education. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The job characteristics discussed above are analysed below, focusing on the difference between the geographical areas and the respective national score for Italy, in order to further understand the degree of geographical heterogeneity of skills among workers. For ease of reading, only those differences that are statistically significant are highlighted in Table B.3.2.

The heterogeneity of the geographical areas is confirmed, with average proficiency scores for the North-East higher than the national average across a variety of aspects, the Centre and North-West largely consistent with the national average figure, and a pronounced negative difference seen across the board in the South and Islands with respect also to workers' job characteristics.

In particular, average proficiency scores among employed adults in the North-West do not differ in statistical terms from the national figures for Italy presented above for any of the characteristics observed with the exception of the self-employed, who score higher than the national average in the literacy and APS domains (16 and 14 points respectively).

The situation in the Centre of Italy is very similar, with the exception of greater literacy proficiency recorded among those employed in highly qualified or technical occupations, with an average score of 280 points in the macro-area compared to the corresponding national score of 270.

In the North-East, in contrast, positive differences are seen in relation to several employment characteristics. Permanent workers in this area have higher average proficiency scores than the national averages in both the literacy (8 points) and numeracy (10 points) domains. Higher average skills in the same domains are also recorded among workers in occupations requiring no qualifications and in intermediate clerical occupations. Common across all domains considered, meanwhile, is the higher proficiency level recorded among those employed in the tertiary sector and the self-employed; while, with respect to company size, workers in small and medium-sized firms are found to be more competent: 12 proficiency points higher than the 11- 49-worker size category in the literacy and numeracy domains, and 13 and 17 points higher, respectively, in the small size category (1-10 workers) in the APS and literacy domains.

The opposite picture emerges in the South and Islands. In the South, negative and significant deviations from the national average emerge across all aspects considered, with the exception of those employed on temporary contracts, those in occupations requiring no qualifications or those employed in large production units (250 workers and more). Average proficiency scores recorded among the self-employed are lower than the national figure by 16 points in the literacy domain and 17 points in the numeracy and APS domains.

The situation in the Islands is even more critical: excluding data for which an adequate level of statistical reliability could not be achieved, the remaining differences with respect to the national average are significant and negative, with deviations exceeding 30 points, and as high as 40 points in the literacy domain (37 in the numeracy domain) in relation to those working in small production firms and 43 points in the numeracy domain with respect to the self-employed.

The geographical heterogeneity seen earlier is reinforced even further by this analysis, particularly in the Islands, where a structural difference emerges compared to the national context. The average proficiency score of those employed in small firms should be noted.

Table B.3.2 Average score difference in the literacy, numeracy and adaptive problem solving domains according to the main job characteristics in the Italian macro-areas

Literacy						
Job characteristics		North-West	North-East	Centre	South	Islands
Contract type	Permanent	4	8	7	-18	-29
	Temporary	-4	19	-1	1	
	Self-employed	16	12	3	-16	-41
Occupations	Requiring no qualifications	9	18	2	-4	
	Intermediate manual	5	12	-0	-19	
	Intermediate clerical	5	14	2	-13	-29
	Highly qualified or technical	8	5	10	-18	-33
Economic activity	Primary sector					
	Secondary sector	4	11	2	-21	
	Tertiary sector	7	12	5	-16	-32
Firm size	1-10 workers	4	17	12	-20	-40
	11-49 workers	3	12	3	-17	
	50-249 workers	5	3	7	-16	
	More than 250 workers	3	1	10	6	
Numeracy						
Job characteristics		North-West	North-East	Centre	South	Islands
Contract type	Permanent	3	10	6	-17	-31
	Temporary	-6	11	6	-1	
	Self-employed	12	19	4	-17	-43
Occupations	Requiring no qualifications	7	18	0	-0	
	Intermediate manual	5	10	3	-19	
	Intermediate clerical	5	16	3	-16	-29
	Highly qualified or technical	6	8	9	-18	-35
Economic activity	Primary sector					
	Secondary sector	3	12	2	-19	
	Tertiary sector	6	14	6	-18	-31
Firm size	1-10 workers	6	16	10	-20	-37
	11-49 workers	1	12	4	-14	
	50-249 workers	5	4	11	-18	
	More than 250 workers	-0	6	11	8	
APS						
Job characteristics		North-West	North-East	Centre	South	Islands
Contract type	Permanent	3	6	4	-12	-22
	Temporary	5	2	3	3	
	Self-employed	14	11	1	-16	-26
Occupations	Requiring no qualifications	6	14	-1	0	
	Intermediate manual	5	9	0	-16	
	Intermediate clerical	5	8	3	-13	-18
	Highly qualified or technical	8	3	5	-13	-24
Economic activity	Primary sector					
	Secondary sector	3	9	0	-15	
	Tertiary sector	8	7	3	-13	-22

Firm size	1-10 workers	7	13	8	-17	-34
	11-49 workers	1	7	3	-10	
	50-249 workers	3	1	3	-7	
	More than 250 workers	3	1	5	5	

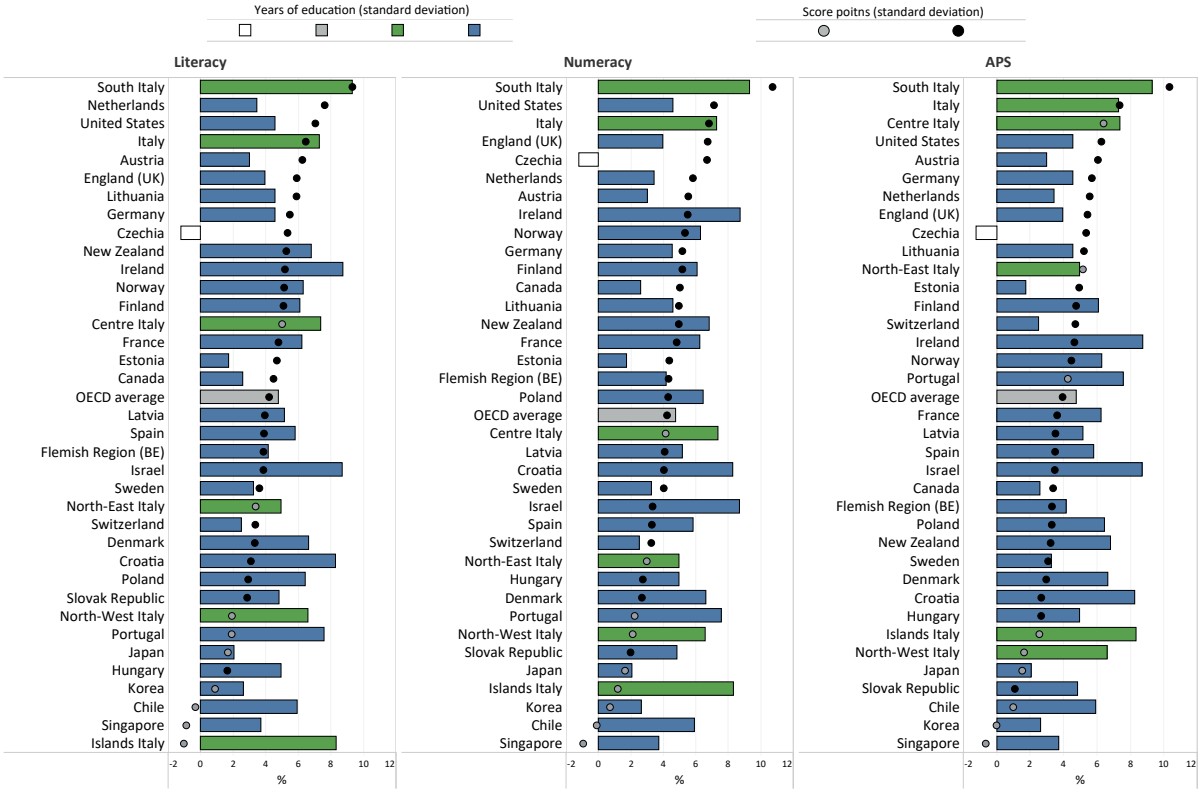
Note: adults aged 25-65 residing in Italy, employed and not enrolled in formal education. Doorstep excluded. Values in grey refer to differences between the macro-area value and the national average that are not statistically significant. Values not reported refer to data that are not representative of the reference population.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The analyses below offer an insight into the effects of skills and investment in education on employment returns, net of potential individual characteristics affecting this relationship. Specifically, Figures 3.3 and 3.4 outline how skills and investment in education, respectively, affect the likelihood of being active in the labour market as opposed to out of the labour force, and of being employed as opposed to seeking employment. As such, the graphs present the average probability gains generated by investment in education – in terms of the number of years spent in formal education – on the one hand, and proficiency level possessed, on the other. To make the results more understandable, the estimated average effects of investment in education and skills are multiplied by the standard deviation of the relative distribution[25].
This analysis thus gives an insight into the effects of education and skills on employment status by adjusting the estimate to control for the effects of known individual characteristics potentially affecting this relationship. In particular, the regression models used to estimate the probabilities of being active or employed include the following predictors: age group, gender, migratory background, parents' highest level of education, the presence of a partner and/or children, as well as the proficiency score in the three domains considered and the number of years spent in formal education.
In Italy, investment in formal education (in terms of years) is one of the main drivers with respect to probability of active participation in the labour market. An increase of one standard deviation in the number of years spent in formal education corresponds to a 7.3% increase in the probability of being either employed or seeking employment, rather than being inactive (Figure 3.3). Skills, on the other hand, are associated with slightly smaller effects, though still statistically significant and of considerable magnitude. In particular, a one-standard-deviation increase in literacy scores is associated with a 6.4% higher probability of being active, while for the numeracy domain the corresponding value is 6.8%. The increase in probability associated with one standard deviation in terms of skills in the APS domain is slightly higher than that associated with investment in formal education (7.3%).
The key role of the latter in relation to employment outcomes is also confirmed in the analysis broken down by geographical area. Across all areas, investment in formal education is associated with positive, significant effects of notable magnitude. The greatest effects are seen in the Islands and in particular in the South, with an increase of 8.3% and 9.3% respectively in the probability of being active in the labour market (compared to inactive). More moderate effects emerge in the Centre and North-West (7.4 % and 6.6 %), while the effect in the North-East is 5.0 %.
In contrast to the national picture, the effect of skills is more mixed across the geographical areas. A significant effect of notable magnitude emerges, common across the three skill domains analysed, in the South of Italy, indicating that investment in skills in this geographical area generates important returns in terms of activation in the labour market, translating into an increase in the probability of being active of around 10%. Similar results are seen in the Centre, albeit of a lesser magnitude and not in the numeracy domain, while in the North-East, positive and significant effects only emerge in relation to an increase in APS skills. In the North-West and Islands, in contrast, investment in skills does not appear to have a statistically significant influence on individual employment status in relation to the phenomenon observed here. The APS domain appears to be more strategic with respect to individuals' likelihood of being active in the labour market, as the associated effect is not only high at the national level, but also positively and significantly

[25] To make the effects of both investment in formal education and skills more interpretable and comparable, the probability effects were expressed not in terms of the incremental effect of having invested one additional year in education or of scoring one proficiency point above the national average, but rather by using the relative standard deviation of each variable as a multiplicative factor for the estimate, calculated at the national level. For example, in Italy, the average effect of having invested one additional year in formal education corresponds to an increase in probability of 1.96%, while in the numeracy domain, the increase in probability associated with having one additional proficiency point is 0.12%. While the data for investment in education are easy to read, the same cannot be said of the corresponding data regarding the numeracy domain, due to the wide range of *proficiency scale* (0-500). In order to address this problem and make the results more usable and comparable, the coefficients presented were multiplied by the relative standard deviations calculated with respect to the total population resident in Italy, i.e. 3.7 years and 55.4 points respectively. The results of this multiplication are shown in the figures.

related to this outcome in three out of five macro-areas.
The picture that emerges from an international comparison is in contrast to what has been observed thus far. In Italy, and especially in the South, investment in education and skills produces the strongest effects on the likelihood of being in the labour force. In particular, Italy shows one of the largest effects among the countries and economies considered, both in relation to the years spent in formal education and across the skill domains examined. This situation appears more unusual in the context of the data from other countries with respect to the effects of education, on the one hand, and skills on the other. Indeed, at an international level, it is generally observed that countries that perform better with respect to education – such as Ireland, Croatia, Portugal and New Zealand – do not perform as well with respect to effects of skills; on the contrary, countries and economies – such as the United States, England (UK) and the Netherlands – that record effects slightly smaller than those observed in Italy across the three skills domains are characterised by moderate returns on investment in education.

Figure 3.3 Effects of education and literacy, numeracy and adaptive problem solving skills on the probability of being active as opposed to inactive by country and Italian macro-area

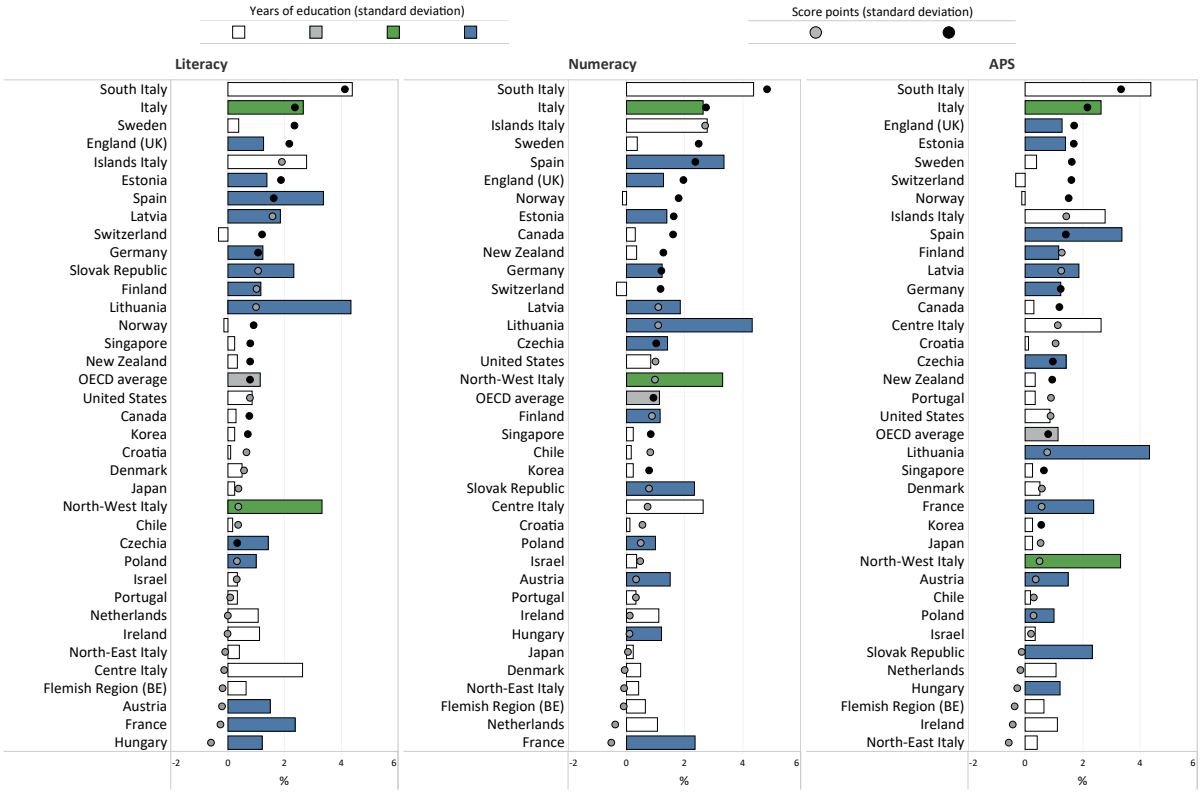


Note: adults aged 25-65 not enrolled in formal education. Doorstep excluded. The following predictors have been included in the regression model: age group, gender, migratory background, parents' highest level of education, the presence of a partner and/or children, as well as the proficiency score in the three domains considered and the number of years spent in formal education. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In Italy, the effects of investment in education and skills on the probability of being in employment, rather than seeking employment (Figure 3.4), are similar to those just outlined. Specifically, an increase of one standard deviation in the distribution of years spent in formal education raises the probability of being employed by 2.7%. Similarly, increases of one standard deviation in the three domains considered result in effects of comparable magnitude: in the APS domain, the estimated increase is 2.2%, in the literacy domain 2.4%, and in numeracy 2.7%. In contrast to the findings set out above regarding the probability of being active in the labour market, however, there is no equally significant role of skills and education, in this case, across territories.
With the exception of the North-West, years spent in formal education are not associated with a direct outcome in terms of employment across the macro-areas. In the North-West, however, the investment is very rewarding, associated with a 3.3% increase in the probability of being in employment. Similarly, with the exception of the numeracy domain in the South, no statistically significant effects of investment in skills emerge with respect to employment across the macro-areas.

The international comparison with respect to the overall data for Italy confirms the central role of education and skills in relation to employment outcomes. With regard to years spent in education, the effect observed in Italy is second only to Lithuania and Spain; additionally, Italy sees the highest probabilities of being employed among the countries and economies participating in the PIAAC in each domain considered.

Figure 3.4 Effects of education and literacy, numeracy and adaptive problem solving skills on the probability of being employed as opposed to seeking employment by country and Italian macro-area



Note: adults aged 25-65 not enrolled in formal education (Panel A) and adults aged 25-65 employed or seeking employment and not enrolled in formal education. Doorstep excluded. The following predictors have been included in the regression model: age group, gender, migratory background, parents' highest level of education, the presence of a partner and/or children, as well as the proficiency score in the three domains considered and the number of years spent in formal education. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

In light of the observations above regarding the quantity of skills possessed by workers resident in Italy and the relationship between these and labour market indicators, the broad-ranging relevance and significance of investment in education and skills certainly also emerges as a key element in relation to upcoming challenges facing the Italian production system (the ecological and digital transition, and ageing workforce, to name but a few). On the other hand, this same factor can also be interpreted as a further, indirect, indicator of the overall condition of the labour market and the Italian situation. In a context where the average skill levels of the employed population are below the international average and labour markets are relatively stagnant, there is a risk of increasing polarisation between the active and employed segment of the labour force and the unemployed and inactive component – a polarisation that Italy must seek to prevent, particularly in light of future challenges.

3.1.2 Skills, educational attainment and earnings

While education levels or years in education have always been regarded as the main proxies for skills, it is now clear that education and skills cannot be assimilated, and must be considered jointly when analysing wage returns to human capital investment.
The following pages present the results of multivariate analyses developed to explore the relationship between education, skills and wages, i.e. to determine the extent to which (gross hourly) wages change with changes in the number of years in formal education and proficiency scores.
Before turning to the topic of wages, however, some statistics are presented on the different proficiency levels of employed adults residing in Italy by working time arrangement, that is, part-time versus full-time

employment (Table 3.2). This information is considered useful as the analysis regarding wages is performed with respect to hourly wages; as such, any differences relating to employed adults working reduced hours will not be captured.
According to Eurostat estimates, part-time workers accounted for just under 18% of the total employed population in Italy in 2023, rising to 31.3% among employed women (Eurostat 2024). As previously mentioned, the working time arrangement should not, in theory, have a direct effect on workers' hourly pay, but only on their monthly or total earnings, when compared with comparable full-time workers. Nevertheless, working on a part-time basis could be a limiting factor, particularly as regards remuneration, both in terms of accessing the labour market and career advancement. Table 3.2 provides an insight into whether the negative effects of reduced-hour employment – in terms of wage outcomes but also, sometimes, job quality – are also partly attributable to differences in skill possession.
The results presented appear, at first glance, to confirm higher average skill levels among full-time workers compared to those employed part-time. However, in none of the three domains considered are the differences in average skill levels by working time arrangement statistically significant. In other words, there are no differences in the skills possessed by part-time and full-time workers.
These findings are also confirmed in the analysis based on geographical areas. No statistically significant differences emerge between full-time and part-time workers in any of the macro-areas.

Table 3.2 Average score in the literacy, numeracy and adaptive problem solving domains by working time arrangement of employed individuals in Italy and the Italian macro-areas

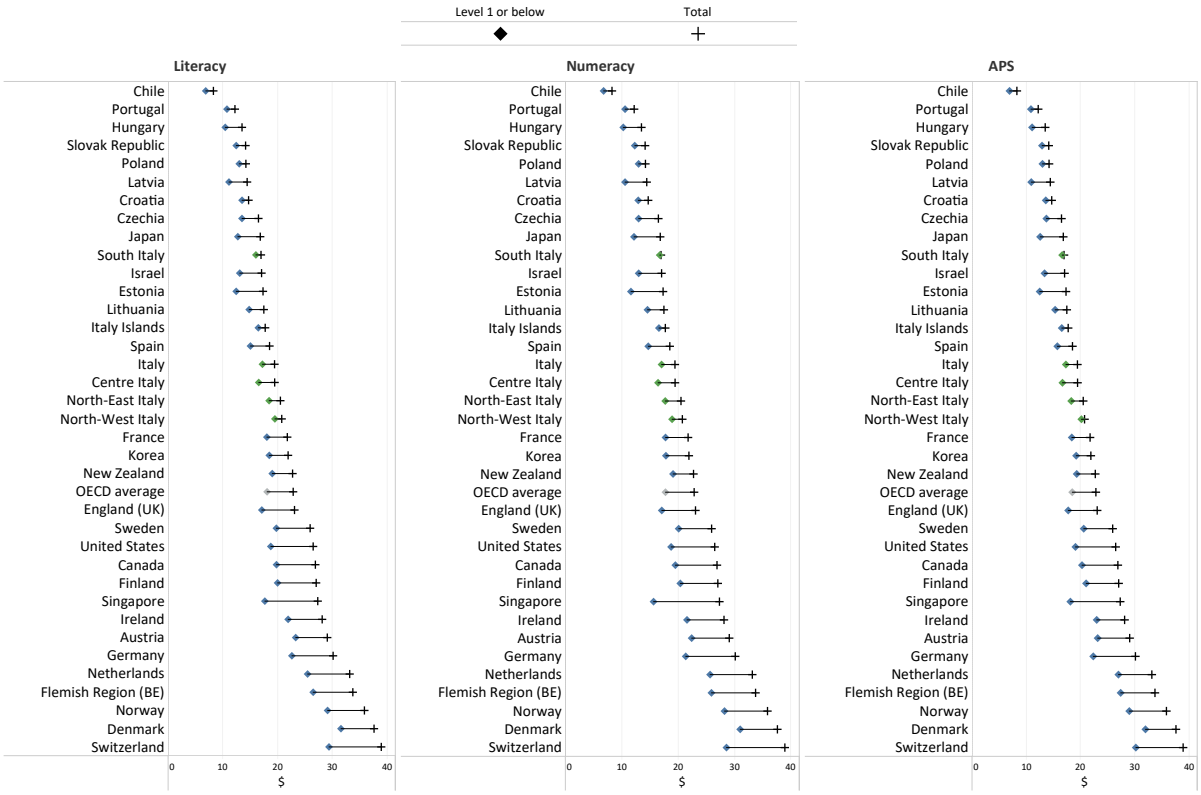
	Literacy		Numeracy		APS	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
Italy	252	250	254	246	237	233
North-West of Italy	258	251	258	247	243	234
North-East of Italy	262	267	265	267	243	249
Centre of Italy	259	252	262	249	241	235
South of Italy	234	243	238	234	224	226
Islands	217	230	217	228	211	219

Note: adults aged 25-65 who are employed and not enrolled in formal education. Doorstep excluded. Part-time workers are classified as employed persons who report working less than 30 hours per week.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Turning now to an analysis of the relationships between skill domains and wages, Figure 3.5 shows the median value of gross hourly wages[26] controlled for the coefficient of purchasing power parity[27] with respect both to the total employed population and employed low performers, i.e. those performing at Level 1 and below.
As mentioned above, higher skills are associated with better performance in the labour market, which should in turn correspond to higher wages. This assumption appears to be confirmed in the Italian context. Indeed, the median gross hourly earnings of all employed adults amount to $19.4, approximately two dollars higher than the corresponding value for those with limited proficiency levels (more specifically, this latter figure is $17.2 in the literacy domain, $17 in the numeracy domain, and $17.3 in the APS domain).
The median gross hourly earnings recorded for the overall employed population across the various Italian macro-areas is not dissimilar to the national figure, with the exception of the South, where employed adults receive a lower wage of $16.9. As regards the sub-population of low-skilled employed adults, only those in the North-West regions present a significant, and positive, difference compared to the national population, specifically in the APS domain: low performers in the APS domain employed in the North-West receive median gross hourly earnings of $20.1.

[26] The reference population for the analyses presented includes all employed adults aged 25-65 who are not enrolled in formal education. Specifically, as with previous analyses, self-employed workers are also included; the hourly wage for this latter group, not directly recorded in the PIAAC, was estimated on the basis of monthly gross wage and average number of hours worked per week.
[27] The adjustment of national hourly wages using the PPP coefficient enables direct comparison among countries net of national currency conversion differences and the cost of living, by reporting the corresponding dollar value using 2022 as the base year.

Figure 3.5 Median gross hourly earnings of employed adults (total and low performers) in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults aged 25-65 who are employed and not enrolled in formal education. Doorstep excluded. The median gross wage is adjusted for Purchasing Power Parity (PPP) and reported in dollars with 2022 as the base year. With regard to the self-employed, gross hourly remuneration is calculated on the basis of the monthly aggregate and average number of hours worked per week. To limit potential distortive effects related to outlier values of gross hourly earnings, the analysis is based on gross hourly earnings between the second and ninety-ninth percentiles.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The international comparison shows that, for all employed individuals, the median gross hourly earnings in Italy amount to $3.4 lower than the OECD average, and the largest gaps are recorded with countries such as Denmark and Switzerland, where the difference exceeds $18. The only country in relation to which no statistically significant differences emerge is Spain, while Italy has a higher hourly wage than 12 countries including Japan, Poland and Portugal[28].

As regards employed adults with limited skill levels, Italy is in line with the average for all OECD countries and economies in the numeracy and literacy domains, but presents a significant negative difference of $1.2 with respect to the APS domain. Consistent with the findings for the total population, the international comparison highlights a group of countries with wages lower than those of Italy across all domains considered. These countries are Chile, Croatia, Estonia, Hungary, Israel, Japan, Latvia, Lithuania, Poland, Portugal, Czechia, Slovak Republic and Spain, plus Singapore in the numeracy domain. Again with respect to employed adults with limited skill levels, Italy sees the greatest negative differences when compared to Denmark and Switzerland, ranging between $11 and $14.

In other words, this comparison shows that although a wage gap exists in Italy between low-performing workers and the total employed population, this gap is less pronounced – less than half the size of the average gap recorded across OECD countries participating in the PIAAC. It is also noted that this result is not so much attributable to the low remuneration of the population with limited proficiency levels, but rather to the overall median remuneration.

Finally, and in keeping with the findings presented above, the following analyses provide an insight into the effects generated by skills, in comparison with investment in formal education, in terms of wage variation, net of potential individual characteristics affecting this relationship. Specifically, Figure 3.6 presents the percentage change in gross hourly wages[29] generated, on the one hand, by investment in formal education

[28] The remaining countries are: Chile, Croatia, Czechia, Estonia, Hungary, Israel, Latvia, Lithuania and Slovak Republic.
[29] In this analysis, gross hourly earnings are presented in their logarithmic form, so that results reported do not translate into changes in terms of dollars, but rather on a percentage basis.

(in terms of one standard deviation from the overall national distribution of years invested in education) and, on the other hand, by the proficiency level possessed (in terms of one standard deviation from the national distribution of proficiency scores for each domain)[30]. Figure 3.6 therefore offers insight into the effects generated by education and skills with respect to wage outcomes, adjusting the estimates to control for the effects of potential individual characteristics affecting this relationship. In particular, the regression models used include the following predictors: age group, gender, migratory background, parents' highest level of education, the presence of a partner and/or children, years of work experience, as well as the proficiency score in the three domains considered and the number of years spent in formal education.[31].

In Italy, investment in education, in terms of years spent in formal education, is again found to have a central role in terms of labour market outcomes, including in relation to remuneration. An increase of one standard deviation in the number of years spent in formal education corresponds to a 13.6% increase in gross hourly remuneration. Skills, on the other hand, are associated with slightly smaller effects, though still statistically significant and of considerable magnitude. Specifically, one standard deviation in literacy scores is associated with a positive effect on gross hourly earnings of 4.5%; the positive effect in the APS domain is 4.9%, while in the numeracy domain it is 5.2%.

The key role of investment in education is also confirmed in the analysis based on geographical areas. Positive and significant effects of notable magnitude emerge in each area. The greatest effects are seen in the Island and in particular in the South, with increases in gross hourly earnings above the national average, at 15.0% and 19.4% respectively. More moderate and similar effects (12.0%) emerge in the Centre and North-West, while in the North-East the effect is lower at 8.7%.

In contrast to the national picture, the effect of skills is more mixed across the geographical areas. In the South, Islands and North-West, proficiency scores across the three domains considered do not appear to have a statistically significant effect on wages. In the North-East, in contrast, and particularly in the Centre, the effects are significant and notable, with the exception of the literacy domain in the North-East, which has a non-significant effect. In the Centre, one standard deviation in the literacy and numeracy domains corresponds to slightly lower increases in gross hourly earnings than investment in formal education, at 9.3% and 10.1% respectively.

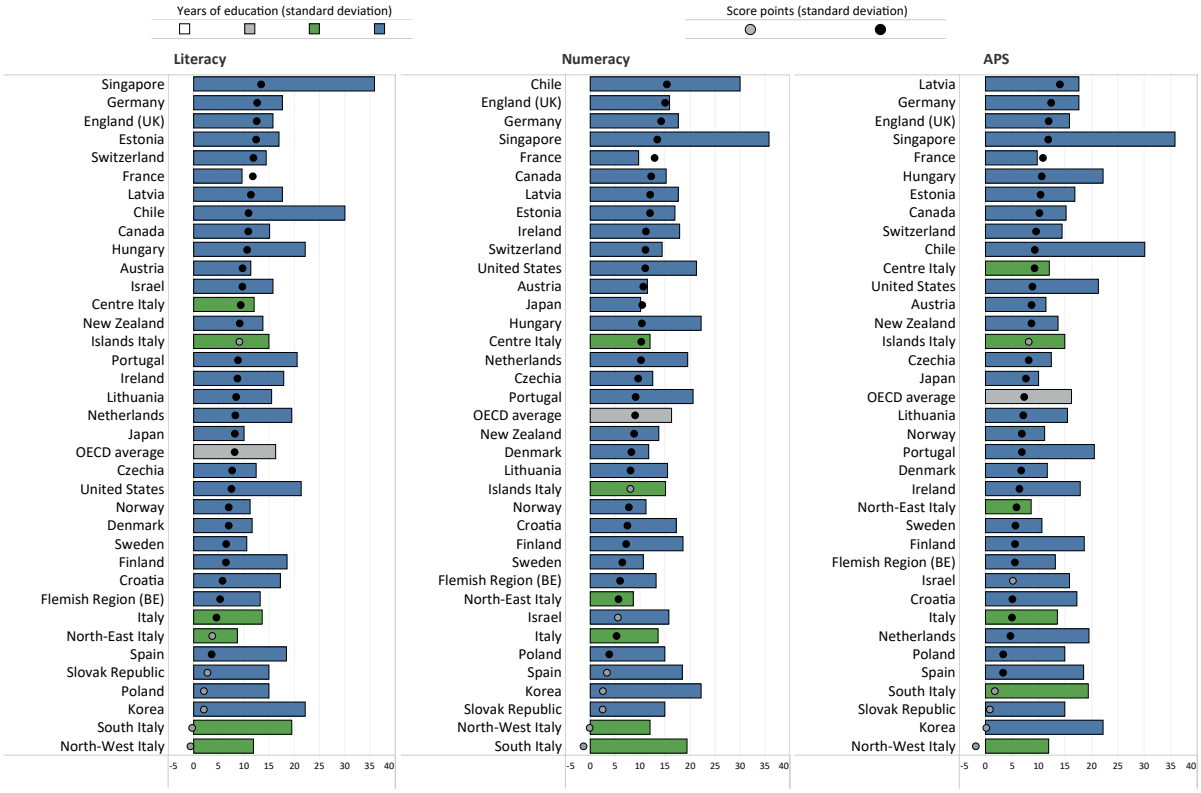
International comparisons show that, in Italy, the effects of investment in education produce moderate returns with respect to wages, which in all cases are below the OECD average. Across the countries and economies observed, an increase in standard deviation relative to years in formal education generates an average positive change in gross hourly earnings of 16.2%. The performance of the South of Italy is striking in this regard, with a positive change recorded in keeping with the countries with greater increases. Setting aside Singapore and Chile, which are outliers with effects exceeding 30%, the South deviates from countries such as Korea, the United States, and Hungary – whose increases are slightly above 20% – by only a few percentage points. The performance of the North-East is also striking, but in the opposite direction, as the employed population in this macro-area benefit the least, among the countries and economies considered, from investments in education in terms of wage outcomes.

With respect to investments in skills also, the effects observed in Italy are moderate and below the OECD average across all domains considered, with differences of over 3 percentage points in the literacy and numeracy domains and slightly less in APS. At a macro-area level, on the other hand, the Centre stands out due to above-average effects, in keeping with countries such as Israel and New Zealand in the literacy domain, the Netherlands and Hungary with respect to numeracy, and Chile and the United States with respect to APS. The North-East, the only other area with significant effects related to skills, does not deviate from the national figure, with moderate effects below the OECD average.

[30] See footnote 28 for further details.

[31] In order to limit potential endogeneity effects, the regression model predictors do not include individual job characteristics of the firms in which employed adults work, such as company size and economic sector. Similarly, considering the heterogeneous nature of the labour markets in the countries and economies considered, it was decided to use work experience in years as the only predictor related to individual job characteristics.

Figure 3.6 Effects of education and skills on gross hourly earnings in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults aged 25-65 who are employed and not enrolled in formal education. Doorstep excluded. The median gross earnings are adjusted for Purchasing Power Parity (PPP) and reported in dollars with 2022 as the base year. With regard to the self-employed, gross hourly remuneration is calculated on the basis of the monthly aggregate and average number of hours worked per week. The following predictors have been included in the regression model: age group, gender, migratory background, parents' highest level of education, the presence of a partner and/or children, work experience in years, as well as the proficiency score in the three domains considered and the number of years spent in formal education. To limit potential distortive effects related to outlier values of gross hourly earnings, the analysis is based on gross hourly earnings between the second and ninety-ninth percentiles. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

3.2 The mismatch of skills and education

Mismatch is a persistent issue in Italy, characterised by mismatch between the skills or education levels possessed by employed adults and those actually demanded by companies. This phenomenon affects several sectors and can be observed in relation both to technical skills and soft or cross-sector skills, i.e. skills relevant to multiple sectors. The effects of this mismatch have led to negative results both in terms of productivity and capacity for innovation and economic growth in recent years (Vandeplas and Thum-Thysen 2019).

The imbalance between educational attainment and skills on offer and in demand in the labour market, which is also affected by the rapid evolution of technology and work processes, means that companies' digital and technological skill requirements cannot always be met by the different levels of the education system (secondary, technical and academic). Sectors such as artificial intelligence, cybersecurity and data science, for example, need qualified figures that are often lacking in Italy. Too often, the Italian education system does not align courses of study with the skills required by the production system (Caroleo and Pastore 2018).

From the opposite perspective, an inverse problem also arises, particularly in Italy, once again linked to the imbalance in the quality of labour demand compared to supply. In particular, industrial systems mainly comprising small and very small production facilities struggle to keep pace with innovation in terms of technical know-how and related production systems, giving rise to potential mismatches in labour demand in the context of more skilled supply (OECD 2017, 57-77). Similarly, little investment in innovation, which has characterised much of the Italian production system in general in recent years, and is normally associated with strategies to reduce labour costs (Inapp *et al.* 2017), tend to result in mismatch whereby workers may be employed in jobs requiring lower levels of attainment in terms of both qualifications and skills.

With a view to further characterising the role of skills, including beyond the sphere of employment status and remuneration, and specifically given the role played by mismatch in regard to these aspects, the following pages focus on the relationship between skills, educational attainment and mismatch. Reference is made in particular to two main types of job mismatch (presented in detail in the next box): qualification mismatch and skill mismatch.

Box 3.2 Definition of qualification mismatch and skill mismatch

Qualification mismatch

A qualification mismatch occurs when a worker has higher or lower levels of educational attainment than required for their job.

In the second cycle of the PIAAC Survey, this type of mismatch was measured using a specific, perception-based question: “If applying today, what would be the usual qualification, if any, that someone would need to get this type of job?”.

Responses to the question are considered in relation to the actual qualification possessed in order to determine the qualification mismatch indicator, which is divided into three distinct categories:

- *over-qualified*, a worker whose educational attainment is higher than that required to perform their job;
- *matched*, a worker whose educational attainment matches the level required to perform their job;
- *under-qualified*, a worker whose educational attainment is lower than that required to perform their job.

Skill mismatch
A skill mismatch occurs when a worker has either higher or lower skills than required to perform their job. In the second cycle of the PIAAC Survey, this type of mismatch was measured using a specific question: "Overall, which of the following statements best describes your skills in relation to what is required to do your job?":

- My skills are higher than required by my job
- My skills are matched to what is required by my job
- Some of my skills are lower than what is required by my job and need to be further developed."

The responses to the question determine the categories of the skill mismatch indicator:

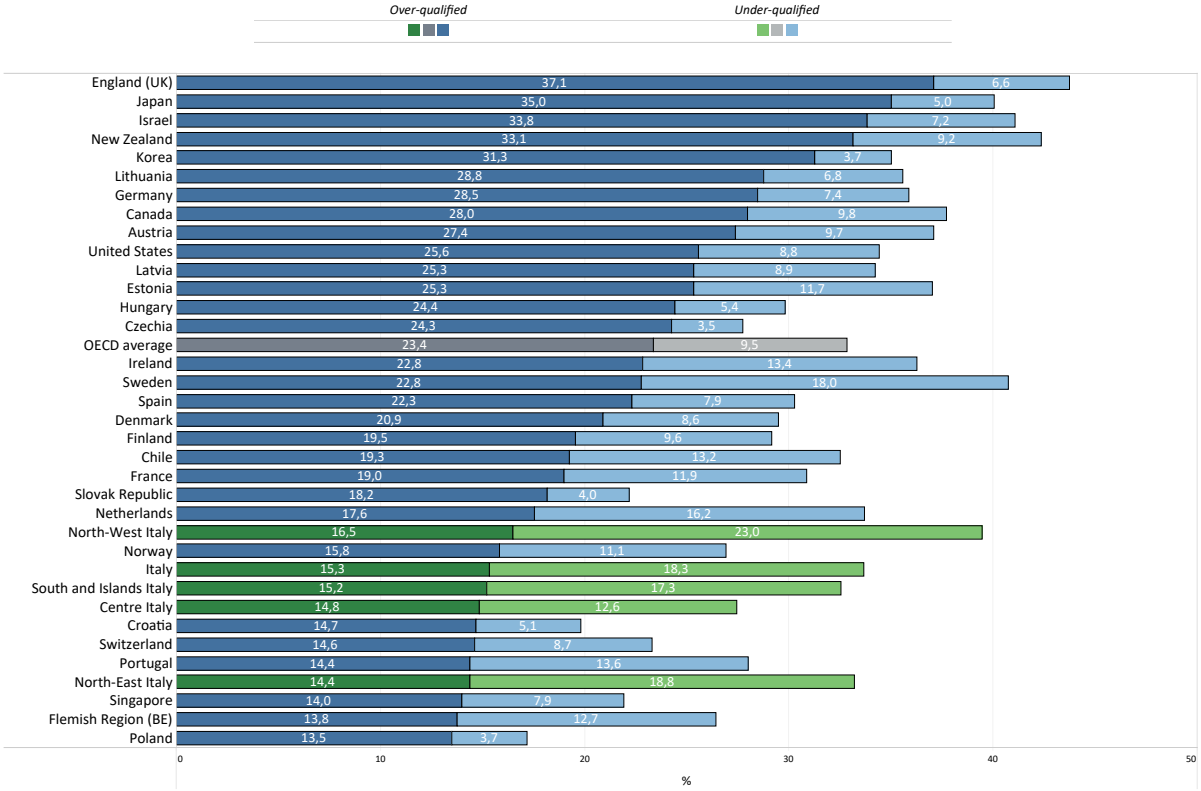
- *over-skilled,* a worker who considers their skills to be "higher than required" for their job;
- *matched*, a worker who considers their skills to be "matched to what is required" for their job;
- *under-skilled*, a worker who considers their skills to be "lower than required" for their job.

3.2.1 Qualification and skill mismatch: Italy and its macro-areas in the international context

The characteristics of qualification and skill mismatch in Italy are unusual compared to the international context. Indeed, as already noted in this report, average proficiency levels of adults in Italy are limited, and in the context of relatively few people with high levels of education compared to other countries and economies and the OECD average, the presence of mismatch phenomena appears even more serious.
15.3% of employed adults aged 25-65[32] in Italy state that they are over-qualified, in terms of educational attainment, to perform the tasks required for their job (Figure 3.7). Looking in more detail at the Italian macro-areas[33], the figures recorded are all consistent with the national figure, with no significant differences. Considered in the international context, the Italian data confirm the findings set out in previous paragraphs, with Italy ranking below the OECD average (23.4%), with a gap of 8 percentage points, but also below countries such as France (19.0%), Spain (22.3%) and Germany (28.5%).
The characteristics of the over-skilling phenomenon appear similar to the qualification mismatch (Figure 3.8). In Italy, 18.4% of workers have a higher proficiency level than required for their job, placing the country at the lower end of the international graph, with a statistically significant difference from the OECD average of 26.1% (7.7 percentage points).
The data from the Italian macro-areas do not deviate significantly from the national figure, suggesting that over-skilled workers are distributed evenly throughout the country. The only significant deviation is seen between the South and Islands, where the percentage of over-skilled workers is 23.1%, and the North-West at 14.2%, resulting in a difference of 8.9 percentage points. This gap can partly be attributed to less specialised labour supply in those areas, resulting in a lack of human capital development.
Considered in the international context, the Italian data on qualification and skill mismatch appear fully consistent with the findings presented above, representing the natural outcome of a labour force characterised by relatively low average skills and limited investment in education. Nevertheless, it is striking that just under one-fifth of Italian workers are over-qualified or over-skilled in relation to the requirements for their job. Likewise, the lack of strong differences between Italian macro-areas, characterised by marked differences in terms of production systems, is also interesting.

[32] The analyses presented in the section on mismatch *refer to the employed population aged 25-65*. Self-employed workers are therefore excluded, as this type of analysis is not considered relevant to that group.
[33] To ensure the data in this paragraph and the next are statistically representative, it has been decided to aggregate the macro-areas of the South and the Islands.

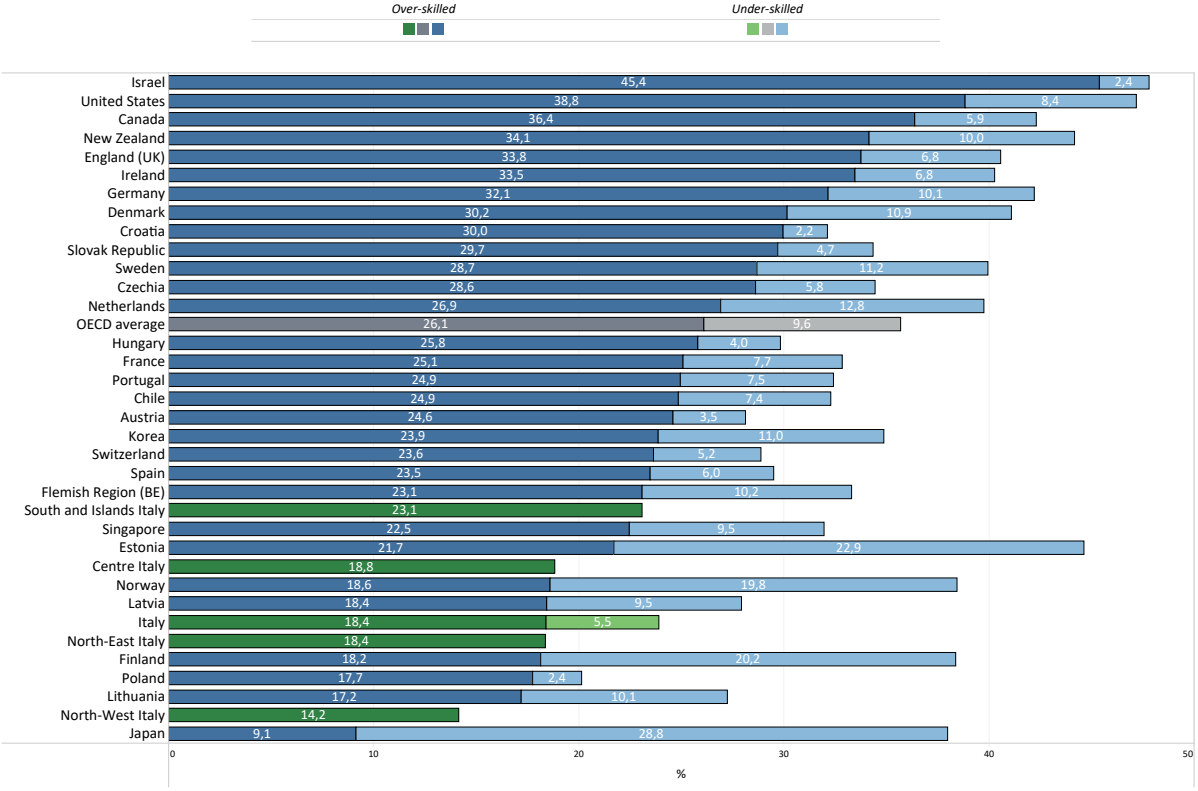
Figure 3.7 Percentage of over-qualified and under-qualified workers by country and Italian macro-area



Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded. Countries and economies are ranked based on the share of over-qualified workers.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The scenario that emerges from an examination of the opposite phenomenon, i.e. the perceived under-qualification and under-skilling of workers for their jobs, is only partially different.
The share of individuals in Italy who self-report skills that are lower than those required for their jobs (under-skilled) is, in keeping with the discussions above, very small. Among the countries participating in PIAAC, the average share of workers affected by this phenomenon is a little under 10% (9.6%); Italy's figure is nearly half that average, at just 5.5% (Figure 3.8). In fact, the phenomenon is so limited that it precludes observation across the various geographical areas of Italy, in accordance with the criteria of statistical reliability.
The opposite scenario emerges in relation to under-qualified workers, i.e. those who report lower qualifications than required for their job (Figure 3.7): at 18.3%, Italy is the country with the highest share of under-qualified workers, against an OECD average of 9.5%, i.e. just over half the Italian figure. Additionally, in the international context, Italy presents a significant difference in relation to all other participating countries, with the exception of the Netherlands and Sweden. The difference of more than 10 percentage points with Spain, a country that has shared certain similar features with Italy in the recent past in terms of general economic challenges and structural problems with the labour market, is certainly the most striking fact.
The only Italian macro-area that deviates significantly from the national average is the Centre, which, at 12.6%, has a lower share than other areas of workers whose qualifications are lower than required for their jobs, recording a significant difference in relation to the North-West (-10.4 percentage points) and the North-East (-6.2 percentage points).
If, on the one hand, the low share of under-skilled workers in Italy is not surprising and can be regarded as a "frictional" value, including due to the associated sampling error that gives rise to a confidence interval of 4.2% to 6.9% for the estimate, on the other, there is little explanation for such a high share of workers who report that the qualification requirement for their job is higher than the qualification they hold. This finding requires further investigation, including due to the fact that, with the exception of the Centre, it is consistent across all macro-areas of the country.

Figure 3.8 **Percentage of over-skilled and under-skilled workers by country and Italian macro-area**



Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded. Countries and economies are ranked based on the share of over-skilled workers. Data on under-skilled workers across the Italian macro-areas are not presented due to insufficient sample size, as this would lead to unreliable estimates.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

3.2.2 A comparison between over-qualification and over-skilling

Both over-qualification and over-skilling are linked to situations of mismatch between the qualifications (educational attainment) and skills of workers in relation to the requirements for their jobs. They are related concepts, pertaining to specific labour market dynamics, albeit producing slightly different effects. Indeed, situations of over-qualification often emerge when the labour market does not offer enough jobs or positions appropriate to specific education levels, requiring workers with high qualifications to take jobs for which the educational attainment requirements are lower than their qualifications. This underutilisation of higher qualifications can negatively affect individual performance (demotivation, dissatisfaction), the productivity of companies (with high turnover) and, more generally, the economic system, which fails to make the most of the available potential (Flisi *et al.* 2017).

Over-skilling occurs when a worker has higher skills (technical or cross-sectoral) than they use in their daily work. This situation may arise due to changes in work tasks or lack of career opportunities, and may lead to a reduction in innovation for companies and economic systems and a general loss of skills (skill obsolescence) (ibid.).

As noted in the OECD International Report (OECD 2024a), there is a correlation between the phenomena of over-skilling and over-qualification. Figure 3.9 shows the relationship between the two phenomena, mapping the countries and economies on the Cartesian plane. In the countries and economies positioned in quadrants I and III, the two phenomena move in parallel, as one increases, so does the other; in the countries and economies positioned in quadrants II and IV, however, the relationship between over-skilling and over-qualification appears to be non-linear. Figure 3.9 confirms the correlation between the two phenomena, which, however, is not overly pronounced, as various countries and economies are positioned in the second and fourth quadrants of the Cartesian plane. Italy and its geographical areas are located in the third quadrant of the graph in Figure 3.9, where the shares of over-skilled and over-qualified workers in the population are below the respective OECD averages and in line with countries such as Chile, France, Poland and Portugal. The North-West of Italy, one of the country's most industrialised and dynamic areas, records the lowest percentage of over-skilled workers. This may be linked to the growing demand for highly specialised professionals, particularly in high-tech sectors and advanced manufacturing – roles that involve managing automated production processes and enhancing efficiency through advanced technologies.

Figure 3.9 **Correlation between over-skilled and over-qualified workers by country and Italian macro-area**

Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

3.2.3 The mismatch in Italy: focusing on over-skilled workers

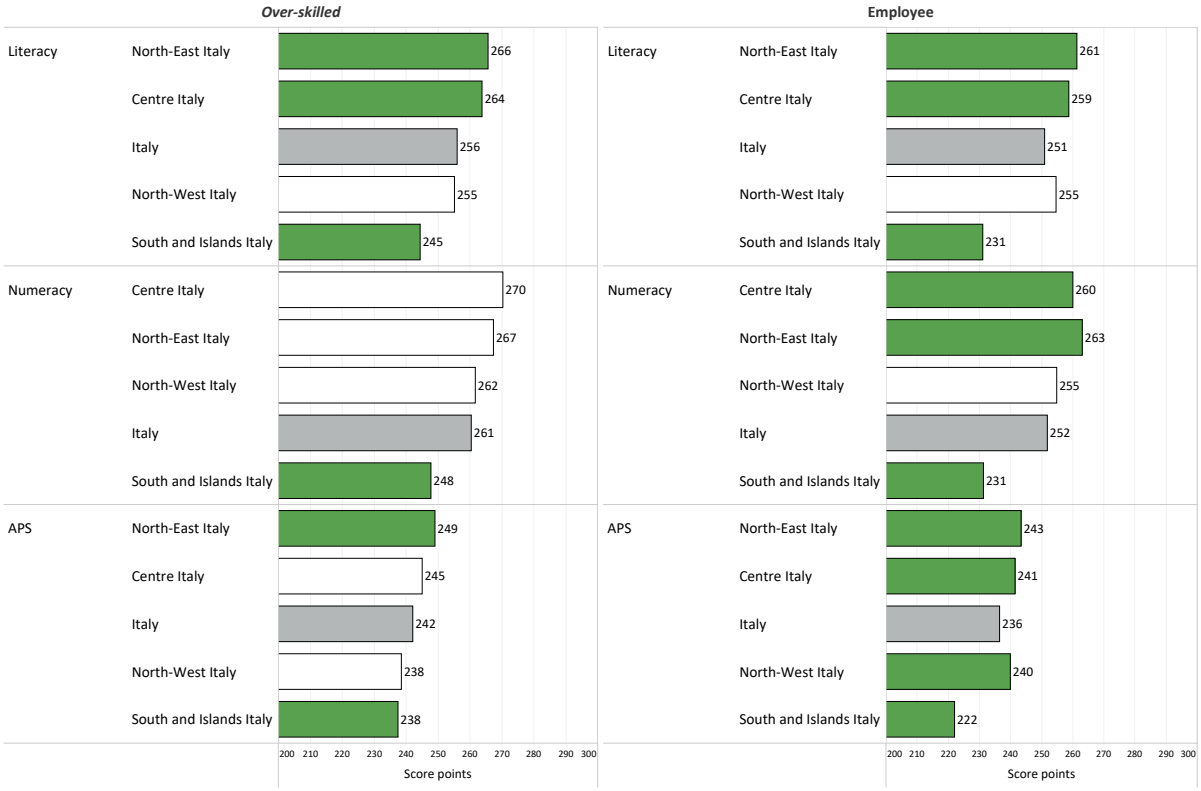
This final paragraph on skill mismatch focuses exclusively on the over-skilled population in Italy.

The phenomenon of employed adults with higher skills than required for their job is a significant issue, particularly in a context like Italy, characterised by economic transformations, mismatches between education and the labour market, labour market rigidity, economic crises and a shortage of skilled jobs impacting employment opportunities. Data from the PIAAC survey provide insights relevant to the – not unanimous – debate on the causes and consequences of segments of the population that, despite the potential shortage of highly qualified professionals, occupy jobs that require lower skills than they possess. Figure 3.10 presents the average proficiency scores in literacy, numeracy and APS, in Italy and across the four macro-areas, of over-skilled workers and all workers. In general, the results reflect the findings set out in the previous sections, with the North-East obtaining higher scores in literacy and APS than the other macro-areas, with values of 266 and 249 respectively, while the Centre recorded the highest average proficiency in numeracy at 270. Average proficiency levels in the South of Italy are found to be lower in this area too, with lower scores in all domains, at 245, 248 and 238 respectively. A comparison between the national average and the macro-areas reveals differentiated results across the domains: in literacy, significant differences are observed in all macro-areas except the North-West; in numeracy, the South and Islands continue to show lower average skills compared to the national level, with a gap of over 12 points. In APS, the result for Italy is statistically different from that recorded in the macro-areas of the North-East and the South, the former being higher and the latter lower, respectively.

The most significant results emerge from a comparison of the results of over-skilled workers with those of all workers: over-skilled workers in the North-West and Centre recorded statistically higher scores in numeracy, while in the South and Islands, statistically significant differences emerge in favour of the over-skilled across all domains, and specifically 13 points in literacy, 16 points in numeracy and 15 points in APS. In general, considering these results in the context of the graphs above, it can be hypothesized that the different concentrations of mismatch are influenced by the different local production systems. Northern Italy seems to be characterised by greater opportunities for skilled work, due to a dynamic market with demand for more advanced skills (although the phenomenon of over-skilling remains). The Centre is in an intermediate position, with a heterogeneous situation characterised by a mix of opportunities and

challenges, and strong competition for highly qualified positions. The South, meanwhile, suffers from a structural shortage of skilled jobs, leading to a high rate of over-skilling, which at 23.1% is the highest in Italy; notable differences are also seen in terms of performance, with results statistically lower than the national average in every domain. What emerges qualifies and enables a better understanding of the findings set out at the start of this chapter as regards the different effects of skills at a geographical level with respect to both employment and remuneration outcomes.

Figure 3.10 Average score in the literacy, numeracy and adaptive problem solving domains of over-skilled workers in Italy and in the Italian macro-areas



Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded. The bars in green on the graph refer to the macro-areas for which there is a statistically significant difference compared to the national value.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Table 3.3 shows the percentages of over-skilled workers (out of the total for the reference group) according to the main job characteristics[34], such as: employment contract (temporary or permanent), working time arrangement[35], occupation, sector of economic activity and firm size.

[34] Data for the macro-areas, and those relating to the primary sector, are not presented due to low sample size.
[35] A full-time worker is defined as working an average of at least 30 hours per week.

Table 3.3 **Share of over-skilled workers in relation to the main labour market characteristics in Italy**

Job characteristics		% of over-skilled workers
Employment contract	Temporary	21.3%
	Permanent	17.9%
Working time arrangement	Full-Time	17.6%
	Part-Time	21.7%
Occupations	Requiring no qualifications	21.1%
	Intermediate manual	19.1%
	Intermediate clerical	19.4%
	Highly qualified or technical	17.0%
Economic activity	Secondary sector	16.8%
	Tertiary sector	18.8%
Firm size	1-10 workers	17.7%
	11-49 workers	18.8%
	50-249 workers	18.5%
	More than 250 workers	20.4%
Total		**18.4%**

Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded. Values for the primary sector are not shown as they are not representative of the reference population.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Situations in which workers have higher skills than required for their job seem to occur more frequently among those working under a temporary contract, on a part-time basis, in the tertiary sector, in occupations requiring no qualifications or in large firms. While there are higher percentages of over-skilled workers in the above categories, an analysis of the significance of the differences finds that none of these percentages differ statistically either from the value recorded for the total population of workers or among the categories. This leads to the conclusion that the phenomenon of over-skilling in Italy is homogeneous and affects all workers to the same extent.

Table 3.4 presents the average literacy, numeracy and APS proficiency scores of over-skilled workers and the total population of workers (aged 25-65) and the corresponding gaps[36].

The average proficiency score of over-skilled workers is 242 points in the APS domain, 256 points in the literacy domain and 261 in the numeracy domain; differences of between 5 and 9 points are seen compared to the total population of workers, but these are not statistically significant. In contrast, when focusing on job characteristics, a number of significant differences emerge.

With regard to employment contract, the scores obtained by over-skilled workers, across all domains, on both temporary and permanent contracts, are statistically higher than those obtained by the total population of workers in the relevant category. Focusing only on over-skilled workers, significant differences of 15 and 10 points respectively emerge in the domains of numeracy and APS in favour of workers on permanent contracts over those on temporary contracts.

[36] The average scores presented in the table for employed adults differ from those presented in the box in section 3.1, as they concern different sub-populations of employed workers. Values in grey refer to differences between the average scores of over-skilled workers *and total workers that are not statistically significant.*

Table 3.4 **Average score in the literacy, numeracy and adaptive problem solving domains in relation to the main labour market characteristics, total workers and over-skilled workers**

Job characteristics		*Over-skilled workers*			Workers			Difference		
		Literacy	Numeracy	APS	Literacy	Numeracy	APS	Literacy	Numeracy	APS
Employment contract	Temporary	249	249	234	236	232	224	13	17	10
	Permanent	259	265	244	254	256	239	4	8	5
Working time arrangement	Full-Time	259	265	243	252	254	237	7	11	6
	Part-Time	248	247	240	249	246	234	-1	1	6
Occupations	Requiring no qualifications	237	239	228	220	218	212	17	21	16
	Intermediate manual	248	252	235	233	234	222	15	17	13
	Intermediate clerical	260	266	251	252	253	239	8	13	12
	Highly qualified or technical	265	270	246	271	272	251	-6	-2	-6
Economic activity	Secondary sector	251	257	235	242	246	230	9	11	5
	Tertiary sector	259	262	245	256	255	240	3	7	5
Firm size	1-10 workers	248	250	236	244	244	232	3	6	4
	11-49 workers	262	266	244	256	255	236	6	11	8
	50-249 workers	256	257	242	253	255	240	2	1	2
	More than 250 workers	265	277	250	259	264	244	6	12	5
Total		**256**	**261**	**242**	**251**	**252**	**236**	**5**	**9**	**6**

Note: employed adults aged 25-65 (self-employed excluded). Doorstep excluded. Values in grey refer to differences between the average scores of over-skilled workers and total workers that are not statistically significant.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Full-time, over-skilled workers are characterised by a higher average proficiency level, across all domains considered, than the total population of full-time workers across all domains; no statistically significant differences, meanwhile, were found between the average proficiency scores of part-time, over-skilled workers compared to the total population of part-time workers. Furthermore, the higher average proficiency level of full-time, over-skilled workers is further confirmed by the comparison with part-time, over-qualified workers, characterised by lower scores in the literacy and numeracy domains.

With the exception of highly-skilled or technical occupations, over-skilled workers across all occupation types have higher average proficiency levels across all domains than those recorded for the total population of workers in the same occupation types. This finding is particularly pronounced in occupations requiring no qualifications, where, for example, a score difference of more than 20 points was recorded in numeracy. This suggests that the impact of over-skilling is greatest in low-skilled occupations where the skill mismatch is most evident and the potential loss of efficiency for the Italian labour market is most pronounced.

As far as sector of economic activity is concerned, while no substantial difference in average proficiency scores is found between the over-skilled and total population of workers in literacy and APS, statistically significant differences emerge in relation to numeracy in both the secondary and tertiary sectors, in favour of the over-skilled. Higher skills are also observed among over-skilled workers in the tertiary sector compared to over-skilled workers in the secondary sector (the highest difference is in APS, at around 10 points).

Finally, over-skilled workers in small firms are characterised by consistently lower average proficiency scores than over-skilled workers in larger firms, suggesting that smaller and potentially less competitive work environments may have negative effects on performance. When comparing the over-skilled group with the national benchmark, statistically significant differences emerge across all domains in firms with 1-10 employees, in favour of the over-skilled.

3.3 Relationship between skills and social outcomes

The Background Questionnaire (BQ) for the second cycle of the PIAAC Survey includes a number of questions that aim to analyse elements that are not purely economic, but rather related to the social sphere, referred to as social outcomes, including: life satisfaction, self-reported health, political efficacy, social trust (trust in others) and voluntary work[37].
These social parameters are particularly useful as a tool for measuring the overall well-being of an area's population, complementing economic indicators. Traditionally, the "health" of a country is measured using economic indicators (unemployment rate, GDP, activity rate, per capita income, etc.). This type of indicators, however, does not always fully reflect the well-being of individuals, or the social and environmental aspects that are fundamental for a satisfying quality of life.
In this sense, the PIAAC survey also takes social and civic aspects into consideration, to allow a broad reconstruction of the overall level of well-being of a country or economy and to investigate the role and influence that individual skills play in this regard. Some questions in the PIAAC Cycle 2 BQ are equivalent to questions in Cycle 1, while others are new or have been adapted for consistency with identical items used in other international surveys such as the ESS Survey (*European Social Survey*[38]).
Cognitive skills are associated with several relevant economic and social aspects, outlined below, and it is important to understand the level of awareness and mastery so that individuals have the appropriate tools to support individual and collective prosperity. In particular, two areas of overall well-being are considered:

- individual well-being in terms of life satisfaction and self-reported health;
- civic and social engagement, encompassing subjective and objective measures regarding preferences and attitudes relating to political efficacy, trust in others, and participation in volunteer activities.

With the exception of the participation in volunteer activities[39], these dimensions will be analysed below.
In particular, life satisfaction is a new measure in the PIAAC 2023 Survey, and is based on questions used in the *European Social Survey* (ESS). Responses are presented on a scale from 0 to 10, ranging from "extremely dissatisfied" to "extremely satisfied", allowing for the measurement of individuals' self-reported satisfaction levels. In the analyses presented below, life satisfaction is classified as "high" if an individual reports a value of 7 or higher.
Self-reported health, on the other hand, is a measure already present in the first cycle of the PIAAC and included in the second cycle without substantial changes. The measurement involves five response options on a Likert scale ("excellent", "very good", "good", "fair", "poor"). Scores of "very good" and "excellent" were classified as "positive" in the health outcome.
Regarding political efficacy and trust in others[40], both were carried over from the first cycle of the PIAAC Survey, but in order to ensure consistency with the ESS Survey, the response options were arranged on a scale from 0 to 10, with responses of 7 and above classified as "positive". In the analysis presented below, however, in order to observe the different behaviours in the Italian macro-areas – which naturally involves a reduction in the size of the population observed – it was decided that for these two dimensions (political efficacy and trust in others), individuals with medium-low levels (i.e. with values of 6 or less) would be taken as a reference point, in order to ensure an adequate degree of statistical representativeness of the data.

3.3.1 Individual well-being: life satisfaction and self-reported health

Life satisfaction is a multidimensional indicator that takes into account various factors affecting quality of life, primarily health, quality of social relationships, security, economic stability and job satisfaction.
This parameter offers a more comprehensive measure of quality of life, considering people's subjective experience of happiness, contentment and perception of their own well-being. This dimension is important in Italy, where moderate economic well-being is associated with social issues and geographic disparities that negatively impact quality of life.

[37] See Appendix 2 of this Report for more details on how information on social outcomes was collected during data collection and then measured.
[38] The ESS Survey (*European Social Survey*) is also managed by INAPP. For more information on the survey in Italy, please visit https://www.inapp.gov.it/rilevazioni/rilevazioni-periodiche/european-social-survey-ess, while the international survey site can be found at: https://www.europeansocialsurvey.org/.
[39] In this first report in order to adhere to a criterion of balance between the two dimensions of overall well-being investigated – it was decided not to consider participation in volunteer activities. This topic is of primary importance in the national context and, precisely for this reason, will be the subject of subsequent, specifically dedicated analyses.
[40] The questions posed in the BQ are: i) for political efficacy "How much would you say the political system in Italy allows people like you to have a say in what the government does?"; for trust in others "Generally speaking, would you say that most people can be trusted, or that you can't be too careful careful in dealing with people?".

Figure 3.11 shows the shares of people in Italy, its macro-areas and the international context that report a high degree of life satisfaction, both among the population as a whole and among individuals with low proficiency (low performers) in literacy, numeracy and APS[41].

Across all geographical areas, the percentage of adults reporting high levels of life satisfaction is positively correlated with proficiency in the assessed domains: the share of low performers reporting high satisfaction is consistently lower than that of the overall population.

Approximately 70% of people living in Italy report high life satisfaction. This percentage rises to approximately 75% when considering the OECD average.

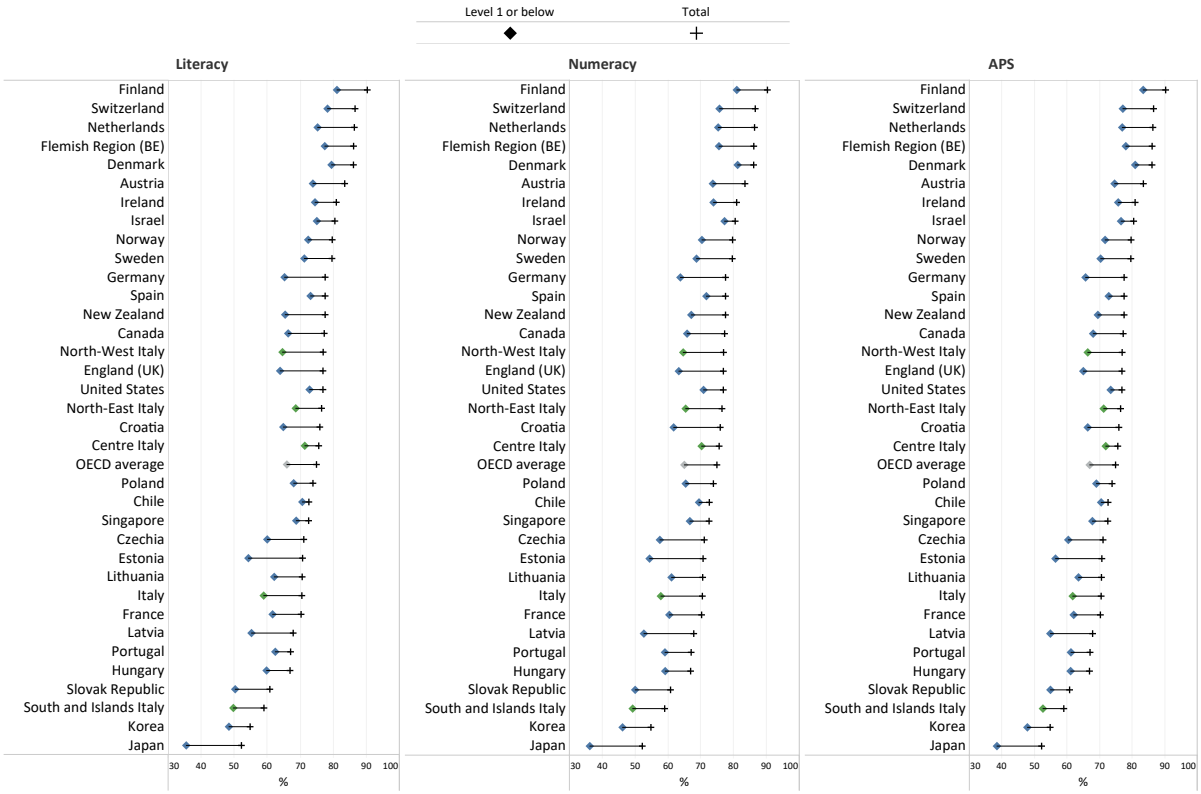
Notable differences emerge across Italy, with markedly more negative scores tending to emerge in the South and Islands, differing from the national Italian figure by about 12 percentage points.

The percentages of adults reporting high levels of life satisfaction decrease when considering those with lower proficiency levels (Level 1 and below): in the case of low performers in numeracy, the percentage drops to 57.7%, rising to 58.8% for literacy and 62% for APS. The shares are even smaller in the South and Islands (around -9 percentage points), with slight differences across the three domains and the smallest difference in the numeracy domain.

The factors that contribute to the emergence and endurance of these geographical differences primarily include problems related to employment (precariousness, low wages and lack of opportunities for professional growth), public services (disparities in terms of resources and accessibility among regions, particularly between North and South) and security (in terms of perceived criminality, trust in institutions and socio-economic conditions). In other words, for the population in the South and Islands, where life satisfaction levels are lower than the rest of the country, the key role of human relations, family and leisure only partly offsets the negative perception arising from structural and employment problems.

[41] In the figure – as in all similar figures that follow, which compare the shares of individuals based on well-being indicators – the data for low performers *vary across the three skill domains, while for the overall population, the data are, of course, consistent across domains.*

Figure 3.11 Share of adults reporting a high degree of life satisfaction, in the overall population and among low performers, in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



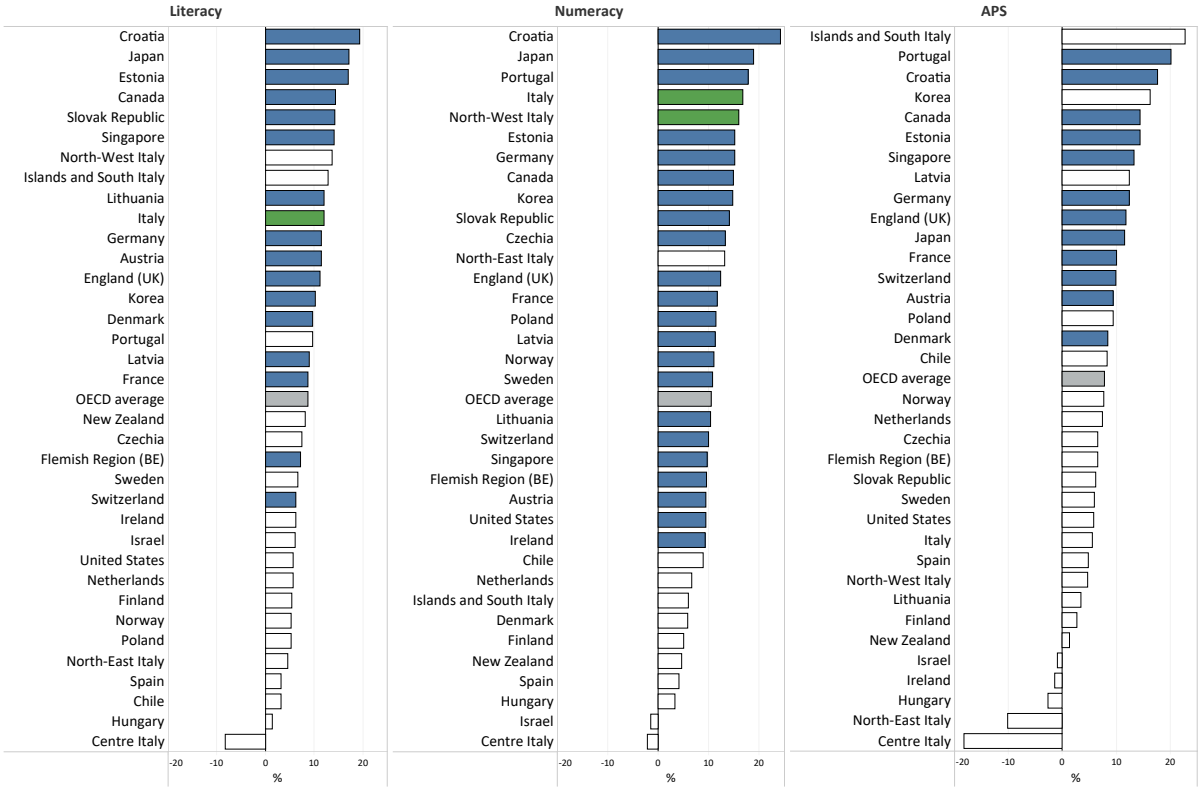
Note: adults 25-65 years. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

To further explore the relationship between proficiency and life satisfaction, Figure 3.12 presents the marginal change in the likelihood of reporting high life satisfaction among individuals with high proficiency levels (Levels 4 and 5), compared to those at the lowest levels (Level 1 and below), across the three domains analysed. In other words, the figure presents the average difference in the frequency with which adults with high proficiency levels report a high degree of life satisfaction compared to adults with low proficiency levels.

This finding provides further insight into the relationship between the proficiency levels of individuals and their relative level of well-being. In particular, the effect presented is estimated by considering and then controlling for socio-demographic characteristics that, in turn, impact an individual's degree of well-being and, in this specific case, degree of life satisfaction, such as age, gender, years of formal education, immigrant background and the presence of a partner and/or children. Net of the effects potentially generated by such individual characteristics, the results indicate that, in Italy, adults with high literacy proficiency (Level 4 and 5) are around 12 percentage points more likely to report a high degree of life satisfaction, compared to individuals with limited proficiency (Level 1 and below). This effect is even more pronounced in the numeracy domain, where the increase in likelihood is 16.7 percentage points. In contrast, when the individual characteristics presented above are controlled for, the effect is not statistically significant in the APS domain. Similarly, in the macro-areas, a high level of proficiency in the three domains is only associated with a positive outcome in terms of life satisfaction, compared to adults with low proficiency, in the North-West, and only in the numeracy domain (increase in likelihood of 16 percentage points); in all other cases, however, this relationship is not statistically significant.

In comparative terms, the effect of high literacy and numeracy proficiency on one's degree of life satisfaction is greater in Italy, for both domains, than on average across the OECD countries (plus 3.4 and 6.2 percentage points, respectively); specifically, it is lower only than Croatia, Japan and Portugal in the numeracy domain, and Canada, Croatia, Estonia, Japan, Slovak Republic and Singapore in the literacy domain. The result for the North-West of Italy, regarding the effect associated with high numeracy proficiency, confirms the overall national trend, ranking below only the national average itself and, as expected, Croatia, Japan and Portugal.

Figure 3.12 Individual well-being: difference in the likelihood of reporting positive life satisfaction between high performers and low performers in the literacy, numeracy and adaptive problem-solving domains by country and Italian macro-area



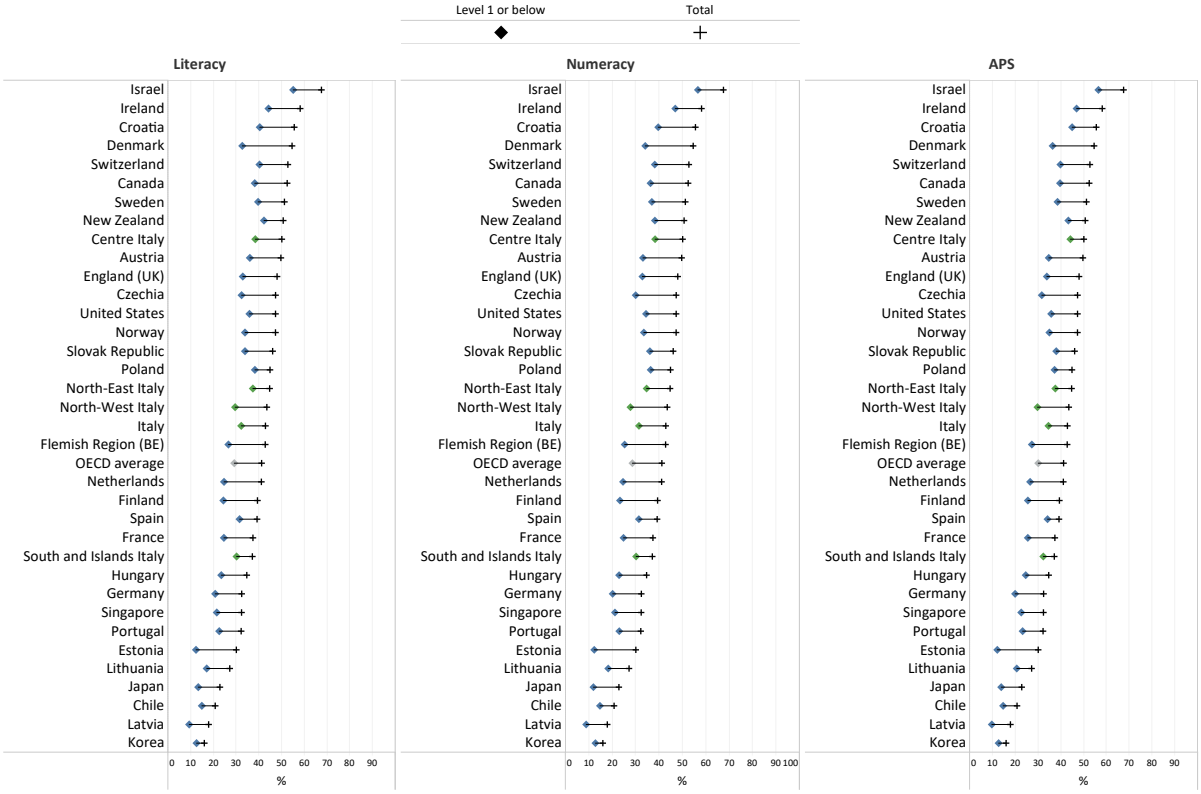
Note: adults 25-65 years. Doorstep excluded. The following predictors were included in the regression model: age, gender, years of formal education, immigrant background and the presence of a partner and/or children, as well as the proficiency level in the three domains considered. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The self-reported health[42] parameter measures how individuals assess their general state of health, independent of any medical diagnosis, and is a subjective indicator of the population's well-being. Socio-economic conditions have a strong influence on health, both in direct and subjective terms, as a more negative self-perception of health tends to be more frequent among individuals with lower incomes or lower educational attainment. In recent years, including in the context of the Covid-19 pandemic which impacted living conditions and health, there has been increased focus on the relationship between well-being, health and socio-demographic characteristics (particularly among the young and economically disadvantaged). Individual health, considered not in exclusively physical terms, but also in mental and relational terms, has become a priority in the recent post-Covid period, capable of guiding future individual choices, particularly among the younger segments of the population (Costabile 2024). In this context, understanding how skills influence the subjective perception of one's own state of health is fundamental.
Figure 3.13 provides an overview of the share of the population reporting a high degree of health, both among the overall population and among low performers.
The dynamics of self-reported health in Italy are peculiar. At a national level, the share of people reporting a high degree of health is moderately low at 42.8%, while the levels recorded in the macro-areas of the Centre and North are more positive than the national figure (at around 50% in the Centre and around 44% in the North). With regard to this parameter also, the situation in the South, where conditions such as lower quality of healthcare and limited access to services and facilities negatively affect perceived health, is reflected in less positive self-reporting of health, at 37%.
In international comparative terms, Italy does not deviate from the OECD average with respect to the degree of self-reported health, with a gap of around 1.5 percentage points. At the same time, however, Italy reports a higher share of adults with a positive perception of their health compared to countries such as the Flemish Region (BE), Finland, France, the Netherlands and Spain in the literacy and numeracy domains, while in the APS domain, Italy scores more positively than England (UK), Czechia and Spain.

[42] The question posed in the BQ is "In general, would you say your health is: excellent, very good, good, fair or poor?".

An analysis of the results of the population with limited proficiency (Level 1 and below) in relation to the overall population shows, both nationally and at an average OECD level, that lower proficiency levels are associated with a reduced likelihood of reporting good health. Indeed, in Italy the share of the low performers reporting good health stands at just over 30% (32.1% in the case of low performers in literacy, 31.3% in the case of numeracy and 34.5% in the case of APS). The Italian finding is consistent with the OECD average of countries participating in the PIAAC survey: here too, the low performers report good health to a lesser extent than the overall population.
Across the Italian geographic areas, the difference in self-reported health between individuals with low proficiency and the overall population shows a fair degree of variability. In general, the North-West regions display the largest gaps, while at the opposite end, areas of the South show the smallest differences: the share of low performers reporting good health is less than 7 percentage points below that of the total population.

Figure 3.13 Share of adults reporting a high degree of self-reported health, in the overall population and among low performers, in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area

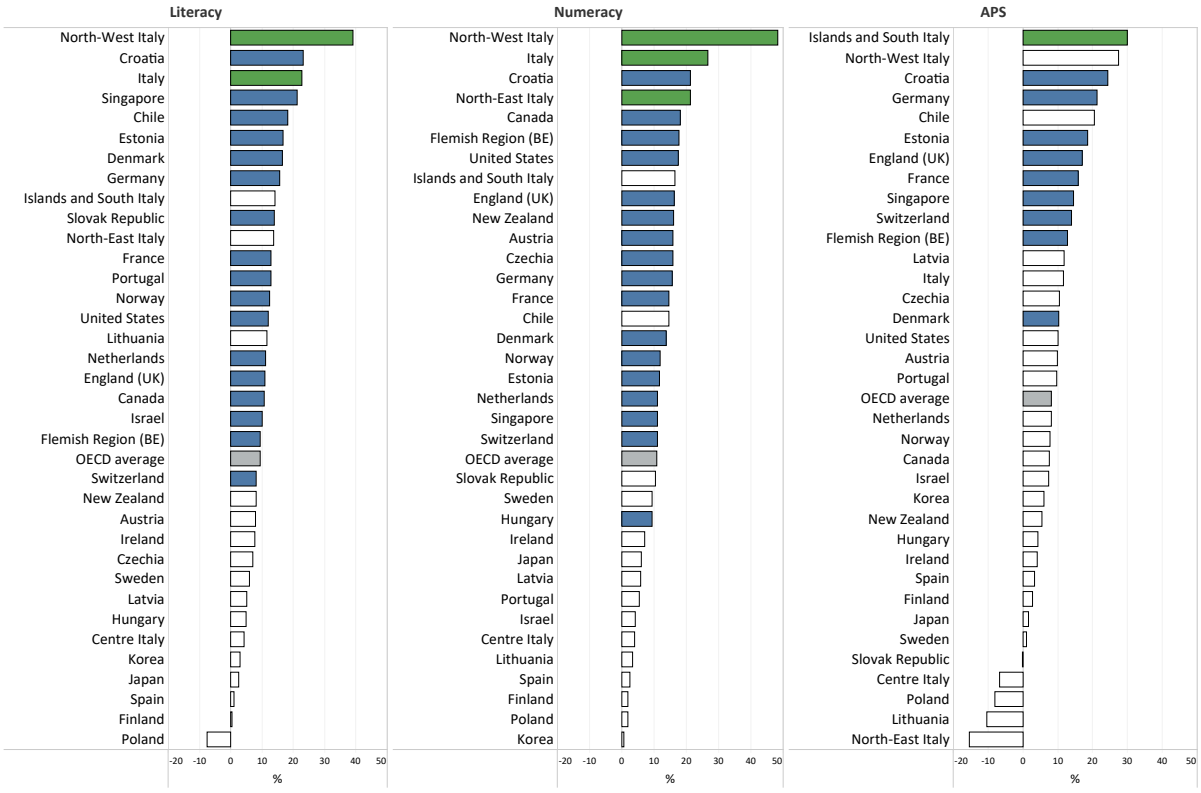


Note: adults 25-65 years. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

The results in Figure 3.14 allow us to further investigate the relationship between the proficiency level of individuals and their self-reported health level.
As in Figure 3.12, Figure 3.14 shows, across the three domains analysed, the average difference in the frequency with which adults with high proficiency levels indicate a high degree of self-reported health compared to adults with low proficiency levels, controlling for the same aspects which may potentially affect the degree of self-reported health. The results indicate that, in Italy, high performers are almost 23% more likely to have a high level of self-reported health than low performers. This effect is most pronounced in the numeracy domain, where the increase in likelihood is 26.7 percentage points. As in the case of life satisfaction, meanwhile, the effect is not statistically significant in the APS domain.
An analysis of the Italian macro-areas reveals that high proficiency is associated with a positive outcome, in terms of self-reported health, compared to low proficiency in the North-West in relation to the literacy domain (increase in likelihood of 39 percentage points), and in both macro-areas of the North in relation to the numeracy domain (around 21 percentage points in the North-East and around 48 percentage points in the North-West). Moreover, in the South, high proficiency levels in the APS domain are associated with significant effects in terms of self-reported health; indeed, this macro-area presents the highest effect

among the countries and economies analysed, with a marginal increase in likelihood of more than 30 percentage points.
In comparative terms, the effect of high literacy and numeracy skills on self-reported health in Italy is greater than the OECD average in both cases – by 13.3% and 15.8% respectively – with Italy showing the highest marginal increase in likelihood across both domains.

Figure 3.14 Individual well-being: difference in the likelihood of reporting positive self-reported health between high performers and low performers in the literacy, numeracy and adaptive problem-solving domains by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. The following predictors were included in the regression model: age, gender, years of formal education, immigrant background and the presence of a partner and/or children, as well as the proficiency level in the three domains considered. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Though clearly impacted by endogeneity factors – for which even adjusted analyses cannot fully control for – the data nevertheless highlight a key aspect: the direct and indirect overall centrality of skills. The findings in the previous paragraphs highlight how skills are associated with employment and wage outcomes, with competitive advantages for skilled individuals in the labour market; such advantages in turn lead to better socio-economic conditions, on average. Such conditions enable healthier, more satisfying lifestyles to be maintained. Based on the results, it can be noted that, with respect to social outcomes and health in particular, skills enable adults to have a more balanced perception of their own needs, and can also guide them in relation to needs that may arise in the future.

3.3.2 Civic and social engagement: political efficacy and trust

Civic and social engagement is closely associated with political efficacy and trust in institutions, as citizens' active participation in public life is influenced by their perception of the ability of governments and policies to respond to collective needs. In general, when citizens find the political system effective and reliable, they tend to participate more actively in social and political life, contributing to social cohesion and collective well-being.

The second cycle of the PIAAC Survey provides an in-depth look at some of the parameters that measure citizens' civic and social engagement, such as political efficacy (understood as citizens' trust in the ability to understand and influence political affairs) and trust in others. Across most of the geographical areas analysed, significant associations were identified between skills in the PIAAC domains and specific measures for civic and social engagement.

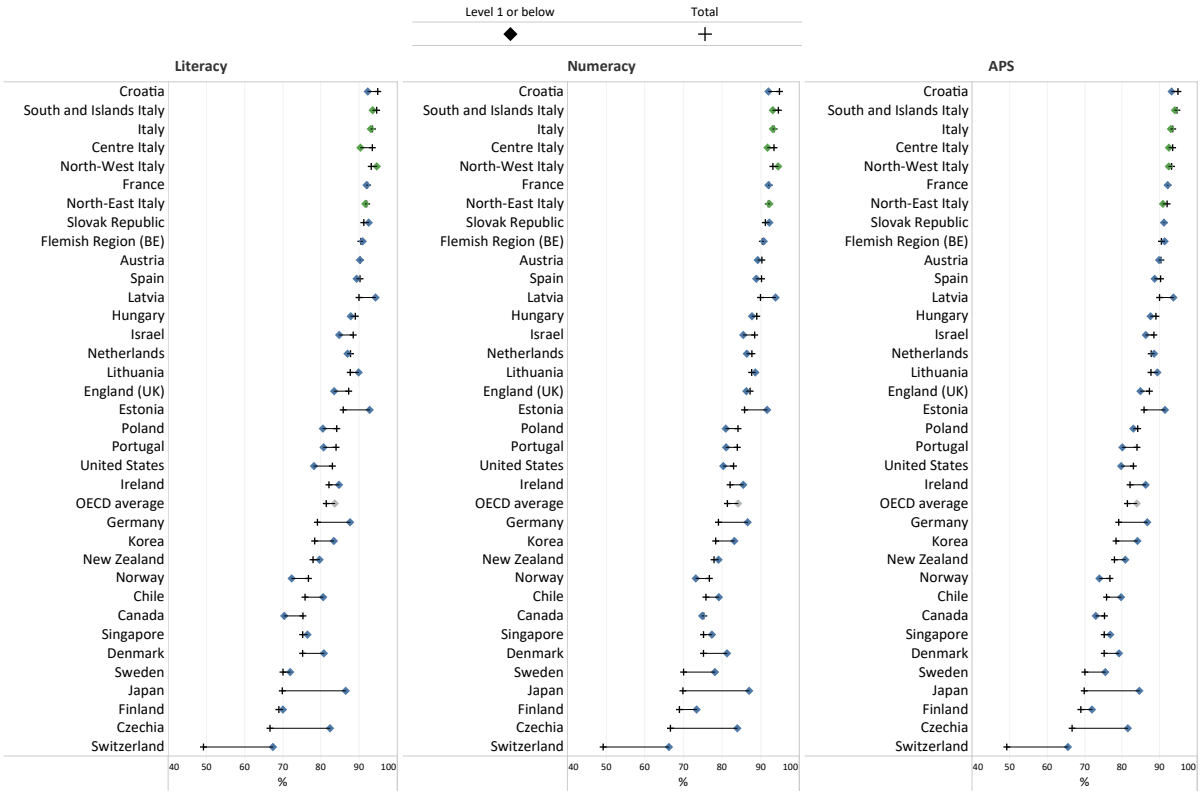
Given the generally limited propensity in Italy toward high perceptions of policy efficacy and trust in others, as mentioned above, the analysis of these two measures examines the medium-low perception of both aspects.

The political efficacy parameter measures how efficient and responsive citizens consider the political system to be to their needs, and refers to the ability of government and institutions to provide public services, implement policies and maintain stability. This parameter is crucial for assessing the quality of governance and the trust of the population in institutions.

As shown in Figure 3.15, the percentage of the population in Italy with a perception of low political efficacy is very high, at 92.4%. Many citizens perceive policies as ineffective in responding to the real needs of the population and in tackling the country's economic, social and infrastructural challenges; slight differences in concentration are seen across the macro-areas, with dissatisfaction greater in the South of Italy, but largely rooted throughout the country. The trend that emerges among low performers is not dissimilar: perceptions of inefficacy remain very high and do not deviate from the figure for the overall population analysed.

The Italian figure (consistent with those of the macro-areas, with slight variations) differs from the OECD average by about 12 percentage points. In international comparative terms, countries such as Croatia and France share this assessment that policies are not sufficiently effective in responding to the needs of the population. On the opposite end of the scale are countries such as Switzerland, Czechia, Finland and Japan, where citizens see concrete results in public policies, greater stability of institutions and have a high level of trust in government. When focusing on adults with lower proficiency levels (Level 1 or below) across the three domains, the distributions confirm the same results, with only minimal percentage variations. The differences between the shares of individuals with limited proficiency levels and the overall population further confirm that the widespread negative perception of political efficacy is not exclusively an Italian phenomenon: in more than half of the countries participating in the PIAAC survey, such differences were not found to be statistically significant.

Figure 3.15 Share of adults reporting a medium-low perception of political efficacy, in the overall population and among low performers, in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



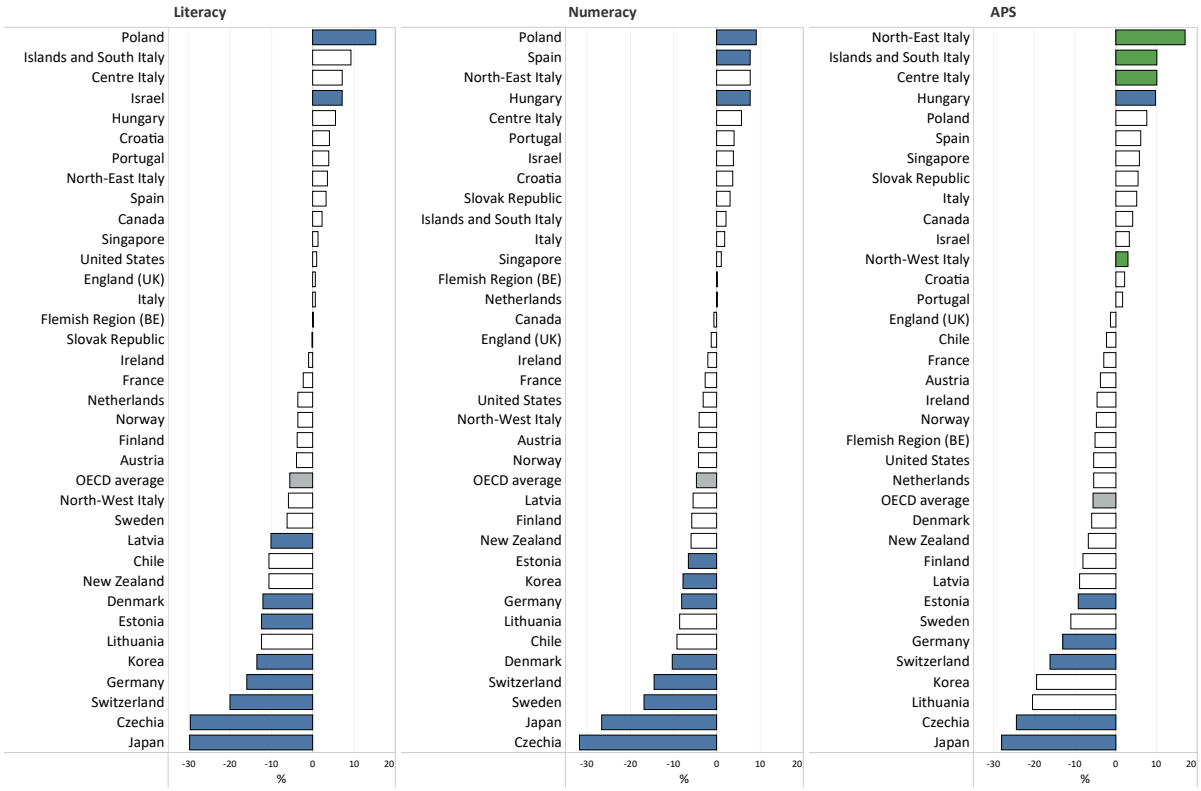
Note: adults 25-65 years. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

With respect to political efficacy, the results presented in Figure 3.16 provide further insight into the relationship between proficiency level and political efficacy. Consistent with the analyses above in relation to the other dimensions, the figure shows, across the three domains analysed, the average difference in the frequency with which adults with high proficiency levels report limited political efficacy, compared to adults with low proficiency levels, controlling for the same aspects which may potentially affect this dimension, indicated above (and in the footnote to the figure).

In Italy and its macro-areas, no significant differences emerge between individuals with high and low proficiency levels in the literacy and numeracy domains as regards their likelihood of reporting a low level of satisfaction with political efficacy. This confirms a negative perception – consistent across all proficiency levels in the assessed domains – among the population residing in Italy regarding the ability of institutions or political representatives to solve problems and respond to the needs of society. A significant difference emerges across all macro-areas from the analysis of the APS domain, indicating that adults with a good proficiency level (Level 4 and 5) in this domain are more likely (e.g. by 17 percentage points in the North-East) to report a low degree of satisfaction with the efficacy of the political system, compared to individuals with limited proficiency (Level 1 and below). This effect, then, is observed within the domain (APS) that involves the practical application of problem-solving skills and the formulation of appropriate solutions to achieve tangible, positive results for society, found to be lacking in the political system, leading to a heightened perception of inefficacy.

In comparative terms, the effect of high APS proficiency on the assessment of political inefficacy in Italy is among the highest of all countries and economies, followed by countries such as Hungary, the only other country where positive and statistically significant changes emerged.

Figure 3.16 Civic and social engagement: difference in the likelihood of reporting medium-low levels of perceived political efficacy between high performers and low performers in the literacy, numeracy and adaptive problem-solving domains by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. The following predictors were included in the regression model: age, gender, years of formal education, immigrant background and the presence of a partner and/or children, as well as the proficiency level in the three domains considered. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

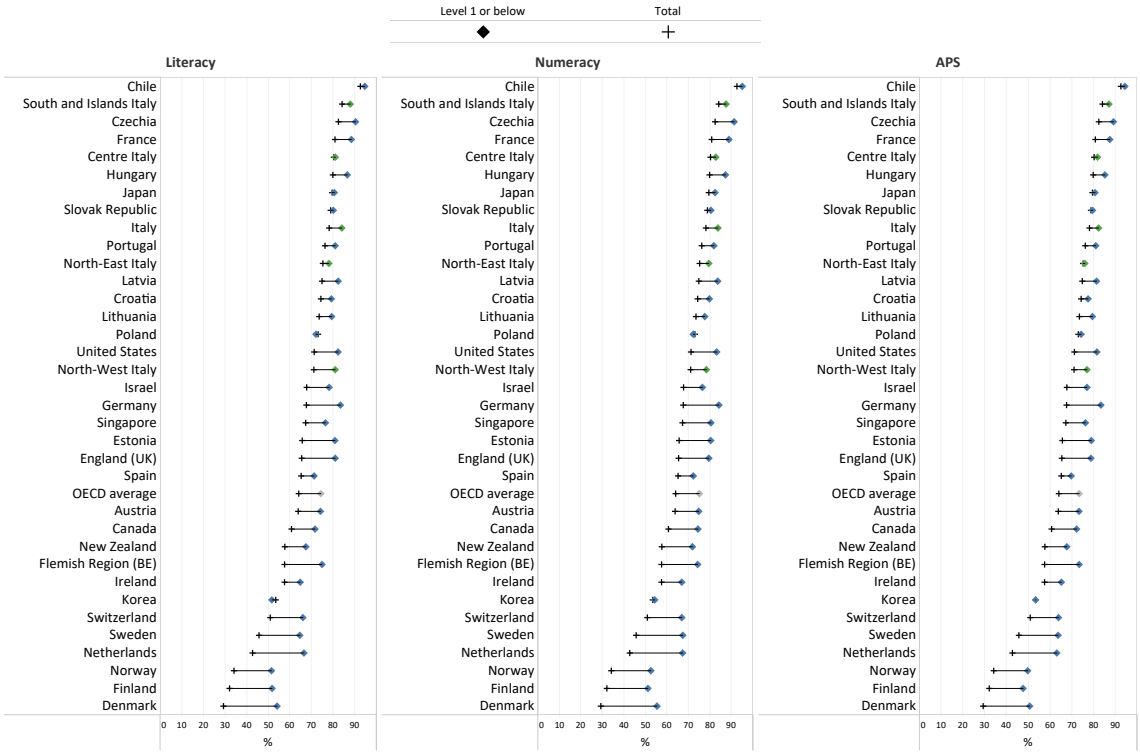
Trust in others is a key driver of civic engagement and has implications for society, as the level of interpersonal trust affects social cohesion and economic development. Societies with low levels of trust tend to be less cooperative, with a lower propensity to work together for the common good. This can negatively affect civic participation and the willingness to engage in collective initiatives. In Italy, trust in others is a complex issue, often influenced by cultural, historical and social factors. In general, the level of interpersonal trust in Italy is lower than the average in Northern European countries, although there are notable geographical variations. The PIAAC Survey data make it possible to analyse the level of trust that individuals place in others. Figure 3.17 provides an overview of how widespread medium-low levels of interpersonal trust are across the countries and economies observed, with a focus on the differences between the overall population and adults with limited proficiency in the three domains considered.

In Italy, trust in others is not very high, with 78% of the adult population reporting medium-low levels. The degree of mistrust is even higher in some areas within Italy, such as the South and Islands, where problems of crime and mistrust in institutions are historically more present, with a difference of 6 percentage points compared to the national figure. In contrast, areas in the North, characterised by greater economic and social integration, demonstrate a relatively higher level of interpersonal trust than the regions of the South. In fact, the North-West deviates from the Italian figure by around 7 percentage points and the South and Islands by 13 percentage points.

In the international context, Italy stands out for its comparatively lower level of trust, especially when compared to Northern European countries such as Denmark and Finland (with over 45 percentage points of difference), and Sweden (32 percentage points). These countries, by contrast, report consistently high levels of social trust, representing a distinctive model compared to other nations and regions. This can be attributed to various factors, including a well-developed welfare state, widespread civic participation, and a stable education system with a strong emphasis on equality and civic and social awareness. When considering the views of adults with a lower proficiency level (Level of 1 or below), the shares of individuals reporting high levels of trust decrease further. A comparison of the share of people in this category reporting medium-to-low trust with the respective share of the overall population in Italy reveals a difference of about

6 percentage points: levels of trust in others among low performers in Italy are even lower than among the overall population. This finding emerges even more prominently in the case of the OECD average, confirming that people with lower proficiency levels have a less positive view of others, in terms of trust, than the overall population.
With reference to the various areas of Italy, the difference between low performers and the total population in terms of share of people reporting lower levels of trust in others is particularly evident in the literacy domain in the North-West regions; it should be noted, however, that it is in these regions that individuals most frequently report trust in others.

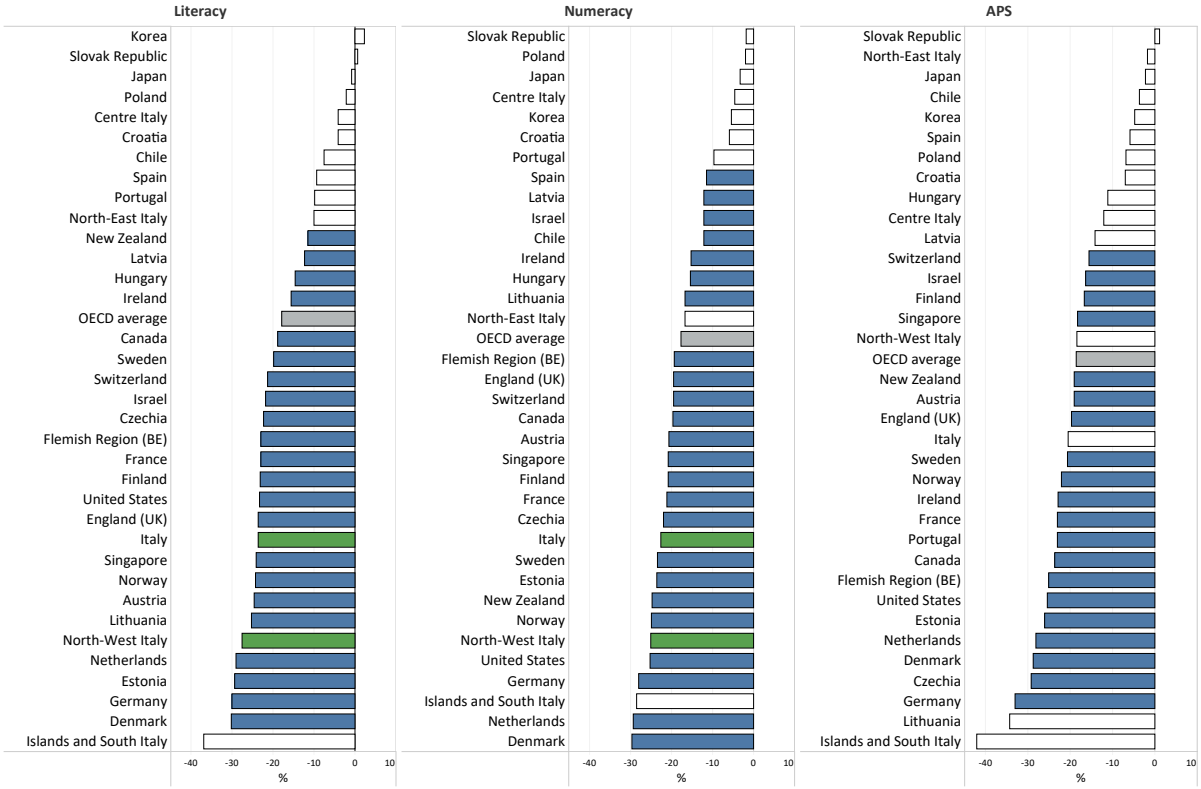
Figure 3.17 Share of adults reporting a medium-low level of trust in others, in the overall population and among low performers, in the literacy, numeracy and adaptive problem solving domains by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

Figure 3.18 sets out the results showing the relationship between the proficiency level of individuals and their relative level of trust in others. Consistent with the analyses on political efficacy, the figure shows, across the three domains analysed, the average difference in the frequency with which adults with high proficiency levels report limited trust in others, compared to adults with low proficiency levels, controlling for the same aspects which may potentially affect this dimension, indicated above (and in the footnote to the figure). At a national level, but especially in the North-West macro-area, adults with high proficiency levels (Level 4 and 5) are more likely to report a high degree of trust than individuals with low proficiency levels (Level 1 and below) (the negative coefficient in the graph indicates a lower likelihood of having a medium-low level of trust), whereas in the remaining macro-areas this relationship is not statistically significant. In the North-West, high proficiency levels are associated with a greater likelihood of having trust in others than among individuals with limited proficiency levels, with a difference of 27.7% in literacy and 25% in numeracy; nationally, meanwhile, these effects are 23.6% and 22.7% respectively.
From an international perspective, these results highlight the extent to which literacy and numeracy skills in Italy, and in the North-West regions in particular, have beneficial effects in terms of community and a shared sense of belonging. Indeed, both the national and macro-area figures discussed are notably higher than the average among OECD countries and economies, with differences exceeding 5 percentage points in both domains for Italy, and 7 percentage points for the North-West.

Figure 3.18 Civic and social engagement: difference in the likelihood of reporting medium-low levels of trust in others between high performers and low performers in the literacy, numeracy and adaptive problem-solving domains by country and Italian macro-area



Note: adults 25-65 years. Doorstep excluded. The following predictors were included in the regression model: age, gender, years of formal education, immigrant background and the presence of a partner and/or children, as well as the proficiency level in the three domains considered. Darker colours denote differences that are statistically significant (at 5%). Countries and economies are ranked in descending order of effect of skills.
Source: INAPP elaborations based on PIAAC-OECD Cycle 2 data

A higher level of proficiency is often associated with a more critical and informed view, greater political and social participation, improved employability and, on average, higher wages, leading to greater economic and social stability. Such factors usually have profound and often positive effects on various aspects of social life, including satisfaction with the functioning of political systems and trust in institutions. The level of satisfaction and trust is not uniform across the different Italian macro-areas, however, where cultural, socio-economic and historical differences affecting also this parameter persist.

Conclusions

The results of the Adult Skills Survey, presented in this first Report, have provided a very complex picture of the situation in Italy.
Such complexity concerns not only the cognitive skills adults possess in the domains of literacy, numeracy and adaptive problem solving, but also the identification of the main factors that may contribute to shaping these skills and the potential consequences of lower skill levels in terms of employment, earnings and social outcomes.
The methodological rigour underlying the PIAAC Survey guarantees that the data and results obtained are of high quality. It follows that the findings on Italy should be cause for concern, given the significant problems that emerge.
The high level of geographical heterogeneity across Italy, with very dissimilar results emerging from the northern and southern regions, means that the average figure for Italy is at times not particularly informative. The starting point – i.e. the factors affecting skill building – and the end point – i.e. the contexts in which acquired skills can be applied and improved – have different characteristics in different areas of the country. In particular, the situation in the North of Italy differs significantly from that in the South and also, to some extent, from that in the Centre; as such, the decision was made to consider the variability of estimates among the different geographical areas in all analyses carried out. In the North of Italy – where the more favourable socio-economic context, combined with better access to training and labour resources, facilitates both the initial development of skills and opportunities to use them – results are often comparable to those of better-performing countries and the OECD average. In the South of Italy, in contrast, less favourable structural conditions, such as a less dynamic economy, higher inactivity rates and more limited access to quality training, tend to hinder both the acquisition of skills and their application in the world of work and everyday life; as such, results for this area are similar to those of the countries participating in the survey that still have much to invest in order to improve the skills of their adult population. These disparities thus highlight how the geographic context plays a crucial role in determining opportunities for skills development and use.
In the skill domains examined, Italy ranks around the bottom of the list of countries and economies analysed, and does not appear to have made substantial progress over the past decade.
In Italy, no significant changes have been observed in either the literacy or numeracy domains[43] between the two survey cycles. Moreover, when geographical areas are taken into account in the data analysis, a significant decline in both domains is observed in the South, and a decline in literacy in the Islands.
Based on the assumption that changes in the demographic composition of the adult population over the past decade – mainly due to increased migration flows and population ageing – may have negatively influenced the overall skill levels at the national level, specific statistical methods were applied to isolate the possible effects of these changes, ensuring that the 2023 data reflect the demographic distribution of the population from the first cycle (in terms of age, gender and immigrant background). This approach made it possible to verify what skills would have been observed in 2023 had the composition of the population remained the same as a decade earlier. However, even with the same demographic composition, no changes are observed in the Italian average, confirming the stability of both average literacy and numeracy skills over the decade. Unfortunately, the decline recorded in the South is also confirmed; notable, however, is the improved performance of the North-West regions, which, had the demographic composition remained the same as a decade ago, would have performed better in both domains. In essence, the lack of change in the evolution of skills in Italy cannot, it would seem, be explained exclusively with reference to migration and an ageing population.
The lack of improvement in Italy's situation in terms of skill levels must also be interpreted in light of the fact that, in the period preceding the first PIAAC survey, available financial resources were largely devoted to investments needed to overcome the economic crisis that began in 2008. This focus diverted attention from investments in education and vocational training systems. By contrast, since 2013 the country has introduced a series of significant measures aimed at promoting lifelong learning and adult education.
The average proficiency score achieved in 2023 by the population resident in Italy, across all three domains analysed, is significantly lower than the OECD average. Residents in the North and Centre of Italy, however,

[43] The first cycle of the PIAAC Survey included the domain of problem solving in technologically-rich environments, which was not assessed in Italy and, in any case, is not comparable with the adaptive problem-solving domain introduced in Cycle 2.

manage to achieve scores in the literacy domain that are, in statistical terms, on a par with the OECD average. The North-East also achieves the OECD average in the numeracy domain. Across all domains, the scores achieved in the regions of the South are consistently below the Italian average.
A detailed breakdown of differences in proficiency scores by socio-demographic characteristics of the adult population points toward some light among the shadows. It confirms the fundamental role of investment in education in enhancing skills. In Italy and across all geographical areas, adults with tertiary educational qualifications achieve higher proficiency scores than those with upper secondary education and higher again than those with lower secondary education or below. It should also be noted, however, that only 20% of the population in Italy between the ages of 25 and 65 have a tertiary educational attainment, while approximately 37.7% hold a qualification below upper secondary school. The share of adults with tertiary education in Italy is notably low compared to the OECD average and to many countries participating in the PIAAC (in Canada, Korea, Denmark, Estonia, the Flemish Region in Belgium, Israel, Norway and New Zealand this share is over 50%).
Furthermore, less skills polarisation among the different levels of education is seen in Italy than in other OECD countries. Individuals with tertiary educational qualifications in Italy show lower average proficiency scores than those with tertiary qualifications across OECD countries as a whole; on the contrary, those with less than upper secondary education display average proficiency scores that are on a par with, or even higher than, the average among the countries and economies participating in the PIAAC. This suggests that, in Italy, people with lower educational qualifications have relatively high skills; by contrast, the advantage in terms of skills of tertiary education is less pronounced than in other international contexts.
Additionally, when skills are analysed by educational level, strong geographical differences are evident to the disadvantage of the regions of the South and the Islands. It is also worth highlighting, on a positive note, that the scores achieved by people with tertiary qualifications residing in the North-West are in line with the OECD average across all domains. The results seen in the North-West regions can serve as a model for other areas of the country.
Women and men in Italy achieve equal results, in statistical terms, in the literacy and adaptive problem solving domains, even if men still perform better than women in numeracy. Undoubtedly positive is the closure of the gender gap in literacy skills, which in the first IALS Skills Survey, conducted by the OECD in 1998, was found to be to the disadvantage of women. This result is less positive when considered in international comparative terms, as women outperformed men in literacy in many countries and in the OECD average results. Also positive is that men and women performed largely similarly in the adaptive problem solving domain, particularly given that the OECD average results reveal a gap in favour of men.
Regarding the gender gap in numeracy – evident in Italy as in OECD average results and in other countries – the data are very telling, presenting a reasonably clear picture of potential actions to reduce, if not eliminate, this gap. In Italy, the gender gap in numeracy skills evident in the overall population widens, again to the disadvantage of women, in analyses focused solely on individuals with tertiary educational qualifications, but closes when considering STEM university graduates alone. This finding from Italy is not consistent with the OECD average, which sees a continued difference in average proficiency scores in numeracy to the advantage of men, both when considering only individuals with tertiary qualifications and when focusing only on adults with tertiary qualifications in STEM disciplines.
The result from Italy clearly shows that action taken to increase women's involvement in scientific, technological, engineering and mathematical educational courses – which could impact women's propensity toward more humanities-based fields – would contribute to an overall increase in the population's numeracy skills, which, as we have seen, are particularly low in Italy compared to other advanced economies. The foregoing is supported by figures on the share of 25-65 year-olds with tertiary education in STEM disciplines by gender: according to PIAAC data, only 14% of women with tertiary education in Italy chose a STEM pathway in 2023, compared to 43% of men with tertiary education.
One of the best results achieved in Italy, particularly in terms of outlook, concerns the younger population. Indeed, the very young (16-24 year-olds) in Italy achieve higher proficiency scores than the rest of the population (this includes 25-34 year-olds in the case of numeracy), a result not consistent with the OECD average or with results seen in many countries and economies worldwide, where the advantage is mainly evident in the 25-34 age group. The territorial analysis also highlights a particularly favourable situation for the regions of the North-East, where 16-24 year-olds not only perform better than the Italian average, but also achieve results in literacy and numeracy that are comparable to those of their peers in OECD countries. In Italy, then, substantial skill loss is observed with advancing age, but from a good starting point. In general, these results confirm the need to focus on the younger population, to invest in encouraging and facilitating them to make school and academic choices that are beneficial in terms of skill acquisition, but also to prevent the loss of skills obtained, ensuring the opportunity to find employment that cultivates the development of further skills.

Another notable result already highlighted in the literature concerns the influence of the family context. Individuals' skills are highly correlated with family background: people with low proficiency levels largely come from culturally disadvantaged families with parents with lower educational levels. Indeed, the data show that across almost all participating countries and all three skill domains investigated, adults with at least one parent who attained tertiary education perform better than those whose parents attained at least upper secondary education, and the latter, in turn, score higher than adults from families in which neither parent completed upper secondary education. In Italy, the skill gap between people from a disadvantaged family background, i.e. with no parent with an upper secondary education, and people from a more favourable family background, i.e. with at least one parent with tertiary education, is decidedly wide across all skill domains. Further confirmation of the crucial role played by family background in relation to individuals' proficiency levels also emerges when, through multivariate statistical analyses, the potential effects of its interaction with other socio-demographic characteristics are isolated. Despite controlling for variables such as age, gender, educational attainment, immigrant background and language spoken at home, the gap in proficiency scores between individuals from different family backgrounds remains evident. This suggests that as well as significantly affecting skill formation, the influence of family background also persists even after other factors have been taken into account, confirming the need for intervention to mitigate inequalities between people that are evident in the early years of life.

This latter finding – which must be considered in light of the information that 61.6% of people in Italy come from families where both parents have less than upper secondary education (compared to an OECD average of 25.4%) – invites reflection on potential action that could be taken to raise the qualification level of the population. In quantitative terms, such action should focus on facilitating an increase in the share of the population achieving at least an upper secondary qualification; also, however, and more importantly, it should focus, in qualitative terms, on ensuring that attainment of such qualifications enables satisfactory economic and social outcomes.

A final aspect analysed, and of significance to acquiring and developing skills, which is also linked to family background, relates to an individual's place of birth, considered in conjunction with their parents' place of birth. According to PIAAC survey data, in Italy, 83.3% of the population were born in Italy to parents born in Italy; 12.2%, meanwhile, were born abroad to parents born abroad, while just over 1% were born in Italy to parents born abroad (the remaining just under 4% were born abroad to parents born in Italy, or have just one parent born abroad). Across all domains considered and particularly, and predictably, in the case of literacy, the data show considerable differences in adults' scores based on immigrant background, to the disadvantage of people born abroad to foreign-born parents. Albeit with varying degrees of concentration, the disadvantage of the immigrant population is evident across all geographical areas.

If focus is shifted to the results, i.e. to what happens to those with different proficiency levels in the world of work or in social life, rather than the differences in skills possessed in relation to employment status (employed, seeking employment or inactive) or different occupational classifications, the situation in Italy, considered in comparison with other countries and economies participating in PIAAC, is not encouraging.

The average proficiency level of employed adults residing in Italy is significantly lower than the corresponding OECD average across each domain considered. The situation of individuals seeking employment is even more critical, again in comparison to the other countries and economies considered, recording lower proficiency levels. Skills polarisation between the labour force and the inactive population is lower in Italy than the average observed among the countries and economies considered, indicating that the inactive population ranks better in the international context, primarily driven by the regions in the North of Italy. Indeed, from a geographical perspective, skills polarisation emerges clearly and structurally. Across multiple indicators, the South and Islands rank lowest among the countries and economies observed; in contrast, the North-West and North-East are often in line with the average OECD figure, with the North-East, in some cases, performing on a par with high-performing countries. In general terms, the Centre emerges as the link in this two-speed Italy, despite marked differences with respect to the situation in the South.

The results also confirm that investments in skills, and education in particular, give rise to significant employment returns in Italy. At a national level, placing more emphasis on education – in terms of number of years spent in education – increases the likelihood of being employed, as opposed to unemployed, by around 3%, and similar results are seen in relation to investment in skills, across all domains. These effects are particularly significant in the South of Italy, especially as regards the likelihood of being active in the labour market rather than inactive. Among the economies observed, the importance of these factors is particularly evident in the South, suggesting that marginal gains from education and skills are significantly higher in less developed socio-economic contexts. The same effect is seen as regards wage returns, but with different significance in different areas of the country. While at a national level, investments in skills and education in particular are associated with significant wage returns, albeit lower than the OECD average,

the skill-related advantage loses significance at a geographical area level, with positive effects seen only in the Centre and North-East. In this case too, however, higher marginal returns on education are seen in more under-developed areas. Investments in education in Italy translate, on average, into a 13% increase in earnings, while investments in skills generate a more modest effect, around 5%. In the South of Italy, the effect of education on earnings is much greater, with returns of 19%, while the effect of skills on earnings is practically nil.
Geographical differences are also evident in the analysis of proficiency levels among different categories of workers. At a national level, the highest skills are found among permanent workers, or the self-employed, in highly qualified occupations and working in large-scale workplaces. In the South too, workers with these characteristics maintain higher proficiency levels than other employed adults in the same regions, albeit with significantly higher differences in comparison with the national averages.
The mismatch in the education or proficiency levels of workers compared to those actually required for their jobs (qualification and skill mismatch) enables further characterisation of the results discussed. In this respect, the share of workers with skill and education levels higher than those required for their jobs is lower than the average observed in other countries and economies. In contrast, an analysis of the opposite situation with regard to education reveals that Italy has the highest share of under-qualified workers among the countries and economies in the survey. At the same time, the analysis of over-skilled workers highlights the extent to which this group represents an underutilised pool of professionalism in the Italian labour market, and particularly in the South. Over-skilled workers have higher skills than other workers, even when considering similar job profiles, and this is particularly evident in the more underdeveloped areas of Italy where, moreover, the phenomenon of over-qualification is more widespread.
Finally, an analysis of the relationship between proficiency levels and social indicators (life satisfaction, self-reported health, efficacy of the political system, trust in others) also points to the importance of investment in human capital as a determinant of greater well-being, albeit with some differences.
In Italy, approximately 70% of the population reports a high degree of life satisfaction. This percentage, which is lower than that recorded in many countries and than the OECD average, decreases significantly when analysing the satisfaction of people with low proficiency levels (low performers), with lower concentrations also seen in areas in the South.
As regards self-reported health, there are shares of individuals in Italy who report good health on a par with the OECD average, with about 43% of the population expressing a high level of self-reported health. This percentage varies across the country with higher values in the North and Centre than in the South. There is quite a clear difference in self-reported health levels between the overall population and adults with low proficiency levels, and even more so between high performers and low performers: people with low proficiency levels less frequently self-report as being in good health.
The picture that emerges of social well-being in Italy, measured through political efficacy and trust, is rather negative. Only 7% of adults residing in Italy say that the political system is effective and responsive to citizens' needs. Considering that increased social and political participation is often linked to the perception of an effective and reliable political system, the data returned by the PIAAC Survey raise a substantial question. This is also confirmed by the average figure for the OECD countries, which, at 19%, is much higher than the Italian percentage.
The result is confirmed in the analysis broken down by geographical areas, with slight differences in concentration and greater dissatisfaction found in the South of Italy. A similar trend emerges when analysing the results for the population with lower skill levels: perceptions of inefficacy remain consistently high. Only in the adaptive problem solving domain do individuals with higher proficiency levels present greater dissatisfaction than those with lower proficiency levels.
A high level of trust in others tends not to be very widespread across the country and is lower than the OECD average. In Italy, only 22% of adults report a high degree of trust in others, and this percentage is even lower in the regions of the Centre and of the South. The Italian figure is well below the OECD average of 38%. In this case too, skills emerge as an area for investment in order to improve the national social climate. In Italy, and especially in the North-West, adults with high skill levels are more likely to report a high degree of trust in others than low performers.

As noted in the introduction, high proficiency levels generate benefits not only for individuals, but also and above all for the community as a whole as, by fostering competitive advantages, they are a determining factor for economic growth, increased employment, social cohesion and competitiveness. It is therefore crucial, as well as in the common interest, to find effective solutions that allow Italy to improve in the situation described in the foregoing chapters.
The data presented clearly highlight the main obstacles to the development and utilisation of skills and

unambiguously point to a need to question the functioning of the education and training systems, guidance activities, systems for integrating people from other countries into social and working life, as well as the production system and structures facilitating the matching of labour supply and demand. It is also clear that in reflecting on how to improve the picture presented above, the diverse situations in different areas of the country must be taken into account, as well as the disadvantage in the regions of the South of Italy.

Such a complex and multifaceted situation, involving a variety of factors, necessarily calls for careful reflection on the possibility of developing an integrated and shared plan of action that jointly addresses social inclusion, training and employment – areas that require particular attention, also in view of the efficient use of available resources.

In the hope of having produced the kind of knowledge envisaged by Einaudi – needed to foster an evidence-based debate that can, in turn, enable informed decision-making – we refer readers to forthcoming publications that will provide further analysis, with a stronger focus on identifying possible lines of public intervention.

Appendix 1 – Methodology, definitions and tools of the second cycle of the PIAAC

1.1 Skill domains covered by PIAAC: Literacy, Numeracy and Adaptive Problem Solving

The theoretical reference frameworks for the OECD-PIAAC Adult Skill Survey, Cycle 2 were developed by international expert groups specialised in the different domains surveyed. These frameworks define and describe the latent skills that the assessment intends to measure; as such, for each domain, they serve as the foundation for both the development and selection of the items and the interpretation of the results. The complete frameworks of Cycle 2 of the PIAAC Survey are available in the original English language version (OECD 2021b), and also translated and adapted into Italian (INAPP 2021a).
As a supplement to the information already provided in the introduction to this Report, the specifics of the three skill domains, as defined in the Cycle 2 framework, are set out below, accompanied by the sample descriptions of some items for each domain.

1.1.1 Literacy

In PIAAC Cycle 2, literacy is defined as the ability to

> *access, understand, evaluate and reflect on written texts in order to achieve one's goals, develop one's knowledge and potential, and participate in society.*

In relation to this definition, the following sections explore the three constitutive dimensions of literacy, which are based on: content, cognitive processes and contexts.

Content

In everyday life, readers interact with a variety of content to fulfil a range of reading purposes. As stated in the definition, the literacy assessment focuses on comprehension of written texts. The texts are further classified according to:

- Text source: single and multiple texts. By *single texts* we mean those that originate in a single source, e.g. a single author, publication medium and date of publication. *Multiple texts* have different authors or were published by different authors or at different times.
- Text format: continuous, non-continuous and mixed texts. *Continuous texts* have sentences organised in paragraphs. Examples are newspaper articles, essays, pamphlets and advertisements. *Non-continuous texts* include tables, graphs, forms and charts, where information is often displayed in lists. Examples include restaurant menus, tables showing interest rates or sports rankings, and navigation links on a web page. *Mixed texts* include both continuous and non-continuous elements: a web page or an article with paragraphs of information supported by a table.
- Text type: description, narration, exposition, argumentation, instruction and transaction; it refers to the six categories that include most of the texts adults encounter in their everyday lives.
- Text organisation: the devices used to present content and facilitate access to relevant information often influence the way texts are structured. These are layout and content representation features, such as titles, headings and, in the case of longer texts, chapters and indexes. Digital texts may include tools such as windows, scrollbars, tabs and hyperlinks.

Cognitive processes

The theoretical framework concerning literacy in the PIAAC identifies three cognitive processes that support the range of reading activities performed by adults: accessing, understanding, evaluating and reflecting on written texts.

- "Accessing" involves identifying one or more texts relevant to a presented task and locating information within and across texts. Readers must navigate among texts or passages, or within texts, depending on the requirements of the task. In the context of evaluation, the complexity of an access task is determined by the interaction between the question posed to the respondent and the characteristics of the texts presented.
- "Understanding" consists of constructing meanings and representations. This includes both the literal and inferential comprehension of a given piece of material both within a single text and across multiple texts.

- "Evaluating and reflecting" involves assessing the accuracy and credibility of information in a text, evaluating completeness and consistency of the information and the relevance of one or more texts for the task, and reflecting on the author's intent, purpose and effectiveness.

Contexts

For adults, reading generally takes place within a social context. Context can influence both the motivation to read and the interpretation of content. As such, the texts for the literacy assessment are derived from four contexts that are familiar to a wide range of participants:

- Work: texts related to work contexts include general job-related content or material associated with finding employment, finances or job availability. No specialised texts specific to a single profession are included in the assessments.
- Personal: materials related to the personal context include texts associated with interpersonal relationships, personal health and safety, home and family, the consumer economy, leisure and recreation. Examples include articles on disease prevention, safety and accident prevention, home and personal finance.
- Community: texts related to the community context are associated with community resources, public services and staying informed. They include official documents, community announcements, blog posts, message boards and news.
- Education and training: finally, education and training materials focus on opportunities for further learning and personal or professional goals.

Changes since the PIAAC Cycle 1 Survey

The conceptual framework for literacy is essentially unchanged from Cycle 1. However, the literacy expert group suggested updates to reflect the growing importance of reading skills in digital environments, which places different cognitive demands and challenges on the reader. In particular, the new framework (OECD 2021b) emphasises the growing need for readers to interact effectively with the multiple texts that can be encountered online in everyday life.

The framework further elaborates on the key aspects of the definition (as stated at the beginning of the paragraph):

- The term "literacy" is used in its broadest but also most literal sense to describe the ability to read written language presented in the form of texts and documents.
- Readers engage in access when they search for texts, sentences or paragraphs within texts, which are relevant to their purpose.
- Any reading activity requires a certain level of comprehension. This can involve very different levels of complexity, from the most basic abilities, such as literal understanding of words and sentences, to more complex inferential abilities, such as understanding the dispute between two authors who make conflicting statements on a subject.
- Evaluating and reflecting means making judgements about a text, which may include deciding whether it is suitable for the task at hand or whether it presents accurate and reliable information.
- The term “written texts” refers to both static and interactive materials. The latter, which relate to digital environments, may include features such as hyperlinks.

As previously mentioned in the introduction, the items in the PIAAC Survey are not only characterised by the cognitive process, context and format but are also defined according to a level of difficulty, determined by a score associated to the domain proficiency scale.

In order to illustrate the types of tasks within each level, some sample items are illustrated below, specifically based on the constitutive dimensions set out above (content, cognitive processes and contexts) and according to an increasing level of difficulty (score).

Illustrative item map: Literacy

Banking (C503P001)

- difficulty: below Level 1 (161 points)
- cognitive process: accessing text (locate information within texts)
- source: single
- pages: single
- context: personal

Based on an image of a very brief text message from a bank, respondents are asked to identify how long a provided identification code is valid. There is some distracting information in the message, with "code" or "identification code" being present in three locations. However, the very limited amount of text plus the fact that a time is listed in only a single location, makes the correct response easy to locate.

BiciMAD (C509P003)

- difficulty: Level 1 (215 points)
- cognitive process: accessing text (locate information within texts)
- source: single
- pages: single
- context: community and citizenship

This task is at the higher end of Level 1 and is based on a short section of a brochure with information about an electric bicycle rental programme. The brochure explains that bicycles are stored at stations around the city, with a number of bases at each station. Respondents are asked to identify the number of bases in the city. That information is explicitly listed in the brochure, but locating the information is a bit more complex for several reasons: the text is longer and the context may be unfamiliar to some respondents, there is no explicit structure (such as headings) to signal where the requested information is located, and there are several other numbers in the text that present distracting information.

App Comparison (C511P004)

- difficulty: Level 2 (230 points)
- cognitive process: evaluating
- source: multiple
- pages: single
- context: personal

The stimulus for this task consists of a web page with reviews of several apps for storing and organising photos posted by five individuals. Respondents are asked how one of those reviews could be made more credible. This item is the easiest "evaluate" item in the assessment. The task requires respondents to go beyond understanding the content of the specified review and to think about how each of four plausible options would or would not improve credibility.

Recycling Guide (C517P004)

- difficulty: Level 2 (270 points)
- cognitive process: accessing text (identify relevant text)
- source: multiple
- pages: multiple
- context: community and citizenship

The stimul This access task is situated in a simulated website consisting of six pages. The number of pages and the dynamic nature of the display adds to the complexity of the task because the respondent must identify the relevant page to locate the requested information. The task opens on the home page of a community recycling site and respondents are asked how residents can order a recycling cart. Respondents need to navigate to the Frequently Asked Questions page, where the information is provided. The names of the pages do not provide strong clues about where to look. Once the correct page is located, there are several mentions of recycling carts, creating distracting information. Together, these features make this one of the most difficult items in Level 2.

Online Learning (C516P004)

- difficulty: Level 3 (325 points)
- cognitive process: evaluating
- source: multiple
- pages: multiple
- context: education and training

This task includes two text sources. The first is a multi-paragraph narrative written by an employee at a manufacturing company describing his experience taking an online training course provided by the company. The second is an advertisement for online worker training programmes. The advertisement includes a list of several advantages of online learning. Respondents are asked to identify the advantages that are supported by the training experiences described by the employee in his narrative. There are no direct statements in the narrative that exactly match the items in the list of advantages in the advertisement, so making those connections requires a deeper understanding of the employee's statements. This factor, along with the need to integrate and compare information across two texts, makes this the most difficult Level 3 item in the assessment.

Desk Cycling (C514P004)

- difficulty: Level 4 (362 points)
- cognitive process: understanding (inferential)
- source: multiple
- pages: multiple
- context: work and occupation

The stimulus for this task includes two text sources: an article about desk cycling (i.e. using a small pedalling device that fits under a desk and can be used for exercise while working) and a blog where four users share their experience using this device. Respondents are asked to identify a statement on which one of the bloggers (identified in the item) and the study director quoted in the article would agree. Some of the provided options are true for one individual but not both, or are true for a different blogger. Respondents must integrate and compare information across the two sources, making this one of the more difficult items in the assessment.

1.1.2 Reading Component Skill

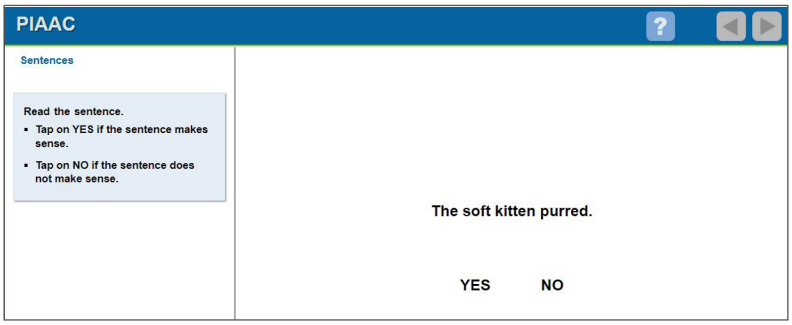
Reading component skills represent the basic set of decoding skills that are essential for extracting meaning from written texts. The assessment of the basic reading components was included in PIAAC from Cycle 1 of the survey, in order to assess the skills of adults at the lower end of the literacy proficiency scale in greater depth.

The reading components of Cycle 2 include two task types: sentence comprehension and passage comprehension.

Sentence comprehension: assessments that present respondents with a series of sentences and require them, for each, to identify whether the sentence makes sense or not.

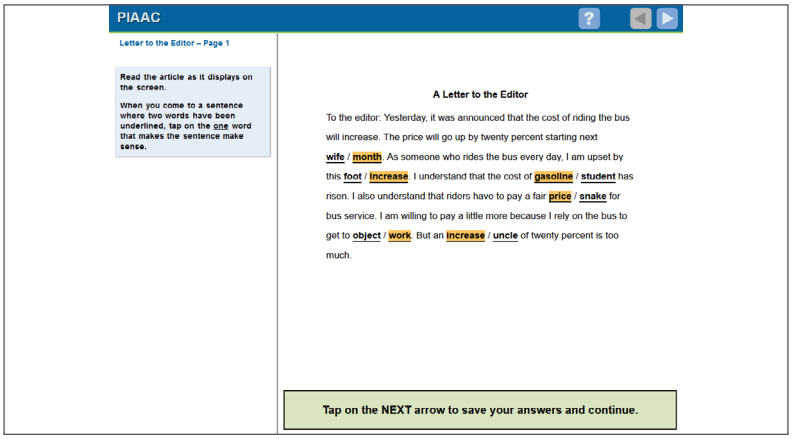
The sentences are presented one at a time on the screen and the respondent has to tap "YES" on the screen if they think the sentence makes sense, "NO" if they think the sentence does not make sense. As soon as the respondent touches "YES" or "NO", the next sentence appears on the screen.

Figure A.1.1 Example of reading component: sentence comprehension



Passage comprehension: assessments in which respondents read a short passage displayed on the screen on a sentence-by-sentence basis. Most sentences in the passage contain a pair of underlined words. Respondents are asked to identify which word, of the two, best completes the sentence.
The following example shows part of an item where three selections have already been made and a fourth sentence has just been displayed on the screen.

Figure A.1.2 Example of reading component: passage comprehension



For both assessments types, in addition to performance data (correct or incorrect answer), completion time for the assessment is also recorded. The time data can be used to provide a measure of reading fluency.

1.1.3 Numeracy

The numeracy construct assessed in PIAAC Cycle 2 is defined as the ability to

> *access, use and reason critically with mathematical content, information and ideas represented in multiple ways in order to engage in and manage the mathematical demands of a range of situations in adult life.*

The three fundamental dimensions of numeracy are: content (which includes both mathematical content areas and different representations of information), cognitive processes and contexts.

Content

Four key areas of content, information and mathematical ideas are covered in the assessment.

- Quantity and numbers: understanding ordering, counting, place value, magnitudes, indicators, relative size and numerical trends.
- Space and shape: understanding and using measurement systems and formulas, dimensions and units, location and direction, geometric shapes and patterns, angle properties, symmetry, transformations, and 2D and 3D representations and perspectives.
- Change and relationship: understanding ways to describe, model and interpret mathematical relationships, quantitative patterns and change. This involves understanding, using and applying proportional reasoning and rates of change, including the use and application of ratios and the recognition, description and/or use of relationship between several variables.
- Data and chance: this content area includes topics such as data collection, data representation, graphs and charts, measures of central tendency and variability, and understanding and reasoning about chance and probability.

Furthermore, the framework identifies four types of mathematical representations in real-world numeracy assessments:

- Texts or symbols;
- Images of objects;
- Structured information;
- Dynamic applications.

The texts included in the assessments may contain symbols and numerical information. To reduce the impact of reading skills on numeracy assessment, text-based stimuli were designed to be short, simple and direct. Images of objects include photos or visual representations of physical objects. Structured information includes data or information represented in tables, graphs, charts and maps, and may also include calendars, schedules and infographics. Dynamic applications include interactive applications, animations, and calculation applications, such as loan calculators, currency or measurement converters, spreadsheets and drawing programs.

Cognitive processes

The framework identifies three cognitive processes associated with mathematical skills.

- Accessing and assessing situations mathematically: adults must be able to examine a contextual problem and determine if and where they can use the essential mathematics to analyse, set up and solve the problem.
- Acting on and using mathematics involves the processes of ordering, counting, estimating, calculating, measuring, graphing and drawing. Adults must use their knowledge of mathematical processes, facts and procedures to solve real-world problems. Where available, they must also select and use appropriate tools, including digital technology.
- Evaluating, critically reflecting and making judgements are the processes required to evaluate a solution to a real-world problem against the original problem situation in terms of its reasonableness and relevance to the original context. On the basis of these judgements, a decision can be made about whether to accept the solution or to revise and adjust it.

Contexts

Numeracy assessment items relate to three real-world context areas that are important for adults.

- Work: mathematical situations encountered in the workplace are generally more specific than those in everyday personal life. Examples include completing purchase orders, maintaining inventories, managing schedules, interpreting work-related charts, and taking and recording measurements.
- Personal: assessments in this context focus on calculation activities related to individuals and their immediate family members. The items include, for example, calculation activities associated with managing money and personal or family finances, health and well-being, shopping, personal time management and travel and holiday planning.
- Social/community: using quantitative data and statistics, adults must be able to interpret information presented by a range of community or governmental authorities and perform tasks associated with social activities and events. Activities in this category include, for example, understanding graphs and numerical information presenting local or national data on crime or health.

Changes since PIAAC Cycle 1 Survey

Development of the new numeracy framework for Cycle 2 of the PIAAC, as previously for literacy, was based on identifying the changes that have taken place over the past decade and analysing how these have influenced the definition of the numeracy proficiency required in contemporary society.
The analysis carried out by the expert group dedicated to this skill domain indicated that the numeracy framework for Cycle 2 must necessarily:

- reflect the importance of digital information, representations, devices and applications as a reality that adults must deal with when addressing the calculation demands of everyday life;
- include a wide range of mathematical and quantitative skills and knowledge and avoid a narrow view that sees mathematics as only dealing with numbers and arithmetical operations;
- better emphasise the importance of critical thinking, reflection and reasoning in the context of mathematics;
- describe the full range of mathematical skills in the adult population.

The main changes from the definition used in Cycle 1 include:

- elimination of the word "ability", as it was considered to imply an innate ability that some people may not possess. This was not in keeping with the belief of the Numeracy Expert Group (NEG) that all adults have the capacity to learn mathematics and apply it successfully in their lives;
- the phrase "interpret and communicate" has been replaced with "reason critically" to align with the NEG view that one core cognitive process for mathematics, particularly in the context of technology environments, is the ability to evaluate, critically reflect and make judgements;
- the phrase "represented in multiple ways" was included in the definition to reflect the importance of digital information, representations, devices and applications in meeting the numeracy demands of everyday life.

In order to illustrate the types of tasks within each level, some sample items are illustrated below, specifically based on the constitutive dimensions set out above (content, cognitive processes and contexts) and according to an increasing level of difficulty (score).

Illustrative item map: Numeracy

Moving (C815P002)

- difficulty: below Level 1 (174 points)
- cognitive process: accessing and assessing situations mathematically
- representation: images of objects
- content: quantity and numbers
- context: work

In this task, a note containing the number of moving boxes needed for each of five rooms is shown, and respondents are asked to calculate the total number of boxes needed. The required operation of addition is signalled by the use of "total" in the question, and there are no extraneous numbers or distracting information included in the stimulus. The numbers that must be added are all whole numbers less than or equal to ten. These features of the stimulus and question make this one of the easiest tasks on the PIAAC numeracy scale.

Bike Tour (C801P001)

- difficulty: Level 1 (198 points)
- cognitive process: acting on and using mathematics
- representation: texts or symbols
- content: quantity and numbers
- context: personal

In this task, an advertisement for a bike tour is presented that shows the number of kilometres that bikers will ride each day on a three-day tour. Respondents are asked to determine the length, in kilometres, of the "complete tour". However, nowhere in the advertisement is the phrase "complete tour" used, nor is a total distance given. Hence, respondents need to act on the information provided and decide how to use the advertisement to answer the question. The numbers in the problem are all two-digit whole numbers.

Expenses (C811P002)

- difficulty: Level 2 (229 points)
- cognitive process: accessing and assessing situations mathematically
- representation: dynamic applications
- content: data and chance
- context: personal

This task is based on a simulated app used to monitor monthly expenses in six categories. At the start of the task, the only visible information in the app is buttons for two specific months. Based on the information in the question, respondents must select the correct month to view a doughnut chart of the expenses for that month. Tapping on any segment of the doughnut chart displays the amount spent in that category as well as the percentage of the monthly expenses that the category represents. Respondents are asked to identify the three categories with the highest spending and then use the drag-and-drop function to put them in order from highest to third highest in terms of spending.

Zoo Visitors (C833P002)

- difficulty: Level 3 (280 points)
- cognitive process: evaluating, critically reflecting and making judgements
- representation: structured information
- content: quantity and number
- context: work

The stimulus for this task is a table showing the average number of visitors that arrive at each of the four entrance gates during each hour that a zoo is open. Respondents are asked to determine in which time slot it would be most helpful to have additional staff members in order to reduce waiting time at the entrances. Actual waiting times are not given in the table, so respondents need to understand how these data are related to wait times and then devise a strategy that can be used to complete the task. There is a lot of information to process in the table, and the total number of visitors during several of

the time periods is very similar, which adds to the complexity of choosing the best strategy in this task.

Electric Cars (C810P002)

- difficulty: Level 4 (348 points)
- cognitive process: evaluating, critically reflecting and making judgements
- representation: structured information
- content: change and relationships
- context: social/community

The stimulus for this task includes two bar graphs: one showing the purchase price for three cars (one diesel, one petrol and one electric), and another graph showing the average cost per kilometre to drive each of these car types. Respondents are asked to calculate how long it would take to recoup the higher purchase price of an electric car as compared to the lower-priced diesel car, based on the different fuel costs for each type of car and the average number of kilometres she drives each year. Respondents must devise a strategy for integrating the information, and several computational steps are required to complete the task. The data in each graph are monetary amounts while the answer needs to be in terms of years and months, which adds to the complexity of the task.

Flying Hours (C812P003)

- difficulty: Level 5 (496 points)
- cognitive process: accessing and assessing situations mathematically
- representation: dynamic application
- content: data and chance
- context: social/community

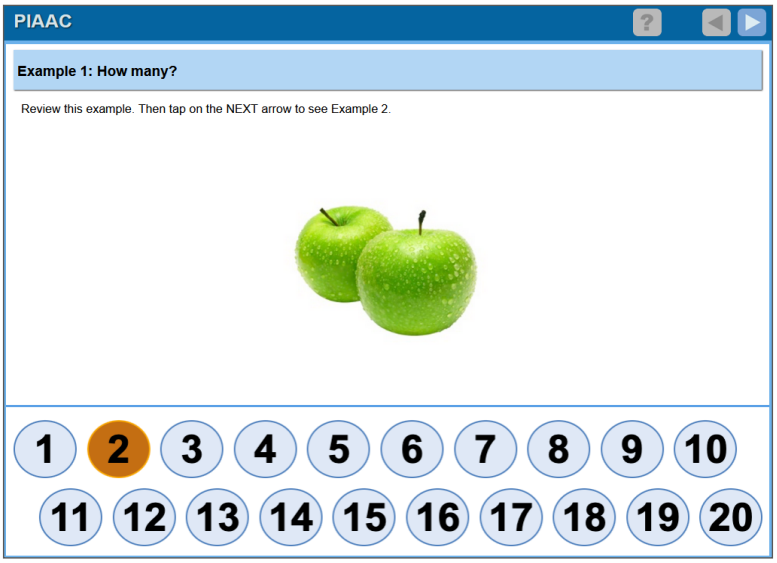
The stimulus for this task is a table of data showing the average number of flying hours and average monthly salary per pilot for ten different airlines. Respondents are asked to identify the best type of graph to display the relationship between these variables. Tapping on an image of each of the four types of graphs given as the options shows the data displayed in that type of graph. However, only one type of graph shows the correct relational nature of these data, so the item requires a relatively sophisticated understanding of statistical representations.

1.1.4 Numeracy component skills

The assessments relating to the numeracy component skills assessment represent a new element introduced in PIAAC Cycle 2, introducing this type of assessment to large-scale international adult surveys for the first time. The skills measured by this type of assessment can be regarded as basic mathematical skills that constitute a prerequisite for developing the more advanced mathematical skills measured by the numeracy assessments. Inclusion of the numeracy component skills assessment allows for more detailed measurement and analysis of the skills of people at the lower end of the numeracy proficiency distribution. The numeracy components focus on number sense. Number sense relates to the understanding of quantities and of how numbers represent quantities. In practice, the numeracy component assessment asks respondents to estimate quantities of certain objects from real-life images and to estimate the relative magnitude of different numerical representations of quantities.

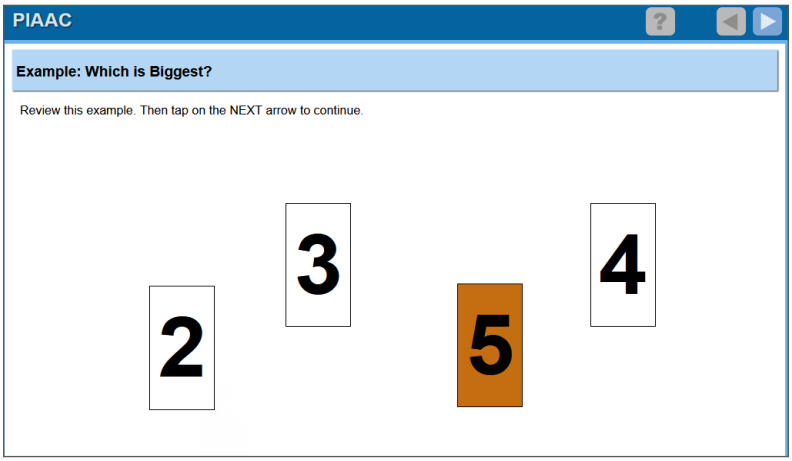
These assessments include two types of items, each focusing on a different aspect of number sense. Below are some samples:

Figure A.1.3 **Example of numeracy component: How many?**



As illustrated in Figure A.1.3, in the "How many?" item group, respondents are shown a screen with an image of a set of objects and are asked to tap on a number to indicate how many items are shown. As soon as a number is selected, the next screen displays. The items vary in terms of the number of objects shown and the format in which they are displayed (e.g. presented in an organised array, grouped or in a random visual display).

Figure A.1.4 **Example of numeracy component: Which is the biggest?**



In this set of assessments, respondents are shown four numbers and are asked to identify and tap on the screen the largest number. Once a selection is made, the next screen displays. Items can include whole numbers, decimal numbers and fractions.

1.1.5 Adaptive Problem Solving

Adaptive Problem Solving (hereinafter APS) is a new domain whose conceptual framework was specifically developed for PIAAC Cycle 2.

APS is conceptualised as "general" problem solving, relevant to a range of information environments and contexts and not limited to digitally embedded problems.

The underlying conceptual model for APS was developed by Greiff et al. (2017). The authors defined three stages of "problem-solving" (definition, search and application), the "cognitive and metacognitive processes" associated with each stage, and the "information environments" in which the problem-solving tasks are situated. This model highlighted important aspects of adaptive problem solving that should be a focus of the assessment.

Adaptive Problem Solving is defined as

> *the capacity to achieve one's goals in a dynamic situation, in which a method for solution is not immediately available. It requires engaging in cognitive and metacognitive processes to define the problem, search for information and apply a solution in a variety of information environments and contexts.*

A key feature of adaptive problem-solving activities is that these problems involve dynamic situations, where resources and information needed to solve a problem are not readily available, or some aspect of the problem changes while the solution is being developed. In addition, the importance of metacognition is emphasised. Metacognitive skills are called upon to monitor the problem-solving process and adapt solution strategies as a problem changes.

Four dimensions were defined for APS: content, cognitive and metacognitive processes, representations and context.

Content

The APS framework identifies three features of tasks that require adaptive problem-solving skills.

- Problem configuration: refers to the initial problem setup and goal state. The problem configuration includes the elements presented in the problem, the relationships among those elements (e.g. whether they interact with each other or are independent) and the resources made available to the problem solver.
- Dynamics of the situation: refers to the change (or absence of change) in the problem situation, the problem constraints across time and how these affect the problem configuration. The number of features that change, along with the frequency and salience of those changes, drives the difficulty of an APS assessment.
- Features of the environment: refers to various features that are characteristic of the environment and the information and resources that are available. The adaptive problem solving process is affected by the amount and sources of available information and how relevant it is to solve the problem.

Items are not classified according to these features, but the developers used them as a reference to create items of varying difficulty.

The APS framework also identifies different types of information sources that are available to solve a problem. These include physical, social and digital resources.

- Physical resources are hands-on and can be manipulated. These might include resources available for driving a car or operating machinery by pressing buttons and pulling levers.
- Social resources require the problem solver to engage in interpersonal and social interactions such as planning an activity with friends or leading a group discussion.
- Digital resources require the problem solver to use digital knowledge and skills to interact with digital features or devices. Examples include using digital tools to sort a table, send an email or format text.

Cognitive and metacognitive processes

As stated in the definition, adaptive problem solving involves both cognitive and metacognitive processes. Metacognitive processes become more important as problems become more complex and have aspects

that change during the course of solving them. These processes are present in each of the three stages of problem solving – defining the problem, searching for information relevant to a solution, and applying a solution – as illustrated below.
The cognitive processes associated with defining the problem are:

- Selecting, organising and integrating problem information into a mental model
- Retrieving relevant background information
- Externalising the internal representation of problems by creating a table, making a drawing, etc.

The metacognitive processes associated with defining the problem are:

- Definition of the goal
- Monitoring problem comprehension

Cognitive processes associated with searching for information relevant to a solution are:

- Searching for operators in the (mental model and) environment
- Evaluating how well these operators satisfy the problem constraints

Metacognitive processes associated with searching for a solution involve evaluating resources with respect to whether they can be executed. In an artificial problem-solving context, such as an assessment, these processes are difficult to distinguish from the cognitive processes. Therefore, the expert group specified that items that tapped into this process should be coded for analysis as requiring both cognitive and metacognitive processes.
When it comes to applying a solution, the primary cognitive process requires implementing the selected operators to solve the problem. As part of the metacognitive processes associated with applying a solution, problem solvers must evaluate whether they are progressing towards the goal and take actions if they are not. This involves: monitoring progress, regulating the application of the operators and reflection.

Contexts

The situational contexts in which a problem might be embedded are:

- Work: including situations where one is working under supervision or with co-workers.
- Personal: including problems related to one's home, family, education, hobbies and finances.
- Social/community: including interactions with others in leisure activities or use of community resources.

In order to illustrate the types of tasks within each level, including for APS, some sample items are illustrated below, specifically based on the constitutive dimensions described above (content, cognitive processes and contexts) and according to an increasing level of difficulty (score).

Illustrative item map: Adaptive problem solving

Product Return (C107P001)

- difficulty: below Level 1 (170 points)
- cognitive process: searching for information relevant to the solution of the problem
- metacognitive process: not applicable
- information environment: digital
- context: personal

This is the first task in a unit situated in a simulated website environment. The environment is simple and well structured, consisting of five pages that contain only images and limited text. Each page can be accessed by clicking on a tab that has a name summarising the content on the page. The task begins on the home page of the website, and the respondent is asked to follow a process for returning an item that was ordered on line. The wording of the problem is clearly defined and uses the keyword "return", which exactly matches the label on one of the web page tabs ("Returns"). The direct match between the task and the relevant web page makes the solution very noticeable. Once the respondent navigates to the Returns page, there is only one action that can be taken on that page, which is to tap on a button to begin the return process. These features make this the easiest task on the PIAAC APS scale.

Transport (C101P001)

- difficulty: Level 1 (188 points)
- cognitive process: defining the problem
- metacognitive process: not applicable
- information environment: physical
- context: work

This task is situated in a simple, well-structured environment with a limited number of elements, consisting of a graphic of a delivery truck and three packages. Respondents are asked to drag and drop the packages onto the truck, given a limited set of constraints (e.g. the truck can only be loaded from the back to the front and the delivery order of the three packages). There is a single problem-solving goal, and operators are visible and arranged logically. To solve this problem, respondents must create a mental model of loading and then delivering the packages and co-ordinate this model with the images of the truck and packages.

Travel Planning (C109P003)

- difficulty: Level 2 (239 points)
- cognitive process: applying a solution
- metacognitive process: searching for information relevant to the solution of the problem
- information environment: digital
- context: social/community

To complete this task, respondents must review four travel options and select the one that best meets a set of requirements. A list of five requirements is provided, four of which are relevant to this task. The resources needed to solve the problem are well structured and consist of a table with several types of information: departure/arrival time (represented graphically), travel mode/duration of trip and round-trip cost. Respondents need to consider the four travel options and match the details with the constraints provided in the travel requirements. Although there are several elements to consider, the difficulty of this task is manageable because the elements can be considered independently when assessing each travel option. Each of the incorrect options can be eliminated by identifying the one travel requirement that it does not meet. This process of elimination requires respondents to use metacognitive processes related to searching for the solution by evaluating alternative solutions.

Garden Time (C102P005)

- difficulty: Level 3 (298 points)
- cognitive process: searching for information relevant to the solution of the problem
- metacognitive process: applying a solution
- information environment: digital
- context: personal

The overall task is to select a combination of three fertilisers that meet a set of optimal criteria for growing trees. This and the previous item in the unit share the same complex environment, which consists of an interactive tool for selecting amounts of fertilisers and two tables where the results of those selections can be viewed. In this environment, the critical information is unknown until respondents begin making their selections.
In this item, there is a change in the problem configuration that requires respondents to adapt their solution strategies. A new fertiliser is introduced, requiring respondents to reconsider the selections from the previous item. The change is explicitly mentioned in the problem statement, but the characteristics of the new fertiliser are only discoverable through the interactive tool. Respondents must derive the composition of the selected fertilisers (the two previous fertilisers and the new fertiliser) and monitor progress to evaluate when their selections best match the target. To complete this task correctly, respondents must generate a complex mental model by iteratively implementing solutions in the interactive tool. They must monitor and evaluate their progress as they work towards a final application of their solution.

Ships Ahoy (C114P005)

- difficulty: Level 4 (350 points)
- cognitive process: applying a solution
- metacognitive process: applying a solution
- information environment: physical
- context: personal

This is an example of a highly dynamic problem where respondents have to continuously adapt their solution to the latest evolution in the problem environment. The environment consists of an interactive simulation where respondents control the speed and direction of a boat as it travels around islands and under varying wind conditions to reach a harbour. The entire route is not visible from the start but is revealed as the boat progresses. Respondents must continuously monitor their progress and adapt the position and speed of the boat as they encounter obstacles while travelling to the harbour.

1.2 Interpreting the PIAAC results: plausible values, proficiency scales and levels

Unlike physical quantities such as distances and weights that can be measured or observed, skills are latent constructs that defy direct measurement or observation. A process of inference is instead required, allowing skills to be measured indirectly by means of individuals' performances in tasks requiring the mastery of such skills. This approach is the most common in large-scale assessment surveys (e.g. student assessments such as the *Programme for International Student Assessment* (PISA) or *Trends in International Mathematics and Science Study* (TIMSS) or *Progress in International Reading Literacy Study* (PIRLS)).
In order to estimate latent constructs based on an observed model of responses to a set of assessment items, statistical models known as Item Response Theory models (hereinafter IRT models) are used. IRT models relate the probability of giving the correct response to an assessment item to the respondent's underlying ability.
The IRT model used in the PIAAC is based on the two-parameter logistic model (2PLM), which assumes that the probability of responding correctly to a given item depends on the skill of the respondent, as well as on two item parameters: the difficulty of the item and the ability of the item to discriminate.
The difficulty of an item defines what an adult, at a given proficiency level, is capable of doing (how likely they are to be able to respond correctly to the item). In the IRT, item difficulty is measured on the same (latent) scale as the respondents' ability. Specifically, in the PIAAC, when the respondent's proficiency level is equal to the item's difficulty, the probability that the respondent will answer the item correctly is 67%.
The discrimination parameter, meanwhile, defines how the probability of responding correctly to items increases (or decreases) as the respondent's skill increases (or decreases).
IRT models are also based on two fundamental assumptions: unidimensionality, which assumes that the same latent ability is related to performance in all items, i.e. that all items measure only one basic skill, and local independence, which assumes that the response to any specific item is independent of any other characteristic of the respondent (such as age, gender or educational attainment), and of responses given to other items in the assessment.
The distinguishing feature of IRT models is that they use information on item parameters administered to respondents to obtain estimates of respondents' proficiency. This approach makes the results of IRT models more "generalisable": proficiency can be estimated even if not all respondents answer the same items. As such, IRT models are particularly useful because they allow all respondents to be placed on the same proficiency scale, regardless of the items they respond to. This means that respondents' performances are comparable, even when based on different tasks. This feature is particularly useful in large-scale assessments, such as PIAAC, which rely on a wide range of items to ensure that the assessment covers all dimensions of the latent constructs that the survey intends to measure. As a wide range of items is required to cover all dimensions of the framework, but time constraints preclude as many (too many) items being administered to each respondent, large-scale assessments often use adaptive designs, in which respondents are administered a set of items that are neither too easy nor too difficult for them. These items are, in fact, the most informative regarding the actual proficiency of the respondents. Very difficult assessments where respondents are unable to respond correctly to any items would tell us what respondents are unable to do but not what they are able to do. Similarly, a very simple assessment in which respondents respond correctly to all items would not tell us whether they could respond to more difficult items.
Adaptive Testing is therefore able to increase the resolution and sensitivity of the assessment, particularly at the lower end of the performance distribution.
In the PIAAC, the use of a computer/tablet to administer the items makes it possible to implement an adaptive structure to optimise correspondence between the respondent's ability and the difficulty of the items.

1.2.1 Plausible Values (PV)

The main goal of large-scale assessments such as PIAAC is to describe the distribution of skills within a large population (or in specific subgroups of that population).
As the aim, in general, is to investigate the relationship between skills and individual characteristics, datasets from large-scale assessments contain plausible values (PV). Technically speaking, plausible values are not estimates of the proficiency of individual respondents, but rather multiple imputed values representing a range of possible (or plausible) proficiency scores for each respondent. The multiple imputed values for each respondent capture the uncertainty and variability of individual scores, allowing for a more accurate and reliable statistical analysis at a population level. As such, the use of plausible values is essential to correctly calculate statistics on the distribution of skills at a population or subgroup level. Plausible values are random draws from the posterior probability distribution of individual proficiency. This distribution takes account of

information on individual characteristics such as age, gender, educational qualification (collected through the Background Questionnaire) as well as the response pattern to the assessment items.
In practice, the plausible values for PIAAC respondents are estimated in accordance with the following steps. First, the IRT 2PL model presented above is applied to estimate the item parameters, a first step known as item calibration.
Secondly, the estimated parameters, considered as fixed values, are subject to regression based on the background information[44]. This step is used to establish the relationship between background characteristics and proficiency. Based on this relationship, it is possible to estimate an initial distribution of skills for each individual, representing the expected proficiency of each person if only their background characteristics were known. Subsequently, based on the information about the type of response observed in the assessment, the posterior distribution of proficiency is estimated. From this distribution, ten values are randomly extracted, referred to as "plausible values". This second phase is referred to as population modelling.
In PIAAC, the procedure for estimating plausible values is performed separately for each country, to take account of the fact that the relationship between proficiency and background characteristics may vary from country to country.
It is important to note that plausible values can also be estimated for domains not administered to respondents. Each respondent in PIAAC is randomly given a set of assessments relating to two of the three domains assessed in the PIAAC (literacy, numeracy and APS). Information on their background characteristics, as well as their performance in assessments in the domains they were administered, is used to estimate their proficiency in the domain in which they were not assessed. For this reason, the PIAAC dataset contains ten plausible values for all respondents in all skill domains.
The plausible values can also be interpreted as imputed (multiple) values for missing variables, i.e. variables that are not observed. The correct use of plausible values in statistical analyses of skills – for example, to calculate the average proficiency level of a particular group of individuals or to perform a regression in which proficiency appears as a dependent or independent variable – requires that they be treated as multiple imputations of an unobserved variable. To properly account for uncertainty due to measurement error, each analysis must be performed separately with each set of plausible values. Analytical activities performed using only one plausible value, or the average of available plausible values, would not produce correct estimates of the uncertainty associated with the estimate, as the uncertainty due to measurement error would not be accounted for.
In PIAAC evaluation, 10 plausible values are estimated for each skill domain.

1.2.2 Proficiency scales and levels

Given the considerations above, in each of the three domains, proficiency in PIAAC is considered a continuum of skills involving the mastery of information-processing abilities that enable individuals to solve tasks of increasing complexity. Assessment results are presented on a scale ranging from 0 to 500 points. Respondents' proficiency and the difficulty of the assessment items are presented on the same scale.
Each scale is divided into "proficiency levels", defined by score ranges. Six proficiency levels are thus defined for literacy and numeracy, ranging from "below Level 1" to "Level 5", and five levels for adaptive problem solving, ranging from "below Level 1" to "Level 4".
In order to facilitate interpretation of the results, a summary description of the characteristics of the types of tasks that adults at a given proficiency level can successfully complete was produced. As such, the following tables present a concise overview of what adults can successfully achieve in each skill domain and at each level.

[44] As the PIAAC Background Questionnaire contains a very large number of variables, a principal component analysis was adopted in order to reduce the number of variables to be used, while maintaining a large amount of variance.

Table A.1.1 **Proficiency levels: Literacy**

Level	Score range	Literacy
5	Equal to or higher than 376 points	At Level 5, the assessment provides no direct information on what adults can do. This is mostly because feasibility concerns (especially with respect to testing time) precluded the inclusion of highly difficult tasks involving complex interrelated goal structures, very long or complex document sets, or tools containing highly complex texts (e.g. extensive catalogues, complex menu structures, or lists of unstructured results from search engines), which require advanced skills to access and process the information they contain. These tasks, however, form part of the construct of literacy in today's world, and future assessments aiming at a better coverage of the upper end of the proficiency scale may seek to include testing units tapping into literacy skills at Level 5. The characteristics of the most difficult tasks at Level 4 offer some insight into what might constitute proficiency at Level 5. Adults at Level 5 may be able to reason about the task itself, setting up reading goals based on complex and implicit requests. They can presumably search for and integrate information across multiple, dense texts containing distracting information in prominent positions. They are able to construct syntheses of similar and contrasting ideas or points of view; or evaluate evidence-based arguments and the reliability of unfamiliar information sources. Tasks at Level 5 may also require the application and evaluation of abstract ideas and relationships. Evaluating the reliability of evidentiary sources and selecting information which is not just topically relevant but also trustworthy may be key to achievement.
4	326 to less than 376 points	At Level 4, adults can read long and dense texts presented on multiple pages in order to complete tasks that involve accessing, understanding, evaluating and reflecting on the text(s) contents and sources across multiple processing cycles. Adults at this level can infer what the task is asking for based on complex or implicit statements. Successful task completion often requires the production of knowledge-based inferences. Texts and tasks at Level 4 may deal with abstract and unfamiliar situations. They often feature both lengthy content and a large amount of distracting information, which is sometimes as prominent as the information required to complete the task. At this level, adults are able to reason based on intrinsically complex questions that share only indirect matches with the text content, and/or require taking into consideration several pieces of information dispersed throughout the materials. Tasks may require evaluating subtle evidence claims or persuasive discourse relationships. Conditional information is frequently present in tasks at this level and must be taken into consideration by the respondent. Response modes may involve assessing or sorting complex assertions.
3	276 to less than 326 points	Adults at Level 3 are able to construct meaning across larger chunks of text or perform multi-step operations in order to identify and formulate responses. They can identify, interpret or evaluate one or more pieces of information, often employing varying levels of inference. They can combine various processes (accessing, understanding and evaluating) if the task requires. Adults at this level can compare and evaluate multiple pieces of information from the text(s) based on their relevance or credibility. Texts at this level are often dense or lengthy, including continuous, non-continuous and mixed texts. Information may be distributed across multiple pages, sometimes arising from multiple sources that provide conflicting information. Understanding rhetorical structures and text signals becomes more central to successfully completing tasks, especially when dealing with complex digital texts that require navigation. The texts may include specific, possibly unfamiliar, vocabulary and argumentative structures. Competing information is often present and sometimes salient, though no more than the target information. Tasks require the respondent to identify, interpret or evaluate one or more pieces of information, and often require varying levels of inference. Tasks at Level 3 also often demand that the respondent disregard irrelevant or inappropriate text content to answer accurately. The most complex tasks at this level include lengthy or complex questions requiring the identification of multiple criteria, without clear guidance regarding what has to be done.
2	226 to less than 276 points	At Level 2, adults are able to access and understand information in longer texts with some distracting information. They can navigate within simple multi-page digital texts to access and identify target information from various parts of the text. They can understand by paraphrasing or making inferences, based on single or adjacent pieces of information. Adults at Level 2 can consider more than one criterion or constraint in selecting or generating a response. The texts at this level can include multiple paragraphs distributed over one long or a few short pages, including simple websites. Non-continuous texts may feature a two-dimension table or a simple flow diagram. Access to target information may require the use of signalling or navigation devices typical of longer print or digital texts. The texts may include some distracting information. Tasks and texts at this level sometimes deal with specific, possibly unfamiliar, situations. Tasks require respondents to perform indirect matches between the text and content information, sometimes based on lengthy instructions. Some task statements provide little guidance about how to perform the task. Task achievement often requires the test taker to either reason about one piece of information or to gather information across multiple processing cycles.
1	176 to less than 226 points	Adults at Level 1 are able to locate information on a page of text, find a relevant link from a website, and identify relevant text among multiple options when the relevant information is explicitly cued. They can understand the meaning of short texts, as well as the organisation of lists or multiple sections within a single page. The texts at Level 1 may be continuous, non-continuous or mixed and pertain to printed or digital environments. They typically include a single page with up to a few hundred words and little or no distracting information. Non-continuous texts may have a list structure (such as a web search engine results page) or include a small number of independent sections, possibly with pictorial illustrations or simple diagrams. Tasks at Level 1 involve simple questions providing some guidance as to what needs to be done and a single processing step. There is a direct, fairly obvious match between the question and target information in the text, although some tasks may require the examination of more than one piece of information.

Below Level 1	Below 176 points	Most adults below Level 1 are able to process meaning at the sentence level. Given a series of sentences that increase in complexity, they can tell if a sentence does or does not make sense either in terms of plausibility in the real world (i.e. sentences describing events that can versus those that cannot happen), or in terms of the internal logic of the sentence (i.e. sentences that are meaningful versus those that are not). Most adults at this level are also able to read short, simple paragraphs and, at certain points in the text, tell which of two words makes the sentence meaningful and consistent with the rest of the passage. Finally, they can access single words or numbers in very short texts in order to answer simple and explicit questions. The texts below Level 1 are very short and include no or just a few familiar structuring devices such as titles or paragraph headers. They do not include any distracting information nor navigation devices specific to digital texts (e.g. menus, links or tabs). Tasks below Level 1 are simple and very explicit regarding what to do and how to do it. These tasks only require understanding at the sentence level or across two simple adjacent sentences. When the text involves more than one sentence, the task merely requires dealing with target information in the form of a single word or phrase.

Table A.1.2 **Proficiency levels: Numeracy**

Level	Score range	Numeracy
5	Equal to or higher than 376 points	Adults at Level 5 can use and apply problem-solving strategies to analyse, evaluate, reason and critically reflect on complex and formal mathematical information, including dynamic representations. They demonstrate an understanding of statistical concepts and can critically reflect on whether a data set can be used to support or refute a claim. Adults at this level can determine the most appropriate graphical representation for relational data sets.
4	326 to less than 376 points	Adults at Level 4 can use and apply a range of problem-solving strategies to access, analyse, reason and critically reflect on and evaluate a broad range of mathematical information that is often presented in unfamiliar contexts. Such information may not be presented in an explicit manner. Adults at this level can devise and implement strategies to solve multi-step problems. This may involve reasoning about how to integrate concepts from different mathematical content areas or applying more complex and formal mathematical procedures. Adults at this level can: • calculate and interpret rates and ratios • devise a strategy to compare large data sets • read and interpret multi-variate data presented in a single graph • analyse complex, authentic algebraic formulae to understand relationships between variables • reflect and reason mathematically to review and evaluate the validity of statistical or mathematical conclusions, claims or arguments while accommodating relevant conditions • formulate a problem so that the result will be at the required level of specificity to the context of the situation.
3	276 to less than 326 points	Adults at Level 3 can access, act on, use, reflect on and evaluate authentic mathematical contexts. This requires making judgements about how to use the given information when developing a solution to a problem. The mathematical information may be less explicit, embedded in contexts that are not always commonplace, and use representations and terminology that are more formal and involve greater complexity. Adults at this level can complete tasks where mathematical processes require the application of two or more steps and where multiple conditions need to be satisfied. Tasks may also require the use, integration or manipulation of multiple data sources in order to undertake the mathematical analyses necessary for the specific task. Adults at this level can: • estimate or perform calculations with a wide range of whole numbers, decimals, percentages, fractions, and measurements, including the application of proportional reasoning • determine a missing value from a data set given the mean • recognise and use patterns (visual and numerical) to estimate values • reflect on and use mathematical reasoning when reviewing and evaluating the validity of conclusions drawn from data, including a limited set of related conditions or statements • evaluate claims and stated relationships using a variety of data sources • recognise a formulation using non-standard notation • use spatial-visualisation to analyse figures, including moving from three- to two-dimensional representations.
2	226 to less than 276 points	Adults at Level 2 can access, act on and use mathematical information and evaluate simple claims, in tasks set in a variety of authentic contexts. They are able to interpret and use information presented in slightly more complex forms (e.g. doughnut charts, stacked bar graphs or linear scales) that includes more formal terminology and more distracting information. Adults at this level can carry out multi-step mathematical processes. Adults at this level can: • use dynamic applications to perform simple measurements, and access and sort data given in tables or interactive charts • apply simple proportional reasoning or solve problems satisfying up to two conditions • formulate processes and expressions to represent situations mathematically, including combining and linking information • use mathematical reasoning when reviewing and evaluating the validity of statements • estimate or perform calculations involving fractions, decimals, time, measurements and less common percentages or perform routine algorithms such as that used to generate the mean • substitute into and evaluate contexts involving authentic algebraic formulae • identify patterns within two-dimensional geometrical representations.
1	176 to less than 226 points	Adults at Level 1 demonstrate number sense involving whole numbers, decimals, and common fractions and percentages. They can access, act on and use mathematical information located in slightly more complex representations set in authentic contexts where the mathematical content is explicit and uses informal mathematical terminology with little text and minimal distracting information. They can devise simple strategies using one or two steps to determine the solution. Adults at this level can: • interpret simple spatial representations or a scale on a map • identify and extract information from a table or graphical representation or complete a simple whole-number bar chart • identify the largest value in an unordered list, including comparing the decimal part of the number • interpret and perform basic arithmetic operations, including multiplication and division, with whole numbers, money and common whole number percentages such as 25% and 50%.
Below Level 1	Below 176 points	Adults performing below Level 1 demonstrate elementary whole number sense and can access and use mathematical knowledge to solve single-step problems, where the information is presented using images or simple structured information set in authentic, commonplace contexts with little or no text or distracting information. The mathematical content is non-formal and explicit. Adults at this level can: • count up to 20 objects that are displayed with varying degrees of organisation (i.e. randomly arranged, separated into groups or in an array) • sort events into chronological order • compare unordered lists of numbers to identify the largest number based on the whole-number component • locate data directly from a graph • perform addition and subtraction with small whole numbers.

Table A.1.3 **Proficiency levels: Adaptive problem solving**

Level	Score range	The types of tasks completed successfully at each level of proficiency
Level 4	Equal to or higher than 326 points	Adults at Level 4 are able to define the nature of problems in ill-structured and information-rich contexts. They can integrate multiple sources of information and their interactions, identify and disregard irrelevant information, and formulate relevant cues. Adults at this level can identify and apply multi-step solutions to meet one or more complex goals. They adapt the problem-solving process to changes, even if these changes are not obvious, occur unexpectedly or require a major re-evaluation of the problem. They are able to distinguish between relevant and irrelevant changes, predict future developments of the problem situation, and consider multiple criteria simultaneously to judge whether the solution process is likely to lead to success. Adults at Level 4 engage in the following cognitive processes: • develop complex mental models of problems by integrating information from multiple sources • establish connections between tasks and stimuli even if these connections are difficult to detect or contain complex interactions • develop strategies to reach several goals in parallel and implement multi-step solutions • continuously update their mental model, search strategies and solutions during problem solving. Adults at this level engage in the following metacognitive processes: • continuously reflect and monitor the problem-solving process even if the environment is complex and changes unexpectedly • constantly revisit and re-evaluate their mental model, the available information and goal attainment • show adequate and immediate reactions to change • cope with frequent and unpredictable change and adapt their solution strategy accordingly.
Level 3	276 to less than 326 points	Adults at Level 3 understand problems that are either static but more complex, or have an average to high level of dynamics. They can solve problems with multiple constraints or problems that require the attainment of several goals in parallel. In problems that change and require them to adapt, they can deal with frequent and, to some extent, continuous changes. They discriminate between changes that are relevant and those that are less relevant or unrelated to the problem. Adults at this level can identify and apply multi-step solutions that integrate several important variables simultaneously and consider the impact of several problem elements on each other. In dynamically changing problems, they predict future developments in the problem situation based on information collected from past developments. They adapt their behaviour according to the predicted change. Adults at Level 3 engage in the following cognitive processes: • generate mental models for moderately to highly complex problems • actively search for solutions by continuously evaluating the information provided in the problem environment • distinguish between relevant and irrelevant information. Adults at this level engage in the following metacognitive processes: • monitor comprehension of the problem and the changes in the problem • monitor and evaluate progress towards the goal of the problem • search for solutions by setting sub-goals and evaluating alternative solutions to the problem • reflect on their approach to solving the problem and, if necessary, revise their strategy.
Level 2	226 to less than 276 points	Adults at Level 2 can identify and apply solutions that consist of several steps to problems that require one target variable to be considered in order to judge whether the problem has been solved. In dynamic problems that exhibit change, adults at this level can identify relevant information if they are prompted about specific aspects of the change or if changes are transparent, occur only one at a time, relate to a single problem feature and are easily accessible. Problems at this level are presented in well-structured environments and contain only a few information elements with direct relevance to the problem. Minor impasses may be introduced but these can be resolved easily by adjusting the initial problem-solving procedure. Adults at Level 2 engage in the following cognitive processes: • develop mental models for simple to moderately difficult problems and adapt these as needed • adequately react to changes that are presented in visible increments • adapt resolution strategies to changes in the problem statement and the environment if these changes are of low or moderate cognitive complexity. Adults at this level engage in the following metacognitive processes: • monitor progress towards a solution that consists of one specific goal • search for optimal solutions by evaluating alternative solution paths within a given problem environment of low to moderate complexity • reflect on the chosen solution strategy if an impasse occurs and when explicitly prompted to adapt.
Level 1	176 to less than 226 points	Adults at Level 1 are able to understand simple problems, and develop and implement solutions to solve them. Problems contain a limited number of elements and little to no irrelevant information. Solutions at this level are simple and consist of a limited number of steps. Problems are embedded in a context that includes one or two sources of information and presents a single, explicitly defined goal. Adults at Level 1 engage in the following cognitive processes: • develop mental models of simple and clearly structured problems • understand connections between tasks and stimuli that are explicit and embedded in a well-structured environment • solve problems that do not change and thereby do not require adaptivity.
Below Level 1	Less than 176 points	Adults performing below Level 1 understand very simple static problems situated within a clearly structured environment. Problems contain no invisible elements, no irrelevant information that might distract from the core of the problem, and typically only require a single step to solve the problem. Adults at this proficiency level are able to engage in the basic cognitive processes required to solve problems if explicit support is given and if they are prompted to do so.

As previously described in the introduction to this Report, according to the assessment model used for PIAAC, at each point on the assessment scale, an individual with that level of proficiency has a 67% chance of successfully completing the tasks corresponding to that score. Such an individual will also be able to complete more difficult tasks (those with higher values on the scale), albeit with a lower probability of success, and will have a higher probability of successfully completing easier tasks (those with lower values on the scale).

The following illustrative table shows how the probability of completing tasks of higher or lower difficulty varies for a person with a proficiency score of 300 on the literacy scale. As shown, such an individual will successfully complete assessments whose difficulty level matches their proficiency level (300 points) 67% of the time; the probability of successfully completing easier assessments (with a difficulty value of 250) reaches 95%, but the probability of correctly answering more difficult assessments (with a difficulty value of 350) drops to 28%.

Table A.1.1 Probability of successfully completing assessments of varying difficulty for a person scoring 300 on the literacy scale

	Item difficulty (literacy scale)			
	200	250	300	350
Probability of success	0.97	0.95	0.67	0.28

Source: OECD (2024b)

With the exception of the lowest level (Below Level 1), a person at the lower end of the level range has a 50% probability of successfully completing tasks at that level. Of course, this probability will vary according to the difficulty of each particular assessment, as illustrated above.

In practical terms, a person scoring at the lower end of Level 2 might successfully complete around 50% of the assessment in a hypothetical evaluation containing only assessments of difficulty Level 2. The percentage of successful completion of this type of assessment would be much higher for a person whose proficiency level is located at the upper end of Level 2. The "average" individual with a proficiency score around the middle of Level 2 will successfully complete around 67% of the items in this hypothetical assessment.

Appendix 2 – Survey Design and Components: Background Questionnaire and Cognitive Assessments

The PIAAC Survey was designed to administer the two main components to respondents: the Background Questionnaire (BQ) and the Assessments (Direct Assessment - DA).
The questionnaire collects information on respondents' socio-demographic characteristics, their education and training pathways, their experiences in the labour market, languages learned and spoken, demographic and family background, work environment and individual attitudes, social and emotional (non-cognitive) skills, use of technology and skills in the workplace and in everyday life.
The assessments, on the other hand, are the instrument used to measure the skills in the survey domains of literacy, numeracy and adaptive problem solving (APS).
The two survey instruments are integrated into a computer platform called the PIAAC Delivery System (PDS), managed through the Case Management System (CMS), which allows a trained interviewer to administer the BQ in Computer Assisted Personal Interview (CAPI) mode and the assessments in independent mode (specifically via Direct Assessment) using tablets at all times.
The survey design and model underlying administration of the components, the structure of the questionnaire and the Cognitive Assessment will be explained below.

2.1 Survey Design

The complex design of the PIAAC Survey and administration of the BQ and DA is outlined in Figure A.2.1. Data collection begins with the Background Questionnaire, administered in CAPI mode by a specially trained interviewer[45].
After completing the BQ, respondents move on to the self-administered direct assessment using tablets. Respondents are first offered a short Tutorial on the tablet to familiarise them with the main functions of the device, necessary to be able to carry out the assessments in the next phase. The ease of use of the tablet, now very common among the adult population, together with the option of using a digital pen, ensure that even adults with little familiarity with digital devices could complete the assessments on the tablet.
Administration of the assessments in Computer-Based Assisted (CBA) mode, via tablet, makes it possible to use adaptive algorithms to ensure that the items presented (i.e. stimuli and respective questions) correspond as closely as possible to the respondent's proficiency level, so that they are neither too easy nor too difficult. The first step in this adaptive process is the Locator, comprising eight preliminary assessments in literacy and eight in numeracy. Depending on the answers provided, the Locator determines the routing and type of administration of the assessment. Respondents are sorted into three different routes:

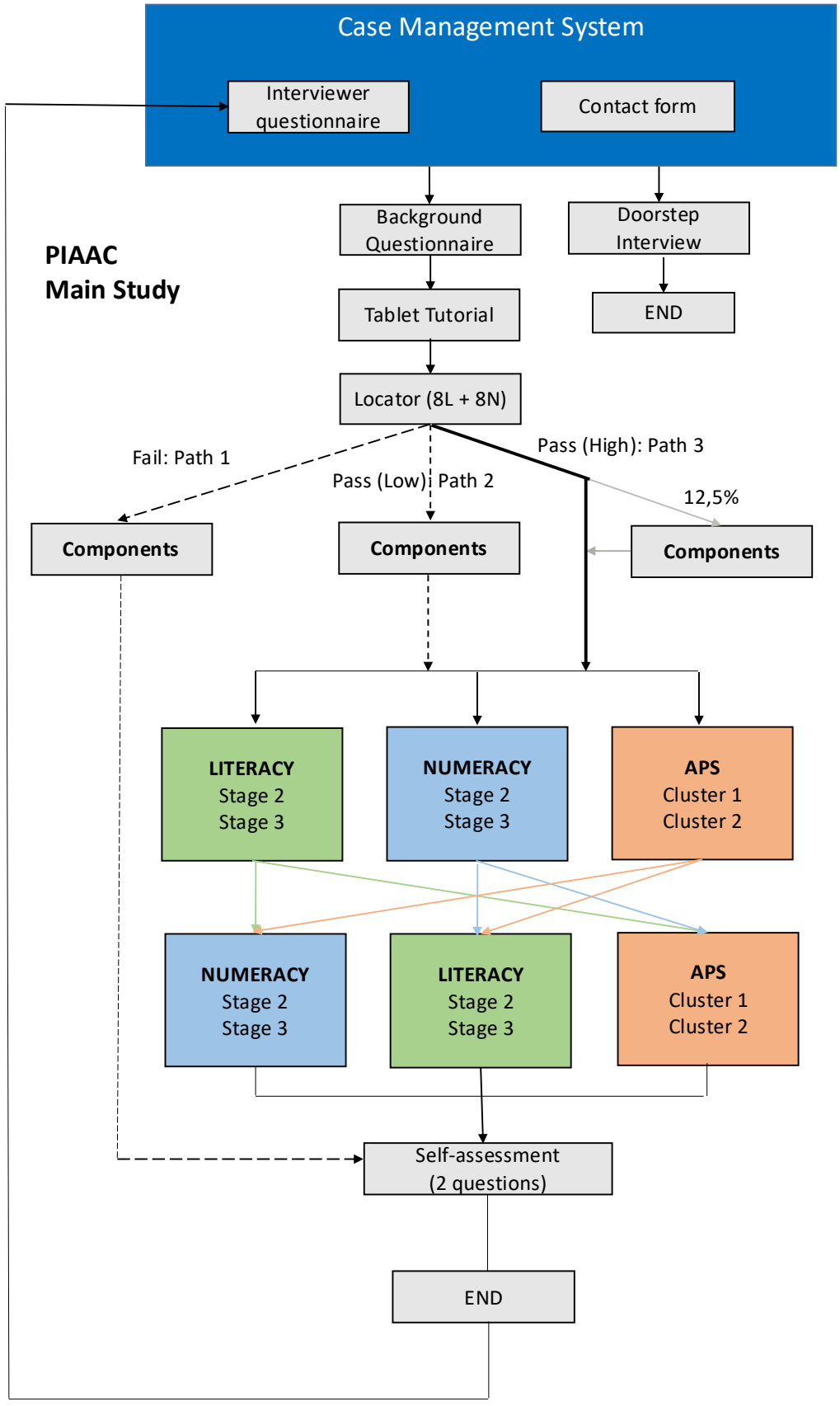
- respondents who fail the Locator test are routed to Pathway 1, where they complete an assessment of basic literacy and numeracy skills through the Reading and Numeracy Components;
- respondents who pass the Locator test with a low score are routed to Path 2. After responding to the components, this group will perform the assessments, randomly receiving a combination of literacy, numeracy or adaptive problem solving assessments;
- respondents who pass the Locator test with a high score are routed to Path 3. A portion of these adults (12.5%) are randomly selected to perform the components, in any case, and then proceed to the literacy, numeracy or adaptive problem solving items. All others proceed directly to the assessment of skills in the domains analysed.

The components, both reading and numeracy, are a tool developed to measure the basic skills required for understanding a written text (reading skills), such as comprehension of sentences and short texts, and basic numerical skills. In Cycle 2 of PIAAC, the results obtained in the component skills were also taken into account in determining adults' proficiency levels, thus enabling a more precise estimation of skills at the

[45] Respondents who are unable to complete the BQ due to a language barrier receive the Doorstep Interview, a short self-administered questionnaire offered in multiple languages (the official languages of all 31 countries participating in the PIAAC as well as the languages of the main linguistic minorities in each country) designed to collect key information on personal background such as gender, age, educational attainment, employment status, country of birth and length of residence in the country where the survey is conducted. Adults taking part in the Doorstep Interview do not take the full survey due to a lack of language skills required for the survey. However, the information collected through the Doorstep Interview is used to estimate the proficiency of these respondents (who represent around 1% of the target population in most countries participating in PIAAC), thus obtaining a more accurate picture of the distribution of skills in the overall adult population.

lower end of the skill distribution. More details on this aspect are included in Appendix 1 of this Report.
The Cognitive Assessment, on the other hand, are structured so that each respondent is only assessed in two of the three domains analysed. Respondents are randomly assigned to a domain (literacy, numeracy or adaptive problem solving) and, having completed the assessment in that domain, adaptively assigned to one of the two remaining domains.
In accordance with the flow shown in Figure A.2.1, the final step for the respondent, following completion of the DA, involves a set of questions asking them to "measure" the effort expended to complete the assessments (with respect to a high-stakes situation) and the ultimate performance.
Finally, the interviewers complete a post-interview questionnaire in which they record their observations on the context, environment and conditions under which the interview took place.

Figure A.2.1 **PIAAC interview flowchart**



2.2 The Background Questionnaire (BQ)

The PIAAC Background Questionnaire (BQ) collects a rich and relevant set of information designed to support the PIAAC's main analytical objectives, namely to:

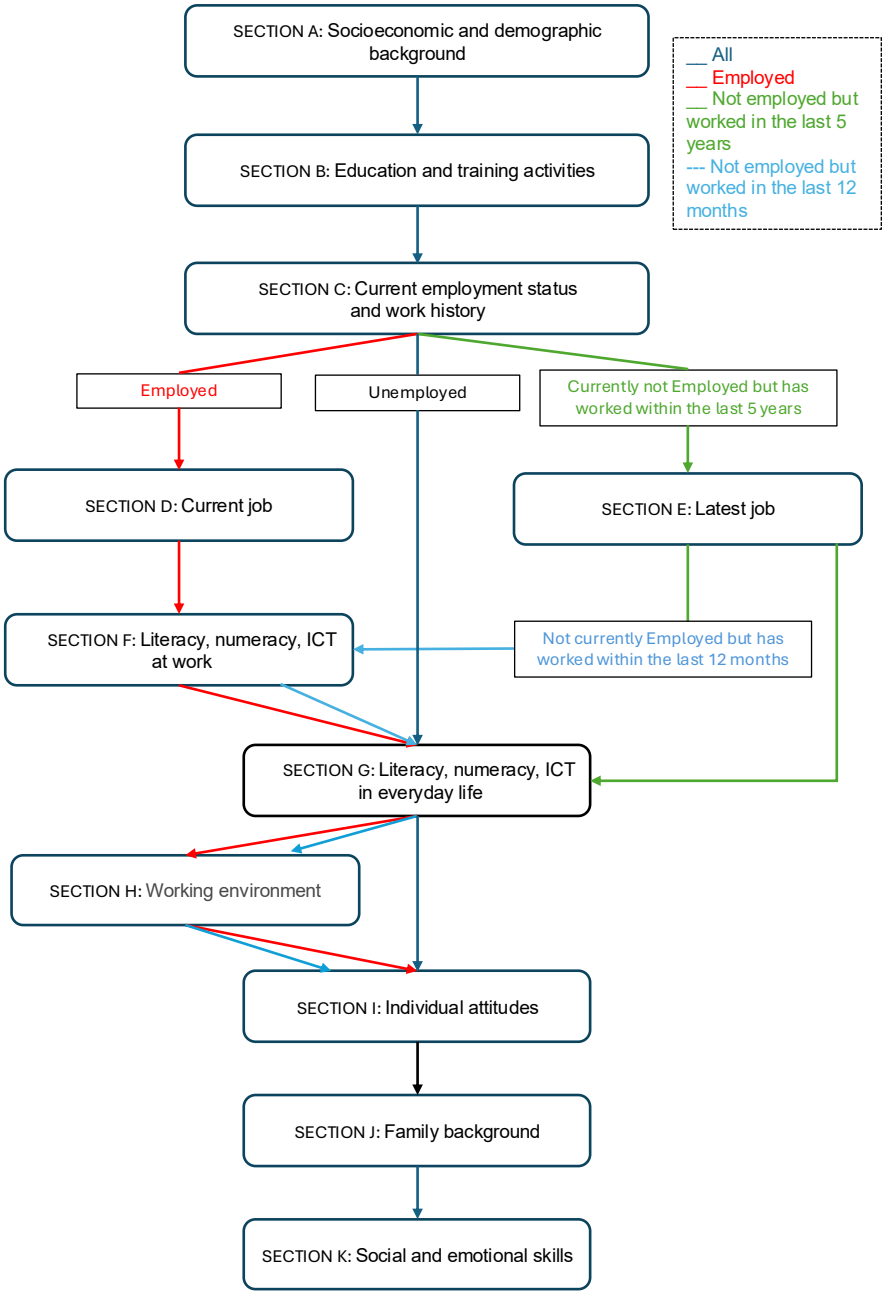
- determine the level and distribution of skills by subgroups of the adult population;
- understand the factors associated with the acquisition, development, maintenance and loss of skills throughout life;
- understand the relationship between skills measured and economic and social outcomes.

The BQ is organised into 11 thematic sections (A-K) and requires approximately 40-60 minutes (depending on the education/training and employment history of the respondent) of administration guided by the interviewer. The PIAAC Cycle 2 questionnaire includes many questions previously used in PIAAC Cycle 1 and in the first OECD skills surveys (IALS and ALL), such as educational attainment, employment status, participation in education and training and learning activities, current and past work history and experience, literacy, numeracy and technology skills in the workplace and in everyday life, some individual attitudes and the family background of the respondents. The PIAAC Cycle 2 questionnaire broadens the survey framework by also exploring a variety of concepts related to respondents' work environment and social and emotional skills.

All participating countries translated and adapted the questionnaire questions to reflect national specificities in areas such as participation in education and attainment of relevant qualifications, labour-force participation and employment. Additionally, countries had the opportunity to add a small number of "national" questions to their own versions of the background questionnaire. In the specific case of Italy, additional information was collected on educational attainment by recording the type of upper secondary school attended (technical/vocational institutes or academic lyceums), as well as on the type of part-time employment (reduced daily hours or compressed week) and the reasons for working reduced hours.

The figure below outlines the sections of the questionnaire, highlighting the possible pathways of administration depending on the respondent's employment status.

Figure A.2.2 **Sections and Flow of the PIAAC Background Questionnaire, Cycle 2**



Below is a brief description of the main areas explored by the PIAAC Cycle 2 BQ and the variables measured[46].

2.2.1 Demographic and contextual characteristics

One of the main objectives of the PIAAC survey is to identify proficiency levels among different population subgroups. To this end, as well as collecting information on demographic variables such as gender and age, the BQ collects data on language spoken, immigration status and the social context in which the respondent grew up (referring to when they were 14 years old). Data on the respondent's family background are of fundamental importance in explaining skills and interpreting skill proficiency levels in relation to factors such as individual well-being indicators. Moreover, this information supports analyses of intergenerational mobility, as well as helping to explain subsequent choices in education, training and vocational pathways.

[46] For more detail on the content of the Background Questionnaire, see OECD (2024a and 2011), INAPP (2021a and 2021b).

Table A.2.1 **Information collected on demographic characteristics and backgrounds**

Domain	Specific data items	BQ sections
Demographic	Year and month of birth, gender, country of birth.	A1-A3
Household and family structure	Number of persons in household, living with spouse or partner, activity of spouse/partner, number and age of children.	J1-J3
Language background	First and second languages spoken during childhood, the language currently spoken at home.	A4
Immigration status	Age at migration, country of birth of parents.	A3
Home environment at age 14	Number of books at home, parents' or guardians' occupation and highest level of education, place of residence (urban versus rural), household composition and family structure.	J4-J9

2.2.2 Qualification and education and training pathways

The PIAAC survey explores the link between skills and education and training activities by collecting information, via the questionnaire, on respondents' education and training levels, distinguishing between formal education and non-formal learning pathways, from the perspective of investments in human capital, and whether or not such investments are made over the individuals' lifetime. Indeed, participation in education and training activities is an element that can help explain the proficiency levels attained in the domains analysed in PIAAC, but that can also be seen as a potential product (or outcome) of the skills possessed by the individual. As far as formal education is concerned, the questionnaire records the educational qualification attained, the type of school attended (technical/vocational institutes or lyceums)[47], other lower-level qualifications and attainments, any enrolment in education and any uncompleted educational courses undertaken. The questionnaire also records any non-formal learning pathways undertaken by the respondent during the 12 months preceding the interview, analysing the data through a set of indicators aimed at highlighting the motivations that led the respondent to undertake pathways to increase his or her knowledge and skills, and distinguishing between professional reasons and personal interests.

Table A.2.2 **Information collected on education experience and current training activities**

Domain	Specific data items	BQ sections
Educational attainment and pathways	Highest qualification (ISCED), the country where this qualification was obtained, the field of study of the highest qualification, age when the highest qualification was obtained, and other qualifications.	B1-B4
Current education	Current participation in formal education (level and field of study).	B5
Incomplete education	Incomplete formal qualification, level of incomplete formal qualification, the age at which formal qualification was interrupted.	B6
Training activities	Participation in training activities in the last 12 months or any point, number of training activities.	B8
Context of most recent training activity	Field of activity, activity mainly job-related, the main reason for participation, took place in or outside working hours, the focus of activity, in person or remote, employment status at the time of participation, related to the digital transformation, perception of usefulness, delivery of a certificate, duration, funding sources.	B9-B21
Barriers to undertaking education and training	Wanted to participate in training activities in the last 12 months but did not, reasons preventing participation.	B22-B23

[47] As already indicated, Italy chose to include this "national" question in order to further explore respondents' educational backgrounds.

2.2.3 Employment status, work history and job characteristics

The PIAAC Survey provides valuable insights for interpreting labour market dynamics in relation to the cultural capital of populations – factors that can predict, for example, possible episodes of unemployment or the (mis)match between workers' skills and employers' requirements. In addition to respondents' employment status, the survey also collects detailed information on job characteristics, such as occupation, specific economic sector, and earnings, as well as on the skills required to perform the job.

The relationship between cognitive skills and labour market outcomes such as employment, earnings and job characteristics is considered central to the Adult Skills Survey. According to human capital theory, cognitive skills are considered an important component of individual productivity. Since skills can influence (and be influenced by) job changes and changes in the type of job, the survey includes some information on workers' career progressions: time spent in the same job, professional development within the occupation, total number of years of experience in the labour market, etc. Similarly, non-employed individuals are asked questions about their most recent work activity and their work in the previous five years. Questions on job characteristics are asked both of those who were employed at the time of the survey (about their current job) and of those who were not employed but had at least one work experience in the previous five years (about their last job).

Table A.2.3 **Information collected on labour-force status, work history and job characteristics**

Domain	Specific data items	BQ sections
Current activity	Labour-force status (International Labour Organization definition), main current activity.	C1-C5
Work history	Ever worked, had paid work in the last 12 months, age at which stopped working (if currently unemployed), total time in employment, received benefits in the last 12 months (unemployment, disability, sickness or retirement), number of employers in the last five years.	C6-C12
Current job	Sector of industry (ISIC) and occupation (ISCO), employed or self-employed, age at which started working with current employer, most important activities, change of position/tasks/unit (while remaining with the same employer) , age started with current employer, establishment size, the evolution of the number of employees, part of a larger organisation, (if self-employed) number of employees, management or supervisory responsibilities, number of subordinates, type of employment contract, usual working hours, qualification and experience required to get this job and satisfactorily perform the duties, level of job satisfaction, gross wage or salary, the existence of bonuses, (if self-employed) earnings from business.	D1-D16
Most recent job (if unemployed)	Sector of industry (ISIC) and occupation (ISCO), most important activities, employed or self-employed, date when started last employment, establishment size, part of a larger organisation, (if self-employed) number of employees, management of supervisory responsibilities, number of subordinates, type of employment contract, usual working hours, qualification required to get this job, the main reason for leaving last job.	E1-E11

2.2.4 Skills use, skill mismatch and work environment

The questionnaire collects information on how often respondents, both at work and in their everyday lives, perform activities that require reading, writing, calculation and use of technology. Furthermore, respondents are asked how often, at work, they engage in activities that require skills other than information processing, but still relevant to many jobs, such as physical and manual skills or interpersonal skills, such as the ability to collaborate, manage people or negotiate and influence others.

Data on the frequency with which certain tasks are performed should not be interpreted as evidence of respondents' proficiency in the skills required to perform them. This interpretation would only be valid under strict assumptions, namely that tasks at work are always assigned to people capable of performing them and that those with a high level of a particular skill perform tasks requiring it more often.

An attempt has been made, particularly in relation to reading, writing and calculation practices, to include a wide range of tasks, some of which are more complex and therefore require higher levels of skill. However, the questions do not specify the complexity or importance of the tasks to overall job performance, nor whether respondents are normally able to complete them successfully. As such, information on the use of skills is primarily collected as an indication of the skill content required by the job and as an approximation of the skills required in the work environment.

This information on the content of skills and tasks in individual jobs is supplemented by other questions aimed at gaining a better understanding of the general work environment in which such activities are carried

out. The latter questions relate more to organisational rules rather than the actual practices of individual workers.
The characteristics of the job and the actual content of the job in terms of tasks workers have to perform are key factors in encouraging workers to maintain or invest in their skills. It is also crucial information in terms of analysing whether labour institutions can efficiently assign workers to occupations. Detailed questions on the use of skills at work (and in everyday life) and on the characteristics of the work environment are included in the PIAAC questionnaire.

The use of literacy and numeracy in skill maintenance and development

The PIAAC Survey not only describes the level and distribution of the skills it measures, but also aims to provide information on the factors associated with the acquisition, maintenance and development of these skills and their effects. Cognitive skills, such as literacy and numeracy, over the course of a lifetime; life paths, interests and personal circumstances affect patterns of acquisition and loss of these skills. Adults strengthen or maintain their skills through reading, writing and calculation practices, as well as through use of ICT both at work and in everyday life. Skills and practice reinforce each other: practising helps increase skill levels, while higher skill levels, in turn, encourage further practice.
Questions on the use of skills are structured into tasks (task clusters) related to cognitive skills and technology (computer use and digital skills). The questions on the use of skills refer to two distinct contexts: use in the work environment and use in everyday life. This differentiation recognises the relevance of skills for different social functions. The questions in the questionnaire record how often adults perform certain tasks, selected to cover the diversity of use in different contexts.

Table A.2.4 **Information collected on skills use at work and in everyday life**

Task cluster	Component activities at work	Component activities in everyday life	BQ sections	
Cognitive skills				
Reading	Read directions or instructions; letters, memos or e-mails; articles in newspapers, magazines or newsletters; manuals or reference materials; bills, invoices, or bank or financial statements.		F1	G1
	Read books or articles in professional journals or scholarly publications.	Read books, fiction or non-fiction.	F1	G1
Writing	Write letters, memos or e-mails; write reports or articles; fill in forms.		F2	G2
Numeracy	Make calculations such as on prices, costs or quantities; read and prepare charts, graphs or tables; undertake measurements.		F3	G3
	Use maps, plans or GPS for finding directions and locations; use advanced mathematics or statistics.	Use information to make financial decisions; use mathematics, such as formulas or mathematical rules.	F3	G3
Technology				
ICT general use	Experience with computer in job.	Ever used a smartphone, tablet, laptop or desktop computer outside of work. Frequency of use.	F4	G4-G5
ICT skills	Use a computer or digital device to communicate with others; to access information.		F5	G6
	Use a computer or digital device to create or edit electronic documents, spreadsheets or presentations; to use specialised software; to use a programming language.	Use a computer or digital device for entertainment or leisure; for online banking or e-commerce; to manage your personal life.	F5	G6

Specific activities and tasks required at work

Cognitive information processing skills, such as literacy, numeracy and problem solving, are only a subset (albeit fundamental) of the various generic skills and aptitudes valued in the labour market, which can improve employability. A range of more specialised skills, such as the ability to work in a team, communication skills or manual skills, are of considerable importance in modern work environments. Assessing these skills in a direct and comparative way is a complex task, which cannot be done using a survey like PIAAC. It was thus decided to ask respondents about the different types of generic tasks they perform in their jobs; this information can then be used to infer the skills needed to perform these tasks. This approach, known as the Jobs Requirement Approach, was introduced by the UK Skills Survey (Felstead *et al.* 2007).
By supplementing these questions with information on the use of literacy, numeracy and ICT skills at work, a detailed picture can emerge of the skills required to perform a job. Knowing the tasks that workers most frequently perform provides insight into the skills required by the labour market, offering a useful

complement to information on the supply of skills derived from the assessments (DA). This approach is in keeping with the so-called task approach to labour markets, widely used in recent academic literature to analyse changes in labour demand in response to shock phenomena, such as globalisation and technological change (Autor *et al.* 2003; Autor 2013; Lassébie and Quintini 2022).
As with the questions on the use of skills at work and in everyday life, respondents are asked how often they perform each task.

Table A.2.5 **Information collected on tasks performed at work**

Activity cluster	Component activities at work	BQ sections
Co-operation	Co-operating or collaborating with co-workers	H1
Influence	Influencing or persuading people; negotiating with people	H5
Problem solving	Solving simple (less than 5 minutes) and complex problems (more than 30 minutes)	H6
Self-direction	Planning your own activities; organising your own time	H4
Learning at work	Learning new things, learning-by-doing process, keeping up to date with new products or services	H9
Horizontal interaction	Sharing work-related information; teaching or training people; giving presentations	H3
Client interaction	Dealing directly with people who are not employees	H3
Physical skills	Working physically for a long period	H7
Manual skills	Using hands or fingers for precision work	H7

Skill and *qualification mismatch*

A key objective of the PIAAC Survey is to provide an in-depth insight into the actual use of skills. Workers may not possess the necessary skills to adequately perform their work or, on the contrary, may be employed in jobs that do not allow them to use their acquired skills productively. Although such mismatches are to some extent unavoidable, measures can be taken to minimise them, as they tend to negatively affect economic productivity and individual well-being.
Skill mismatch can have a negative impact on economic growth, increasing labour costs, reducing productivity, slowing the adoption of new technologies and ultimately reducing overall output (OECD 2016b; Adalet McGowan and Andrews 2017). Individuals in a situation of skill mismatch also face higher risks of unemployment, lower wages and lower job satisfaction (OECD 2016b; Allen and van der Velden 2001; Quintini 2011).
The data from the first cycle of the PIAAC Survey made an important contribution to improving measures that can be used to assess this phenomenon (Pellizzari and Fichen 2017; Pérez Rodríguez *et al.* 2023; OECD 2013). In particular, PIAAC data make it possible to go beyond traditional measurements based on self-reported mismatch, supplementing such reports with concrete information on skills gathered directly from the survey itself.
Some questions regarding self-assessment of qualification mismatch and skill mismatch have been retained in the second cycle of the BQ, improving on the first cycle questionnaire with a new question that allots respondents to indicate in which particular skill areas they consider themselves under-skilled, over-skilled or well-matched.

Table A.2.6 **Information collected on aspects of qualifications and skills mismatches**

Domain	Specific data items	BQ section
Subjective skills mismatch	Whether the respondent feels over-skilled, well-matched or under-skilled, and for which skills this evaluation would apply	H19
Match of qualifications to job requirements	Educational qualification and work experience needed to get their current job	D12

Work environment and organisational processes

The use of different skills at work, as well as incentives to maintain existing skills or invest in developing new ones, are also influenced by the work environment and in particular by organisational processes. For this, the questionnaire includes questions to describe the organisational norms and processes in which individual work tasks are embedded. Work organisation can have notable consequences for worker productivity and well-being (Bloom *et al.* 2014). In the context of the PIAAC survey, there is a particular interest in capturing so-called high-performance work practices, such as teamwork, knowledge sharing, setting clear objectives, continuous feedback and the use of rewards for good performance. These practices are often considered

useful for better allocating skills to tasks and incentivising workers to invest in their own skills development. Another aspect investigated relates to how the work environment has evolved in recent years, what changes, if any, it has had on demand for skills and training policies, and whether workers have been adequately supported in this changing context.

Table A.2.7 **Information collected on the working environment**

Domain		Specific data items	BQ Section
Task discretion		Respondent has control over the sequence of tasks, speed of work, working hours or how the work is done	H8
Work pressure		Working to tight deadlines or at a very high speed	H12
Work format		Short repetitive tasks	H17
Changes in the working environment		Changes in the last three years to: machinery, information and communication, working methods and practices, outsourcing and relocation, products or services, contact with clients. Existence of employer-supported training	H18
Optional[48]	Teamwork	The presence of a team leader, the influence of team members on leader selection, tasks and work targets	H2
	Participation in decision-making	Able to apply own ideas in work, involved in improving the work organisation or work processes	H14
	Social support and knowledge sharing	Receive assistance from supervisor or manager, receive assistance from co-workers, helping co-workers to learn new things	H10, H13

2.2.5 Non-labour-market outcomes

The benefits of possessing appropriate skills are not limited to higher productivity and better economic performance, but enable adults to participate fully in all aspects of social life. For this reason, the PIAAC Survey collects information on individuals' general well-being and how they perceive themselves as citizens. In particular, the questionnaire collects information on respondents' personal attitudes towards society and political participation, participation in voluntary activities, their (self-reported) health and life satisfaction.

Table A.2.8 **Information collected on tasks performed at work**

Activity cluster	Component activities at work	BQ section
Co-operation	Co-operating or collaborating with co-workers	H1
Influence	Influencing or persuading people; negotiating with people	H5
Problem solving	Solving simple (less than 5 minutes) and complex problems (more than 30 minutes)	H6
Self-direction	Planning your own activities; organising your own time	H4
Learning at work	Learning new things, learning-by-doing process, keeping up to date with new products or services	H9
Horizontal interaction	Sharing work-related information; teaching or training people; giving presentations	H3
Client interaction	Dealing directly with people who are not employees	H3
Physical skills	Working physically for a long period	H7
Manual skills	Using hands or fingers for precision work	H7

[48] Administered only in Austria, Chile, Croatia, Czechia, Denmark, England (UK), Estonia, the Flemish Region (BE), France, Hungary, Italy, Latvia, New Zealand, the Netherlands, Poland, Portugal, Slovak Republic, Spain and the United States.

2.2.6 Social and emotional skills

Social and emotional skills encompass a number of factors or traits, with "traits" defined as modes of thinking, emotional activation and behaviour that is relatively stable over time, relating to how individuals perceive themselves and how well they can regulate and manage their thoughts and behaviour. They are considered important factors in achieving goals, working with others and managing emotions.

Also known as non-cognitive or soft skills, they are generally distinguished from cognitive and information processing skills, as they are not usually measured through learning tests or IQ tests. This is not to suggest, however, that manifestation of these skills does not involve cognitive activities (Kankaraš 2017). These skills include personality traits, attitudes, values, self-perceptions, temperament and social skills.

Social and emotional skills are recognised as an essential component of a person's human capital and are increasingly integrated into national and international frameworks that set targets for skill development. They have been shown to affect employability and job performance, health and longevity, happiness, interpersonal relationships and active citizenship. Furthermore, there are also examples where these social and emotional skills facilitated learning processes at school and contributed to academic performance.

The PIAAC Cycle 2 questionnaire includes a section with a self-assessment of social and emotional skills, based on the Big Five Inventory model (Soto and John 2017), and a question on patience, an essential quality for learning as it reflects the disposition to invest in the future. The Big Five model – assessing extraversion, agreeableness, conscientiousness, emotional stability and openness to experience – is the most comprehensive and validated framework for understanding social and emotional skills, with five main dimensions, each of which can be broken down into more specific traits, covering many aspects of non-cognitive skills and personal attributes relevant to success in the labour market and social life.

Table A.2.9 **Information collected on social and emotional skills**

Constructs	Domains	Facects	BQ section
Big Five	Open-mindedness	Intellectual curiosity, aesthetic sensitivity, creative imagination	K
	Conscientiousness	Productiveness, responsibility, organisation	
	Extraversion	Energy level, sociability, assertiveness	
	Agreeableness	Respectfulness, trust, compassion	
	Emotional stability	Anxiety, emotional volatility, depression	
Patience	Willingness to give up something now to benefit from more in the future		I4

Note: the social and emotional skills form was optional. Three countries (Korea, Japan and the United States) decided not to administer the Big Five Inventory. Austria, Denmark, England (UK), Finland, the Flemish Region (BE), France, Hungary, Ireland, Israel, Latvia, Lithuania, the Netherlands, Poland, Singapore, Sweden and Switzerland used an abbreviated version (the BFI-2XS version (15 items in total)), which measures only the five main domains, without assessing specific individual traits. Canada, Chile, Croatia, Estonia, Germany, Italy, Norway, New Zealand, Portugal, Czechia, Slovak Republic and Spain used the extended version (the BFI-2S version (30 items in total), which measures also specific individual traits.

2.3 Cognitive assessment

As already noted, the cognitive assessments were carried by each respondent directly by themselves on the tablet provided by the interviewer; the role of the latter, in this phase, is merely to observe and supervise the process, keeping interaction with the respondent to a minimum. Indeed, the software installed on the tablet to manage the overall data collection activity was developed to guide the respondent through the various sections of the assessments, without any intervention by the interviewer required. Upon completion of the self-administered assessments, a message appears on the tablet telling the respondent when to return the tablet to the interviewer.

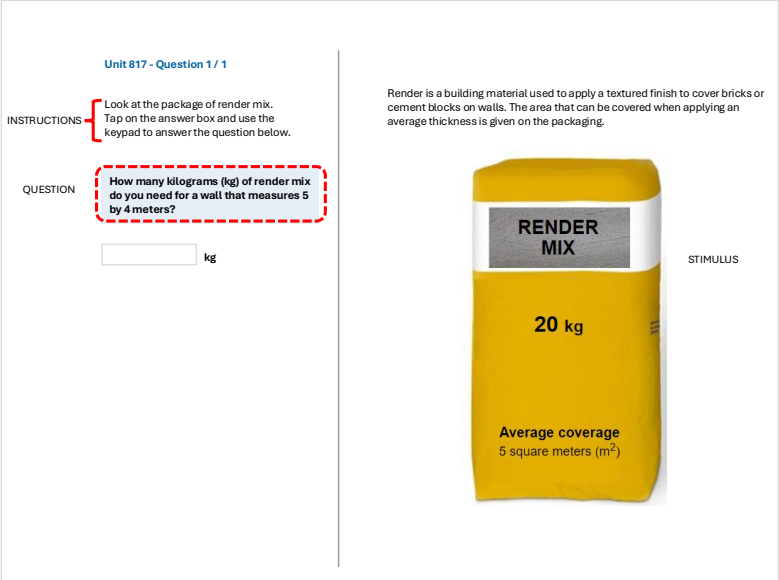
The assessment components consist of four sections. The first section is the Tablet Tutorial, in which a series of tutorial videos demonstrate some basic functions required to perform the assessment: tapping, dragging, highlighting images, and highlighting text, using both the digital pen and a finger. The Tutorial also presents a series of screens with general instructions on the assessments and the layout of the screen in which they are to be performed. This section illustrates and guides the respondent on the various formats of response options provided by the survey and the navigation options available using the tablet. During the Tutorial, the respondent can practise responding to the various questions (e.g. by selecting one or more options, tapping a sentence and entering a numerical response).

The next section is the Locator, where eight literacy and numeracy assessments are administered to the respondent at random. Based on the responses provided, the Locator will determine the Assessment flow and administration type, as illustrated in the survey flowchart (Figure A.2.1).

The respondent may be directed to perform the components. This section involves administration of both

the reading components – which measure basic reading skills, such as comprehension of sentences and short texts – and the numeracy components – which measure basic numeracy skills. These simple questions take little time, estimated to last just under ten minutes.
In the final section of the assessments (Assessment), a combination of literacy, numeracy and APS assessments are administered to the respondent at random.
The assessments, defined in terms of the required cognitive processes, content and context in Section 1 of this Appendix, are organised as sets of questions associated with a specific graphic stimulus presented in the format illustrated in Figure A.2.3.
To the left of the image, a section on "instructions" is available at all time, with suggestions on how to carry out the assessment; the respondent is asked to read the information on the right in the graphic part (stimulus) and then respond to the question below, while also specifying, depending on the item proposed, how the answer should be given (option selection, text selection, or typing the response using a numeric keypad).

Figure A.2.3 Example of the structure of an assessment



The example shown in figure A.2.3 is a numeracy item called "Render Mix". In the stimulus, respondents are told that render is a building material used to apply a textured finish to cover brick or cement walls. A picture of a bag of mix is also displayed, with information on the label regarding the mass (20 kg) and the average area that the bag of mix can cover (5 m^2), if applied to an average thickness.
For this assessment, respondents must determine, as stated in the question, how many kilograms of render mix are needed to cover a wall that measures 5 x 4 metres. This problem can be solved using proportional reasoning based on the surface area of the wall to be covered and the coverage information on the label. In other words, since the wall to be covered measures 5 x 4 metres, i.e. 20 m^2, and the label states that 20 kg of mix will cover 5 m^2, how many kilograms will cover 20 m^2? Since the area of the wall to be covered is four times larger than the area that a bag of mix can cover, the quantity of mix needed will also be four times larger, so the correct response to enter in the appropriate section is 80 (kg).
Tablet-based assessment makes use of adaptive algorithms to optimise item administration. Such algorithms use information from the questionnaire (such as age and education level), as well as information from responses to previous items, to estimate respondents' skill and assign subsequent items that are neither too easy nor too difficult.
As indicated above, the items are administered at random in two domains of analysis (either literacy or numeracy or APS). Following completion of the assessments in one domain, the respondent is randomly assigned a second domain.
The APS assessments are arranged according to a balanced block model, in which items are divided into five clusters/groups. Respondents who must solve the APS items are presented with 2 groups of items, selected at random. A hybrid multi-stage adaptive/linear model is adopted for literacy and numeracy. The adaptive component of the model is based on 6 different groups of assessments to be administered in Phase 2 (where Phase 1 refers to the Locator), with 3 low-difficulty groups and 3 high-difficulty groups. Phase 2

group assignment is based on the results of the Locator and the personal characteristics collected in the Background Questionnaire. Phase 3 also includes six groups: 2 low difficulty, 2 medium difficulty and 2 high difficulty. Assignment to groups in Phase 3 is determined by the results obtained in Phase 2. Finally, a linear component is introduced to ensure that each assessment is submitted to a sufficient number of respondents from across a wide range of skill proficiencies. The linear component of the evaluation comprises 6 groups of assessments in Phase 2 and 6 groups in Phase 3.

The overall DA therefore includes a variable number of items pertaining to the various skill domains, resulting in each individual respondent being administered between 31 and 35 questions in the assessment session. Assessments must be carried out in a single session and cannot be paused to be resumed later.

The adaptive testing process involves assessments being displayed on the tablet screen, with the responses submitted by respondents being automatically (immediately) coded as correct or incorrect, without the need for "human" activity and without involving coders tasked with interpreting the answers. Automatic coding is essential because the adaptive system is based on cumulative task performance. At various points in the assessment, the system decides, based on decision rules stored in the program, which further assessments (at higher or lower levels of difficulty) are to be presented to the respondent, selecting from a group of predefined assessments. The main advantage of the adaptive system is that each respondent's skill level can be best assessed using a relatively small number of assessments compared to traditional surveys in which respondents must answer all questions in the assessment, from the easiest to the most difficult. As such, the adaptive system allows for a more accurate and detailed assessment of the respondents' proficiency level, while simultaneously reducing the quantity of responses and chances of respondents being presented with many tasks above their proficiency level, which can cause frustration.

The use of computer-based assessments makes also it possible to interpret the cognitive process engaged in by the respondent during the assessment in more detail, thanks to memorisation of the path taken: which pages were visited, which navigation tools were used, the sequence of actions and time spent on each item before arriving at the response. As such, the data collected through computer-based assessments serve as an important basis for research by introducing a quality control system into the assessment process underlying the cognitive tests.

Appendix 3 – Sampling Strategy for the Survey of Adult Skills in Italy

The OECD, in collaboration with the consortium overseeing implementation of the Survey at an international level, prepared a document called *PIAAC Technical Standards and Guidelines* at the start of the second cycle of the programme, containing guidelines and standards to be followed for the implementation of the Survey in the country. The document therefore contains all the information and rules to be followed in order to obtain a high level of quality in the statistical data produced by the survey, including with a view to maximising the international comparability of the results obtained. Among other things, the document describes the essential elements for defining and implementing the sampling strategy. These elements stipulate that all countries participating in the Survey must adopt a probability sampling design with a sample size determined in advance[49] and establish target response rates.
In Italy, the sample design implemented, which meets the methodological requirements set by the OECD, envisaged 4,500 completed interviews, assuming a 50% response rate. A two-stage sample design was selected with stratification of both primary stage units (Italian municipalities) and final stage units (individuals aged 16-65 residing in the municipalities selected in the first stage).
The sample design for selecting individuals from the reference population is structured as follows:

- Selection of Primary Stage Units (PSUs) from a pool of approximately 7,900 Italian municipalities;
- Selection of Final Stage Units (FSUs), i.e. individuals residing in Italy aged between 16 and 65 inclusive.

The decision to also stratify the second-stage units was mainly driven by the introduction of two oversamples: the first consisting of young people aged 16–29, and the second of Italian residents with foreign citizenship. Including over-sampling, the total sample size was set at 7,500 completed interviews.

3.1 Reference population and sampling frame

The reference population of the PIAAC survey, i.e. the set of statistical units to be investigated, comprises individuals residing in Italy aged 16-65 on the reference date set at 1 January 2023, regardless of citizenship, nationality or language spoken. Excluded from the reference population are individuals permanently residing in institutions and communal settings (prisons, hospitals, nursing homes, colleges/boarding schools, monasteries and barracks). The target population also includes people on holiday or travelling and students sharing private accommodation.
The reference population in 2022 amounted to just over 37.4 million individuals.

3.1.1 Sampling frame for PSU selection

For the PSU selection, the demographic information published by ISTAT for each Italian municipality was used, containing all the information useful for defining the primary-stage sample. These lists provide information on the number of people residing in each municipality, including in the case of sub-populations, such as the population aged 16-65 or the population aged 16-29, broken down by age, gender and citizenship.
The archive used for stratification and selection of PSUs was constructed based on the above information.

3.1.2 Sampling frame for FSU selection

The selection of the sample of individuals (FSUs) was based on the Municipal Population Registers (Liste Anagrafiche Comunali, LAC), namely the centralised and computerised database of municipal registries available to ISTAT. LACs contain the main registry and personal information of individuals residing in each Italian municipality, including gender, date and place of birth, citizenship and address.
Access to this archive made it possible to directly select the sample of individuals to include in the survey. It should be noted that LACs are periodically updated based on births, deaths and migration events, thus ensuring an excellent level of population coverage.

[49] At an international level, the required sample size was defined primarily based on psychometric considerations, i.e. taking into account the need for adequate sample sizes that could allow for stable characterisation of the assessment items and estimation of separate population models (among the individual countries) to obtain appropriate skill values to be used to describe the distribution of skills in a country.
Minimum sample size has been set at a range of between 4,000 and 5,000 completed cases per reference language. Accurate definition of the sample size also takes account of the design type adopted by the country (number of stages of sampling, presence and volume of Primary Sample Units – PSUs), as well as issues related to the cost of carrying out the field stage, with the aim of finding the best balance between sampling efficiency and cost.

3.2 Sample size

As anticipated, minimum sample sizes are defined in the PIAAC document *Technical Standards and Guidelines*. The minimum actual sample size (i.e. the number of individuals completing at least the BQ or responding to the Doorstep Interview) was set at 4,000 in the case of single-stage sample designs drawn from registers with equal probability of selection. In the case of two-stage sample designs, meanwhile, the minimum sample size was set at 4,500, while for countries with sample designs with 3 or more selection stages, a sample size of at least 5,000 completed interviews was required.
As Italy adopted a two-stage sample design, the sample size was set at 4,500 completed interviews. However, given the need to produce more reliable estimates for both the youth and the foreign subpopulations, the initial sample size of 4,500 individuals (defined as the core sample) was increased to 7,500 by adding an oversample of 1,500 individuals aged 16-29 and an oversample of 1,500 regular foreign residents. The number of PSUs to be included, on the other hand, was set at 225 municipalities.
Obviously, in order to reach the number of complete interviews set in advance, the actual sample size of 7,500 cases must be increased, taking into account the expected response rate and eligibility rate on the one hand, and the design effect (DEFF) on the other, given the deviation from a simple random sample design of equal numerosity that adopts a Hortvitz-Thompson (HT) estimator (Kish 1965). In other words, it is necessary to estimate the expected response rate, eligibility rate and DEFF on the basis of which the raw (or planned) sample size is determined – namely, the number of individuals to be drawn from the LACs and invited to participate in the survey, with the aim of achieving 7,500 completed interviews.
Information from the first cycle of the PIAAC, the Field Trial (pilot survey) of the second cycle of the PIAAC and the European Social Survey (ESS) conducted for Italy by INAPP were used to estimate the response, eligibility and DEFF rates.
The response rate set for the BQ was 50%, while the assessment response rate was set at 97% and the eligibility rate at 97%.
A model based on the product of two factors, clustering and weighting, was adopted to calculate the DEFF. The design effect due to clustering depends on the intraclass correlation coefficient between individuals within PSUs and the expected average number of responding individuals per PSU. The design effect due to clustering was set at 1.29 with an intraclass correlation coefficient of 0.015 and an expected average number of respondents per PSU of 20. As DEFF values of less than 1.5 do not require an increase in planned sample size under OECD guidelines and technical standards, the DEFF value was not taken into account in the overall calculation of the raw sample size; as such, the overall effect of sample design was estimated at 1.29.
On the basis of the parameters described above, a planned sample size of 9,593 individuals (subsequently rounded up to 10,000) was determined for the core sample and a sample size of 3,300 units for each oversample, thus arriving at a total sample (also called overall sample) of 16,600 names.
To account for the possibility that the response rate during the fieldwork phase might be substantially lower than the target rate, a reserve sample was selected at the same time as the base sample, with a size equal to 50% of the planned sample.

3.2.1 Sample allocation in the strata

With a view to minimising the sampling variability of the estimates, geographical stratification based on geographical areas (North-West, North-East, Centre, South, Islands) and on the size class of the municipalities with reference to the population aged 16-65 (up to 2,000 inhabitants, 2,001 to 10,000 inhabitants, 10,001 to 50,000 inhabitants, more than 50,000 inhabitants) was used in the first sampling stage.
Stratification was also envisaged for the second sampling stage, mainly due to the need to adequately manage the two oversamplings. In this case, the stratification variables used were age group (aged 16-29, 30-49, 50-65) and citizenship (Italian, foreign). Second-stage stratification was carried out within each PSU.
The 225 PSUs were allocated to the first-stage strata in proportion to the size of the municipality in terms of its population aged 16-65 (Table A.3.1). At the same time, the total sample size was allocated to each PSU by means of proportional allocation criterion across the population and then subdivided, within each PSU, with respect to age groups and citizenship, again using a proportionality criterion. Table A.3.2 shows the population and sample volumes according to the variables used in the second-stage stratification[50].
Table A.3.2 shows that the allocation of final units in the sample involves oversampling the 16-29 age group and foreign citizens compared to the proportional allocation. This is necessary in order to have a sufficient

[50] For reasons of space, the allocation of the sample of individuals in the second-stage strata is not reported since, as mentioned, this allocation was made within each PSU.

number of respondents, given that the expected response rate for these classes is lower than the average for the reference population.

Table A.3.1 First sampling stage: allocation of municipalities in strata

Municipality Type[51]	Geographical area of the municipality	Municipality size (aged 16-65)	Population aged 16-65	Number of municipalities	Number of sample municipalities (PSUs)
Non-Self-Representative	North - West	Up to 2,000 inhabitants	1,411,121	2,002	9
		2,001 - 10,000 inhabitants	3,497,631	837	23
		10,001 - 50,000 inhabitants	2,737,467	145	18
		More than 50,000 inhabitants	557,411	8	4
	North-East	Up to 2,000 inhabitants	606,566	614	4
		2,001 - 10,000 inhabitants	2,971,198	646	20
		10,001 - 50,000 inhabitants	1,760,155	109	12
		More than 50,000 inhabitants	1,401,983	16	9
	Centre	Up to 2,000 inhabitants	422,805	484	3
		2,001 - 10,000 inhabitants	1,634,991	349	11
		10,001 - 50,000 inhabitants	2,372,276	121	16
		More than 50,000 inhabitants	987,062	14	7
	South	Up to 2,000 inhabitants	861,382	1,040	6
		2,001 - 10,000 inhabitants	2,478,897	553	17
		10,001 - 50,000 inhabitants	3,581,996	175	24
		More than 50,000 inhabitants	951,403	13	6
	Islands	Up to 2,000 inhabitants	386,601	439	3
		2,001 - 10,000 inhabitants	1,105,164	246	7
		10,001 - 50,000 inhabitants	1,554,206	75	10
		More than 50,000 inhabitants	294,216	4	3
Self-Representative			5,828,842	13	13
Total			**37,403,373**	**7,903**	**225**

Source: elaborations on ISTAT data – Municipal resident population, 2022

[51] For a definition of Self-Representative and Non-Self-Representative, see the section below.

Table A.3.2 **Second sampling stage: distribution of the population aged 16-65 and of the sample by age group and citizenship**

Age group	Citizenship	Population aged 16-65	Sample aged 16-65
Aged 16-29	Italian	7,298,677	2,326
	Foreigner	928,812	3,955
Aged 30-49	Italian	12,883,548	3,455
	Foreigner	2,109,373	2,320
Aged 50-65	Italian	13,249,472	3,540
	Foreigner	933,491	1,004
Total		**37,403,373**	**16,600**

Source: elaborations on ISTAT data – Municipal resident population, 2022

3.3 Sample design

Some clarifications should be made before describing the sampling plan adopted. The chosen sample design provides for the largest municipalities – i.e. municipalities for which the inclusion probability value equals or exceeds 1, defined as self-representative (SR) municipalities – to be included in the sample with certainty. The remaining municipalities, defined as non-self-representative (NSR) municipalities, are divided into strata, with a sample of municipalities to be selected from each.
More specifically, a so-called complex, two-stage sample design is applied, with stratification of both primary units (municipalities) and secondary units (individuals). The selection of NSR municipalities within the strata occurs with probability proportional to their size in terms of the resident population aged 16-65.
The probabilistic unit selection system is as follows:

- each SR municipality constitutes a separate stratum while the NSR municipalities are divided into strata proportionally;
- for each stratum of the NSR municipalities, a number of sample municipalities are selected by means of a selection scheme without replacement and probability proportional to size (PPS) of the municipality in terms of the resident population aged 16-65 years;
- within each municipality selected at the first stage and for the SR municipalities, a sample of individuals is selected randomly and without replacement on the basis of the allocation scheme taking into account age group and citizenship.

Owing to the probabilistic selection scheme described above, each individual has a known inclusion probability, which is used to define the sampling weights and to construct the direct estimator.
The sample design adopted has a general structure similar to those used in the major large-scale household and individual surveys conducted by leading statistical information agencies at a national and international level.

3.3.1 Inclusion probability

The process for calculating the inclusion probability assigned to each individual is set out below; it is the product of the inclusion probability of PSUs and the inclusion probability of FSUs.

Inclusion probability for the first sampling stage (P_{psu})
The inclusion probability of municipality i in stratum h (defined by the cross-classification of geographical area and municipality size classes) is defined as follows:

$$P_{psu} = P_{hi} = m_h \frac{MOS_{hi}}{MOS_h}$$

where*:*
MOS_h is the number of individuals aged between 16 and 65 years residing in stratum h and represents the Measure Of Size of the stratum;
MOS_{hi} is the size of municipality $\boldsymbol{i}$ defined in terms of number of individuals residing in the municipality aged between 16 and 65 h and represents the Measure Of Size of the first stage unit.
When the inclusion probability at the first sampling stage is greater than 1, this probability is reset to 1 and the municipality is included in the sample with certainty and assigned the role of a SR municipality. An

iterative procedure allows for the recalculation of the probability for the remaining NSR municipalities.

Inclusion probability for the final units (individuals) (P_{fsu})
As noted previously, due to the decision to perform oversampling in the case of the younger and foreign populations, calculation of the FSU inclusion probability deviates from the standard formulae provided by the OECD, as stratification of second-stage units is required. Stratification within each PSU results in six sample strata (Italian citizens in three age groups and foreign citizens in three age groups).
The conditional inclusion probability of the individual ℓ in the second-stage stratum k (defined by the cross-classification of citizenship and age group) is:

$$P_{fsu|hi} = P_{k\ell|hi} = \frac{r_{k|hi}}{P_{hi}}$$

$$\text{dove } r_{k|hi} = \frac{n_{k|hi}}{N_{k|hi}}$$

$n_{k|hi}$ is the total number of individuals to be selected in stratum k
$N_{k|hi}$ is the total number of eligible individuals in stratum k

The overall inclusion probability, as mentioned, for each individual is calculated as the product of P_{psu} and $P_{fsu|hi}$.

3.4 Fieldwork phase: sample yield

The fieldwork phase of the survey in Italy began in mid-September 2022 and ended in early July 2023, following significant training of the staff to be involved in the survey, and intensive testing of the IT equipment to be used.
Implementation of the fieldwork was entrusted to a specialised external company.
At the start of the fieldwork phase, processing began on all names selected for the overall sample, i.e. 16,471[52] in total.
Each name was contacted directly, in the first instance, at their residential address (provided in the sampling list). Prior to the preliminary contact, an invitation letter to participate in the survey was sent, signed by the President of INAPP, which also included information on the processing of personal data and an illustrative brochure.
The preliminary contact and interview phases were managed by the interviewers using software specifically provided by the International Consortium: the PIAAC Delivery System (PDS).
Each name on the sampling list was contacted a minimum of six times prior to a final outcome being assigned. Attempts to contact a specific name were made on different days of the week throughout the collection period and at different times of the day, avoiding contact on consecutive days.
Despite constant and intensive monitoring of the data collection phase, as well as many actions introduced to increase the sample yield (including incentives for the respondent and interviewer), an extension of the data collection period and use of a portion of reserve names[53], the set target of 7,500 completed interviews could not be reached.
The table below shows the distribution of names with respect to the final outcome.

[52] The number of names selected (16,471) deviates slightly from the number of names to be selected (16,600) due to incomplete coverage of second-stage strata in some small municipalities.
[53] At the end of March 2023, processing began on a further 2,689 cases.

Table A.3.3 **Distribution of final contact outcomes for all cases processed during the fieldwork phase**

Final outcome	Number of cases
01 - Completed	4,815
03 - Interview definitively interrupted	2
04 - Refusal by respondent	4,719
05- Refusal by another person	506
07- Language barrier	181
08 - Reading and writing difficulty	7
09 - Learning difficulties / mental incapacity	37
12 - Hearing impairment / deafness	1
13 - Visual impairment / blindness	1
14 - Speech impairment	5
15- Physical disability	1
16 - Other disabilities	23
17- Other (unspecified)	95
18 - Death	16
20 - Untraceable person	2,517
21 - Maximum number of contacts	4,523
22 - Invalid address	570
23 - Moved within the country	452
24 - Temporarily absent / Not available during the fieldwork phase	360
25- Not in target population	329
27 - Duplicated case	0
90 - Technical problems	0
Total	**19,160**

Source: INAPP analyses of data collected in Italy during the fieldwork phase of the PIAAC survey, Cycle 2

It should be noted that 32 Doorstep Interviews were carried out during the fieldwork phase, some of which involved definitive outcomes (language barriers).
A total of 4,847 interviews were therefore conducted and subsequently assigned proficiency values.
Among the cases closed without an interview, the most frequent reasons – each accounting for almost the same proportion and together representing just over 50% of all cases – were refusal to participate and the maximum number of contact attempts reached.
The main reasons why sampled individuals refused to participate in the survey were lack of interest and lack of time (the latter also related to the length of the interview).
Almost all individuals who responded to the BQ also took the self-administered assessments.
Feedback from interviewers regarding the fieldwork revealed a particularly difficult and unexpected situation. The interviewers found it more difficult to locate the selected individuals than in the Pilot phase carried out in 2021, and reported a general lower willingness to cooperate.

3.5 Estimation Phase[54]

The estimation phase is a particularly delicate and important point in the entire cognitive process based on inferential procedures. The principle underlying sample estimation methods is that the sample units also represent the population units not included in the sample. This principle is realised by giving each sample unit a weight indicating the number of population units represented by that unit. At this stage, any distortion factors resulting from under-coverage of the sample selection list in relation to the reference population and non-response totals can be corrected. Some estimation techniques are also particularly useful in ensuring

[54] The estimation phase for the PIAAC Survey, Cycle 2 was managed by the Consortium which, on behalf of the OECD, oversaw implementation of the survey at an international level. All information required for construction of the weights was provided to the Consortium by the national teams.

high estimation efficiency and, ultimately, an accurate representation of the phenomena of interest.
More specifically – as the selection and application of certain estimation procedures must be performed with the aim of generating sample weights such that the weighted sample estimates represent the population of interest as accurately as possible – calculation of sample weights for a large-scale survey must aim to:

- control for non-coverage of certain sub-populations in the sample due to imperfections in the selection starting lists or for other reasons;
- minimise the distorting effects resulting from differences between respondents and non-respondents and thus from self-selection phenomena;
- obtain unbiased estimates of the parameters of interest by correcting estimates for population sub-groups for which sampling is not proportional to population size;
- relate sample totals to the population size of interest;
- reduce the sampling errors of estimates based on known population totals of auxiliary variables related to structural characteristics of the population of interest that are known with a high level of accuracy;
- allow the estimation of sample variances using replication methods.

In the case of the PIAAC Survey, Cycle 2, the procedure for constructing the final weights involves constructing weights at an individual level that represent the inverse of the probability of selection of that individual, adjusted based on non-response to the BQ or Doorstep Interview.
The following is a summary of the operational steps taken to construct the final weights.

3.5.1 Base weight

The base weight is defined as the inverse of the inclusion probability of individuals (see section on inclusion probability).

3.5.2 Unknown eligibility adjustment factor

Before proceeding to calculate the adjustment factors of the base weights for total non-response, if the eligibility status of some individuals is not known (e.g. the person was not traced), an adjustment factor for unknown eligibility should be constructed, defined as the (estimated) probability of being an eligible person. An adjustment factor is calculated based on the proportion of eligible individuals among the respondents, defining an estimate of the probability of being eligible. This factor, which essentially assigns a fraction of the weights of individuals with unknown eligibility status to ineligible individuals, is intended to reduce the weight of cases with unknown eligibility status (taking into account an estimated proportion of ineligible individuals). Individuals with unknown eligibility status for whom the weight is reduced are treated as eligible non-responders. This adjustment is carried out within specially defined adjustment cells.

3.5.3 Non-response adjustment factor

In the non-response adjustment phase, non-respondents are divided into two categories. The first includes cases of non-literacy-related non-response, i.e. individuals who did not participate in the survey due to issues unrelated to language or speech difficulties. Non-literacy-related non-respondents are likely to be more similar to respondents in terms of proficiency scores. The second category concerns literacy-related non-responses, i.e. individuals who did not participate in the survey due to language barriers, reading and writing difficulties, learning disabilities and mental disabilities. Individuals in this non-response category are assumed to differ from non-responders with respect to their proficiency level.
For this reason, the estimation procedure adjusts respondent weights to reflect cases of non-literacy-related non-response.
Adjustments to respondent weights based on non-response are intended to distribute the base weights of non-literacy non-respondents across the weights of respondents. This sampling strategy aims to reduce potential non-response bias that may arise when non-response depends on the phenomena being studied (i.e., in this case, on individuals' proficiency performance) (Little and Rubin 2002). The adjustment factor is calculated as the inverse of each individual's response probability. This unknown probability can be estimated using the sample data. For this purpose, non-response adjustment (or correction) cells are constructed, determined by means of tree classification algorithms that relate the response indicator variable to structural characteristics of individuals that are known as respondents and non-respondents. The sample of both respondents and non-respondents in a given cell (defined according to a socio-demographic profile) makes it possible to estimate the response probability. The adjustment process assumes that the estimated response probability within each cell is homogeneous for all individuals in the relevant sample, and that the response probabilities for individuals in different cells are heterogeneous.
When defining the non-response adjustment cells, the number of cases in each cell was taken into account,

avoiding cells with a small number of cases in order to have efficient estimates of the response probability. The information used to define the adjustment cells in the non-response adjustment phase, selected as a result of the tree classification analysis, is:

- geographical variables (region of residence and population size of municipalities);
- gender;
- age;
- citizenship;
- country of birth;
- share of people with low educational attainment at the geographical macro-area level;
- share of people with high educational attainment at the geographical macro-area level;
- number of employed adults at a geographical macro-area level;
- number of unemployed adults at a geographical macro-area level;
- number of employees at a geographical macro-area level.

The classification tree therefore identifies socio-demographic profiles in which to estimate response probabilities and calculate adjustment factors as the inverse of these probabilities.

3.5.4 Calibration

The next step involves construction of calibrated weights using known totals, obtained from sources outside the survey, for a set of structural characteristics of the target population.
The calibration procedure makes it possible to:

- reduce the impact on the estimates of any under-coverage of the selection lists;
- reduce the sampling error;
- ensure that the estimates produced by the survey are consistent with those obtained by other surveys of the same type.

For the PIAAC Survey, Cycle 2, a generalised regression estimator was adopted (Särndal *et al.* 1992) representing a specific subclass of calibrated estimators.
The known totals used for the PIAAC Survey, Cycle 2 were taken from the Labour Force Survey carried out by ISTAT in 2022 and are defined on the basis of the geographic variables of individuals' place of residence and socio-demographic variables according to Table A.3.1.

Table A.3.1 **Variables used for the construction of the calibrated estimator totals**

Description	Method
Geographical area	North-West North-East Centre South Islands
Municipality size (population aged 16-65)	Up to 2,000 inhabitants 2,001 - 10,000 inhabitants 10,001 - 50,000 inhabitants 50,001 inhabitants or more
Gender	Man Woman
Age group (1)	Aged 16-19 Aged 20-24 Aged 25-29 Aged 30-34 Aged 35-39 Aged 40-44 Aged 45-49 Aged 50-54 Aged 55-59 Aged 60-65
Age group (2)	Aged 16-29 Aged 30-49 Aged 50-65
Citizenship	Italian Foreigner
Country of birth	Italy Other country
Employment status	Employed Unemployed
Unemployment status	Seeking employment Other
Type of work	Employee Other
Educational attainment	Lower secondary or below Upper secondary Tertiary education
Low educational attainment	Lower secondary or below Other
High educational attainment	Tertiary education Other

The subpopulations for which the number of individuals is known (or estimated from the Labour Force Survey) are defined based on these variables (Table A.3.2).

Table A.3.2 **Nesting for the calibration procedure**

			No. of constraints*
Gender	Age group (1)		20
Geographical area	Gender	Age group (2)	30
Municipality size	Gender	Age group (2)	24
Geographical area	Citizenship		10
Geographical area	Country of birth		10
Geographical area	Employment status		10
Geographical area	Unemployment status		10
Geographical area	Low educational attainment		10
Geographical area	High educational attainment		10
Gender	Educational attainment		9
Geographical area	Unemployment status		10
Geographical area	Type of work		10

* Redundant constraints are removed from the calibration procedure.

The resulting weights ensure that the sample produces estimates of the counts for each subpopulation considered in the calibration that coincide with the corresponding totals.

3.5.5 Weight trimming

The weights obtained as a result of non-response adjustment and calibration undergo a process of "trimming" in order to reduce the variability of the sample weights and reduce the variability of the estimates of the parameter of interest. Trimming introduces an element of bias into the estimates (Lee 1995) and, as such, a balance must be struck between reducing variability and increasing bias, summarised by the overall mean squared error.

To define the cut-off point of the calibrated weight, the coefficient of variation (CV) of the weights is examined and the cut-off is calculated to obtain a minimum number of "cut-off" weights. During the trimming phase, cells are constructed and, in accordance with international-level guidelines, weights that are greater than the value calculated within each trimming cell are cut off.

In Italy, the variables used in the trimming procedure (by which the cells are defined) are citizenship and age group of individuals. The defined trimming cells are: Italians aged 16-29, foreigners aged 16-29, Italians aged 30-49, foreigners aged 30-39, foreigners aged 50-65.

Following the trimming procedure, the weights no longer satisfy the consistency property of the estimates in relation to the known totals defined for the calibration sub-populations; as such, the weights are then subject to a second calibration step on the known totals already defined. This yields the final weights calibrated to the population.

The table below presents the main descriptive statistics for each weighting step with reference to the cases examined and the weights generated.

Table A.3.4 **Descriptive statistics on the cases and weights of the entire sample for the weighting steps**

Descriptive statistics	Base weight[a]	Weight adjusted for unknown eligibility[a]	Weight adjusted for non-literacy-related non-response[b]	Weight adjusted for literacy-related non-response[c]	Calibrated weight	Trimmed weight[d]	Calibrated final weight[d] (SPFWT0)
Number of cases without missing or null values in the weights	18,815	18,815	4,797	50	4,847	4,847	4,847
Sum of weights	37,229,875	37,174,749	36,960,248	214,501	37,403,373	37,388,634	37,403,373
Average of weights	1,979	1,976	7,705	4,290	7,717	7,714	7,717
Weight with minimum value	158	138	217	1283	94	94	90
Weight with maximum value	3,902	3,902	26,250	30,603	60,001	46,745	49,070
CV(weight)*	0.71	0.71	0.81	1.05	0.87	0.87	0.87
	1.50	1.50	1.65	2.10	1.76	1.75	1.75

[a] Includes all persons in the sample who are eligible.
[b] Includes respondents who did not take the skills assessment, but answered the BQ, for reasons not related to language or speech difficulties.
[c] Only includes literacy-related non-respondents.
[d] Includes respondents described in footnotes b and c.
* Coefficient of variation (CV): ratio of standard deviation to mean.
Source: INAPP analyses of data used in Italy for the estimation phase of the PIAAC survey, Cycle 2

The following table shows the sample numbers for the PIAAC Survey, Cycle 2, as well as the estimates produced following application of the final weight[55] for the main variables used in the calibration procedure.

[55] By construction, the estimates correspond to those produced by the Labour Force Survey, ISTAT (2022).

Table A.3.5 **Distribution of the sample and population with respect to the main characteristics used in the estimation phase**

Characteristics		Frequency	Weighted frequency	%
Gender	Men	2,347	18,651,997	49.9
	Women	2,500	18,751,376	50.1
Age group	Aged 16-29	2,011	8,195,940	21.9
	Aged 30-49	1,505	14,979,079	40.0
	Aged 50-65	1,331	14,228,354	38.0
Geographical area	North-West	1,246	9,962,622	26.6
	North-East	1,388	7,293,599	19.5
	Centre	911	7,389,750	19.8
	South	925	8,686,733	23.2
	Islands	377	4,070,669	10.9
Educational attainment	Lower secondary or below	1,865	14,437,063	38.6
	Upper secondary education	2,148	16,136,451	43.1
	Tertiary education	834	6,829,859	18.3
Citizenship	Italian	2,890	33,581,976	89.8
	Foreigner	1,957	3,821,397	10.2
Country of birth	Italian	3,043	32,331,366	86.4
	Other	1,804	5,072,007	13.6
Employment status	Employed	2,819	22,568,627	60.3
	Seeking employment	278	2,016,912	5.4
	Inactive	1,750	12,817,834	34.3
Total		**4,847**	**37,403,373**	**100.0**

Source: elaborations of PIAAC data, Cycle 2

3.6 Variance estimation

The sampling strategy adopted for the PIAAC Survey, Cycle 2, as illustrated in the previous paragraphs, involves a two-stage selection sample design, with stratification of first- and second-stage units, selection of units without replacement and variable probabilities in the first stage, an estimator calibrated on weights controlled for eligibility, total non-response and in some cases a trimming process. This so-called complex sampling strategy does not allow for the adoption of standard procedures for estimating sampling variance and performing statistical hypothesis testing. The impossibility of using standard procedures for variance estimation is also due to the use of Item Response Theory (IRT) models for estimating proficiency (Birnbaum 1968; Lord 1980).

Replicate-based methods are used to estimate the sampling variance for the PIAAC survey. These methods account for the variability in the estimates due to the complex sampling design, the use of unequal selection probabilities, weight adjustment factors, and measurement errors arising from the use of IRT models.

Generally speaking, replication methods consist of dividing the complete sample into sub-samples that mirror the design of the complete sample. For each sub-sample, the process of calculating the final weights is replicated. The variance of the estimates obtained from the subsamples for each parameter of interest – whose mean value is obtained from the full-sample estimate – yields, after applying appropriate correction factors, the variance of the estimate for each parameter.

Of the different replication methods proposed in the literature, the International Consortium recommends the Balanced Repeated Replication (BRR) with Fay's adjustment (also known as Fay's method). Unlike other methods, this approach allows for the calculation of unbiased estimates of the sampling variances related to percentile estimation and helps reduce the risk of respondent identification, given the impossibility of identifying clusters by observing a zero in the replication weights (as may occur with other replication approaches).

Given the above, the PIAAC Survey, Cycle 2 in Italy adopts the BRR method with Fay's adjustment by a factor of 0.3 and the creation of 80 replications.

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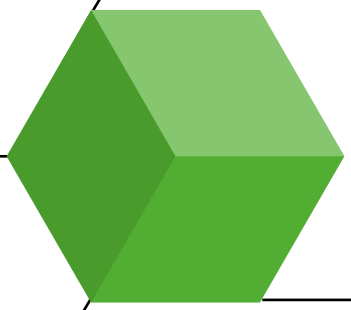
PIAAC National Project Manager

The Survey of Adult Skills, conducted within the framework of the PIAAC Programme (Programme for the International Assessment of Adult Competencies), carried out by the Organisation for Economic Co-operation and Development (OECD), is designed to measure the cognitive skills in literacy, numeracy, and adaptive problem solving of the adult population in many countries around the world, including Italy. These skills, understood as key information-processing skills, play a significant role in many aspects of people's lives. High levels of skills, in addition to bringing advantages in the labour market, enable people to make more informed choices regarding their lifestyle, health care, expenditure and saving behaviours, and engagement in political and social life.
The Report "PIAAC - Cycle 2. Cognitive Skills in Italy in the International Context" presents the main findings from the second cycle of the Survey of Adult Skills, analysing the quantity and dynamics of skills, as well as the socio-demographic characteristics of the population that most frequently determine variability in the set of skills and professional and social outcomes, that result from different investments in human capital.
The Report aims to present the elements required to understand the situation in Italy within the global comparative framework of the countries participating in PIAAC.



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