BRIO Platforma Digitală pentru Îmbunătățirea Performanței Școlare

Report on students' digital literacy level in Romania

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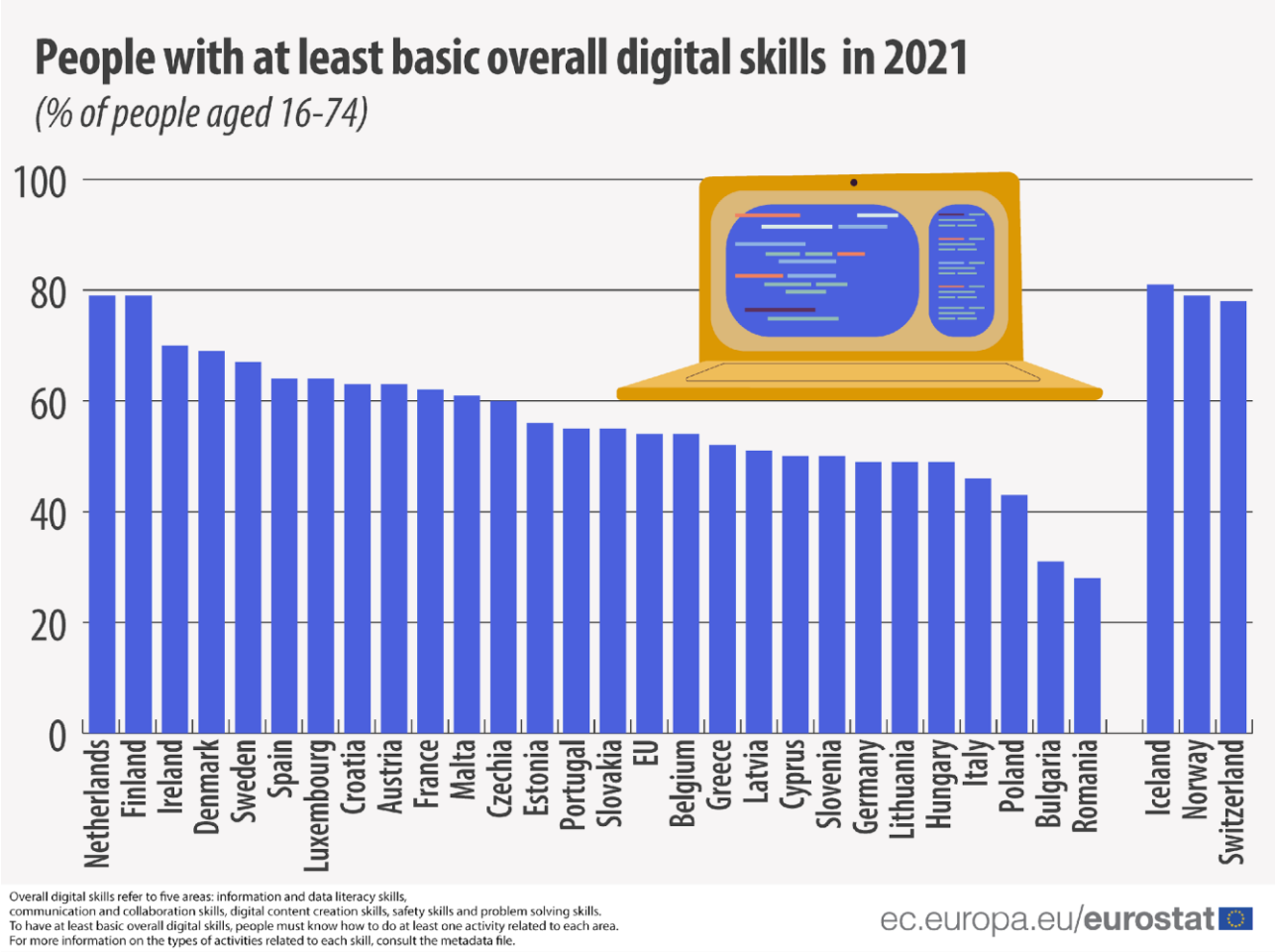
1. Background

Since 2016, core digital literacy skills have formally come to the attention of the European Union and have since been a key component in the economy's development strategy. The importance and role of core digital competences at both European and country level have led to the formulation of EU objectives and strategies to support national development-focused actions and interventions. These objectives are based on statistical data provided by Eurostat every 2 years, which shows the level of digital skills for the 16-74 age groups. The latest data[1] on digital skills places Romania on the last place in the ranking of the 32 countries (Figure 1).

Figure 1. Ranking of digital skills in 2021



[1] Eurostat, 2022, How many citizens had basic digital skills in 2021?

The European Commission has defined the digital skills in relation to certain key performance indicators for development strategy and vision, thus creating the DigComp competence framework (The Digital Competence Framework[2]), now to iteration 2.1, which has found concrete applications in several European Union countries in both evaluation and intervention / development projects.

The DigComp 2.1 competence framework divides the digital skills into 5 categories, each with 3-6 subcategories, measured on an 8-level scale:

- Information and data literacy - refers to the ability to accumulate information and data from the online environment, including establishing the need, searching for information, judging credibility, and storing and organizing information and digital content for later access.
    - Browsing, searching and filtering data, information and digital content
    - Evaluation of data, information and digital content
    - Management of data, information and digital content
- Communication and collaboration - refers to all situations where socialization is transposed into the digital environment, such as joint task solving, community involvement, communication with loved ones and personal identity management in the online environment.
    - Interaction through digital technologies
    - Content distribution through digital technologies
    - Civic involvement through digital technologies
    - Collaboration through digital technologies
    - or Netiquette
    - Digital identity management
- Digital content creation - refers to the ability to create and modify or update digital content, including programming knowledge and understanding of copyright and licenses.
    - Digital content development
    - Integration and re-elaboration of digital content
    - Copyright and licenses
    - Scheduling

[2] Carretero Gomez, S., Vuorikari, R. and Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use. EUR 28558 EN, Publications Office of the European Union, Luxembourg.

- Security - refers to the ability to store information and data from the online environment, including establishing the need, searching for information, judging credibility, and storing and organizing information and digital content for later access.
    - Protection of digital devices
    - Protection of personal data
    - Protection of health and well-being
    - Environmental protection
- Problem solving - refers to the ability to identify needs and problems and to solve conceptual and practical problems in digital environments, respectively the innovation of processes and products, being up to date with digital evolution.
    - Solving technical problems
    - Identifying the needs and appropriate technological solutions
    - Creative use of digital technology
    - Identifying the limits in one's own digital competence

The scores presented to *Figure 1* indicate that 58% of the EU population aged 16 to 74 had at least basic digital skills in 2021, Romania being last with a 28% representation of basic digital skills, followed by Bulgaria (31%) and Poland (43%), while Finland and the Netherlands are in the lead with 79% representation of core digital skills.

In order to correctly establish the resources, strategy and actions necessary for maximizing the digital skills of Romanians, we need a more comprehensive picture of the nation, in many ways. On the one hand, the data transmitted to Eurostat are estimates based on the behaviour of using the digital resources (e.g. internet and infrastructure) and not data derived from the actual *measurement* of these skills. On the other hand, these estimates do not include the 6-16 age group, for which we currently have no estimates and which is especially important for the digitization policies of education. The society's hope regarding the contribution of these age groups to the development of the Romanian economy is significant in the sense that they are part of an active educational system that can directly train a behaviour of use and development of digital skills, in order to build the future digital talents of Romania.

In order to identify the level of digital skills in all age groups and to establish the necessary interventions, we need a high-performance and relevant measurement tool in relation to supplementing the information that Romania lacks.

Brio is a standardized testing system designed in accordance with the most stringent global standards by the specialists in psychometrics. Together with the partners[3] strongly involved in the Romanian education system, Brio launched in October 2021 the digital literacy test, which measures digital literacy skills for students in 1st-12th grades. This report analyses the data obtained after the first 7 months of operation of the digital literacy test in Romania.

[3] UiPath Foundation - Partner digital literacy test Brio; BCR - Implementation Partner digital literacy test Brio.

2. About digital literacy (digital proficiency)

Basic digital skills (in short, “digital literacy” or “digital proficiency”) are the abilities of a person to access, create and transmit information through and through the digital context. Digital literacy does not mean the ability to use a computer, laptop or similar device, this being possible by simply training or reading a technical instruction manual specific to that device.

Digital literacy is a set of skills that allow a person to access and use digital information for the purposes for which it is needed, to operate with the found information in relation to the evaluation and critical thinking, performing all the processes of working with that information in a secure, fair, optimal and productive way.

Digital literacy has significant effects on the education system. Developing and expressing analytical spirit in the sense of locating information in the online environment (for example: sites, platforms) or in digital format (for example: PDF materials, Word), developing and manifesting critical thinking in the sense of evaluating information and arguments, securing the process information in the sense of using reliable and relevant sources of information (for example: resilience to fake news, or trap sites), optimizing working hours and using all the functions provided by technology (for example: creating search filters), the development of general culture in the sense of identifying and mastering models, knowledge applicable in the real world, are just some of the effects of digital literacy in the educational process of each student.
Also, the development of communication and relationship skills, to identify and select the appropriate channels for the exchange of messages and information, the development of skills for building interpersonal relationships, development of creativity, originality and competitive spirit, are part of the set of effects produced by digital literacy.

Digital skills are closely linked to students' school performance both in terms of access to correct and complete information, and in terms of its use in various contexts and in different ways of delivery or transmission.

The development of the educational system and the maximization of school performance presuppose in today's society the existence of digital skills within the actors of the educational system (students, but also teachers and parents). The existence of these skills makes it possible to turn technology investments into tangible results (for example: computer labs) and generates a certain type of resilience of system to the challenges or vulnerabilities brought by a crisis context (for example: the specificity of education in Covid-19 pandemic).

3. Measuring the digital literacy level

The digital literacy (digital proficiency) can be observed, measured and developed through pedagogical interventions - and it should be measured and developed, as the ability to use technology is increasingly important for students. Among other things, to have easy access to information, to socialize, to express their creativity and to achieve performance in various fields, thus constituting an important basis for their future in school, in society and later on the labour market.

Digital literacy is not a set of skills that the student acquires once, and then successfully uses it in the educational process that follows - in this respect it is not similar to the ability to write or read. On the contrary, digital skills can be developed at any time and are best developed in stages and according to the need for applicability they have. Specifically, the period of schooling between the 1st and the 12th grade allows the student to go through all the contexts for the development of the necessary digital skills, successively and connected with life situations, so as to understand and correlate their use with the specific moments of the educational path.

3.1. About Brio system

Brio is the standardized digital testing platform for Romanian students. Through Brio school tests, Romanian students in the 1st-12th grades can objectively assess their knowledge in the main school subjects and can improve their performance during exams.

The Brio platform has been designed by specialists in psychometry, in accordance with the most rigorous global standards, and respects the entire school curriculum from Romania. Brio is an objective and actionable guidance and information tool that supports sustained training and performance, accurately identifying areas where the student still needs to work to be competitive with his or her peers.

3.2. Measurement tool for the digital literacy level – Brio digital literacy test

Brio digital literacy test measures students' skills in interacting with various digital devices and programs in a variety of scenarios: school, home and family, friends and hobbies.

Brio digital literacy test is accessible for free to both students (1^{st} – 12^{th} grades) and teachers, based on an account registered in the Brio platform (www.brio.ro), where the process of generating and administering the test is performed, the active sessions and the completed sessions of the students are managed, their scores and evaluation reports are centralized and the progress of the tested students can be identified and monitored.

Each digital literacy test session has two components of interest to the student, parent and teacher: the obtained score and the test report. The information can be used by students, parents and teachers to understand in detail what knowledge and skills the student has, but also what knowledge and skills can be further developed (according to the DigComp 2.1 model). At the same time, based on the scores obtained by the student, personalized ways of educational intervention can be developed.

- **The score for the digital literacy test**

  The scores are presented in the form of a Brio score, on a scale that varies from 0 (very weak) to 100 (very competent). The higher the score, the higher the level of digital skills.

- **Digital literacy assessment report**

  Following the literacy test, the student (and the teacher, as the case may be) receives an evaluation report based on his/her answers from the test. This report contains the scores obtained by the student and reflects the profile of the measured competencies.

  The competence profile shows the overall scores for all measured digital competencies. Competence scores range from 0 to 100 and allow for the overall observation of the weakest and strongest points of the student being tested.

3.3. Methodology of Brio testing tool for digital literacy

The measuring tool for digital literacy among Romanian students was developed in partnership with the UiPath Foundation and with the support of the Romanian Commercial Bank (BCR) as a project implementation partner.

Brio digital literacy tests are based on modern statistical technology (Item Response Theory), being standardized digital tests. The items were developed based on a process where experts generated items, these following to be refined in several stages and then subjected to critical analysis by other experts, etc. The assessment of digital skills in Brio tests is conducted with three different types of items:

a. items of competence self-assessment: the student estimates the degree to which he considers that he can perform a certain task or that he has certain knowledge;
b. knowledge items: the student answers questions that have right and wrong answers;
c. items related to the frequency of manifestation of a behaviour: the student must answer and specify if he has ever performed certain behaviours specific to digital literacy and also how often he manifested that behaviour.

Also, each item is created by reference to a scenario, which facilitates the understanding of the context of manifestation of that behaviour by the tested student.

In order to ensure the accessibility and easy application of the Brio digital literacy tests (through the online platform, with automatically provided scores), they are reduced to assessment items with 4 pre-coded answers, from which the tested student chooses only one as correct.

The competency model underlying the Brio digital literacy tests is DigComp 2.1, but for easier communication of the scores in this report we discuss 3 major stages of development: non-functional (scores between 0-50), minimum functional (scores between 50 -75) and functional (scores between 75-100).

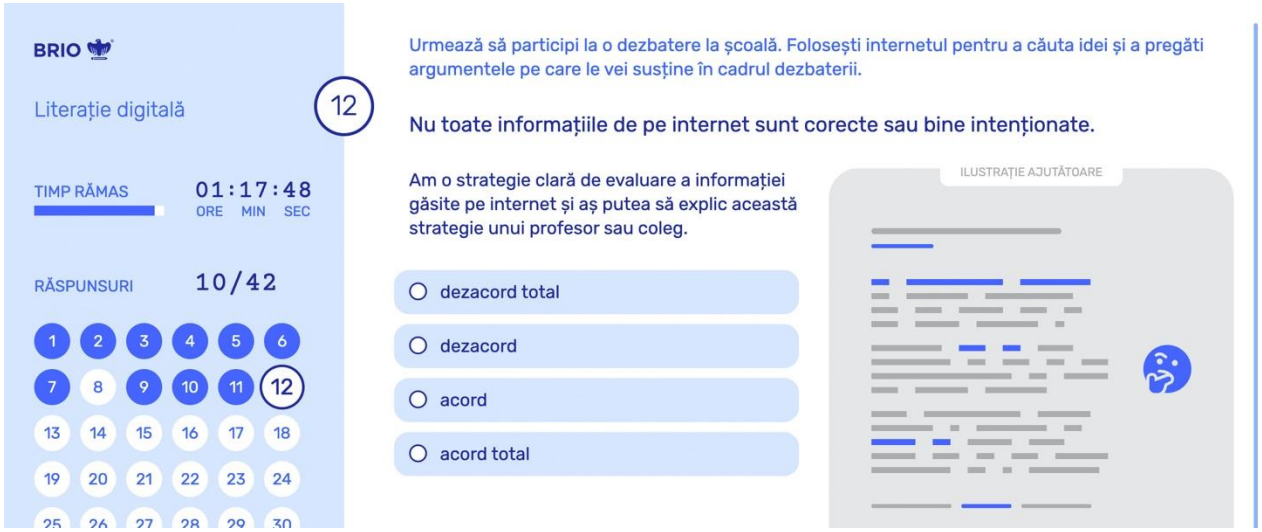
The Brio digital literacy test is based on a bank of items with 6500 digital literacy items, grouped both in different units and assessment approaches, as well as according to school levels (grades I-IV,

grades V-VIII and respectively grades IX-XII). Each test is generated to order, based on a sample of item bank items, so that two students who are being tested at the same time do not receive identical tests. It is important to note, however, that based on the parameters of the items in the system, equivalent tests are always generated in terms of the level of difficulty.

The Brio literacy test has a solving time of between 30 minutes and 4 hours and 12 minutes, automatically allocated by the system depending on the level of the test class selected, the number and type of assessment units selected. Specific competencies can be tested in small-scale tests, or the entire block of 21 competencies can be tested (in 5 categories), noting that in this case the time allotted for solving them will be much longer.

In the next image (*Figure 2*) we present an active digital literacy testing session, for the level of class V-VIII, with two selected assessment units (Information and data literacy and Digital content creation), with a solving time of 1h and 24 minutes and a total of 42 items. Brio test system gives the student the freedom to choose the order in which to access the problems, to answer the items or to modify the answer offered (the only condition being the time frame of the solution automatically assigned by the system).

Figure 2. Item example from Brio digital literacy test



In interpreting the scores, the literacy index generated by the test (a score that can range from 0-100) is classified into one of three competency categories, described based on the following parameters:

The "non-functional" level represents the scores between 0-50

The student who is placed in this category can use technology only guided by others in order to perform simple tasks. More specific:

- The student can search, evaluate and save information from the internet only if he is helped by another person and can do so only at a rudimentary level; for example, if another person tells you exactly what words to search for on Google, they can do so, but they don't know if the information is correct or credible; he can save certain documents found on the internet on his device only if he is constantly guided or he finds himself in difficulty.
- The student may use social networks, forums, and other applications to interact with others, but may not voluntarily select those applications or sites and may not easily juggle them; if she receives help, understands issues related to online conduct (for example, being respectful); he finds it difficult to use the internet and other digital media to participate in society (for example, to sign petitions, or to make appointments for public and private services).
- Only guided and helped can create and edit digital content (for example: text documents, photos, etc.) and can remember simple rules related to copyright and licenses; he knows what programming is, but he has no knowledge in the field.
- Only if he receives clear explanations the student can take basic steps to protect himself, others, and to protect the environment when using technology, but cannot do so spontaneously and voluntarily (e.g., if he is told to have a correct posture, he can remember and apply this).
- He can explain to others' problems that arise (for example, technical issues, or things they do not understand) in order to receive help.

The "functional minimum" level represents the scores between 50-75

A student who falls into this category can use the technology well enough to do so on their own, without guidance, in case of well-defined tasks (i.e. when they exactly know what the outcome should be, such as sending an e-mail or finding specific information). More specific:

- The student can find clear answers to questions on the Internet, can find out when information is obviously erroneous or malicious, and can save documents that he can easily find later.
- The student can find methods and strategies for searching, evaluating and storing (storing) when operating with information, files and digital content in general and can explain step by step how to get the desired scores.

- The student routinely uses social networks, forums, and other applications to interact with others, and in most cases manages to use the Internet to participate in society (for example, to make a reservation online); knows and uses basics related to online conduct (for example, how to talk respectfully about sensitive issues) and about protecting one's digital identity.
- The student can create and edit digital content in simple formats (for example: text, images, PowerPoint presentations, etc.); understands simple rules about copyright and licensing; understands some simple notions of programming (for example: understands that people can write codes to be executed by computers).
- Follow clear and well-known rules to protect himself and others, protect devices and confidential information, and protect the environment (for example, always have an antivirus installed).
- The student can solve simple problems on his own or ask for help when he does not understand something, although sometimes it is difficult for him to clearly articulate the specifics of the problem.
- The student can solve simple problems that arise when using technology, can find technological solutions to the needs that arise (for example: he can find several educational platforms to help him at school and select the platform that seems most useful to him); he understands the limits of his digital skills and seeks solutions for learning and development (of digital skills), both for himself and for others.

The "functional" level represents the scores between 75-100

A student with highly developed digital skills can help others or even contribute to the development or innovation of processes through technology (for example, be involved in promoting the school he goes to on social media). More specific:

- The student works extremely competently with information and digital content, has a clear strategy for searching and evaluating information according to criteria of credibility, relevance and correctness/accuracy, knows which are the most useful and credible platforms to document depending on the purpose and has strategies and technological solutions adapted to its needs related to the storage of digital content (for example: it knows the best Cloud-type applications on which to keep backups); he can guide other people and adapt to their needs in working with information and digital content (for example, can give colleagues an example of reasoning for assessing the credibility of an article, with useful examples).

- The student can communicate formally and informally in the online environment, using the most appropriate applications and can adapt to the audience, with extensive knowledge of online conduct (for example: he knows what topics are considered "problematic" and knows how to approach them respectful); he can use a variety of platforms to distribute digital content, select the most appropriate platforms, and is a good intermediary in the online environment (e.g., always offers credit when sharing someone else's work or ideas); He knows many ways to get involved in society using technology and understands the many opportunities that the internet offers to be involved and to benefit from services that he would not be able to access without the help of technology.
- The student can create and edit different forms of content very easily and at an advanced level, for example, can integrate very large amounts of information, or can use advanced features of well-known applications (e.g., Microsoft Office or editing programs photo and video); he knows and complies with copyright and licensing rules and can explain to others the legal and ethical implications of distributing copyrighted content; has programming knowledge and knows the best platforms that can be used to continue the process of learning and understanding the importance and usefulness of programming skills.
- The student knows and respects known, but also specific and innovative rules, related to the protection of devices and personal information (for example: using a VPN), physical and mental health (for example: using the internet for social inclusion) and the environment (i.e., the impact of technology production, but also of the use of technology on the environment).
- The student can solve complex and rare problems, even if they are poorly defined; finds opportunities to use technology in a creative way, such as testing new devices or innovative applications, or contributing to knowledge in a particular field (for example, editing and adding information by consulting Wikipedia); the student knows the limits of digital skills and is constantly working to develop these skills and to keep abreast of technological advancement.

4. Sample of this report

This report is based on a total database of 3.000 valid applications of the digital literacy test by students in grades I-XII, the scores being presented in three layers: (1) by age, (2) by gender and (3) by 8 development regions:

- Region no. 1: North-East (Bacău, Botoșani, Iași, Neamț, Suceava, Vaslui);
- Region no. 2: South-East (Brăila, Buzău, Constanța, Galați, Tulcea, Vrancea);
- Region no. 3: South-Muntenia (Argeș, Călărași, Dâmbovița, Giurgiu, Ialomița, Prahova, Teleorman);
- Region no. 4: South-West Oltenia (Dolj, Gorj, Mehedinți, Olt, Vâlcea);
- Region no. 5: West (Arad, Caraș Severin, Hunedoara, Timiș);
- Region no. 6: North-West (Bihor, Bistrița Năsăud, Cluj, Maramureș, Satu Mare, Sălaj);
- Region no. 7: Center (Alba, Brașov, Covasna, Harghita, Mureș, Sibiu);
- Region no. 8: Bucharest-Ilfov (Bucharest, Ilfov).

The data set (sample) on which these scores are based is not a probabilistic sample and does not claim representativeness - it is extracted from students who have been assessed, at their own will or at the request of parents or teachers, with the digital literacy test. At the same time, every effort was made to ensure that the structure of the sample is reflected in a balanced way at least at the univariate and bivariate level structured by age, sex, and geographical region. This was done by a quasi-random extraction from a larger database of the sample used in this report, so that the structure will look as previewed below.

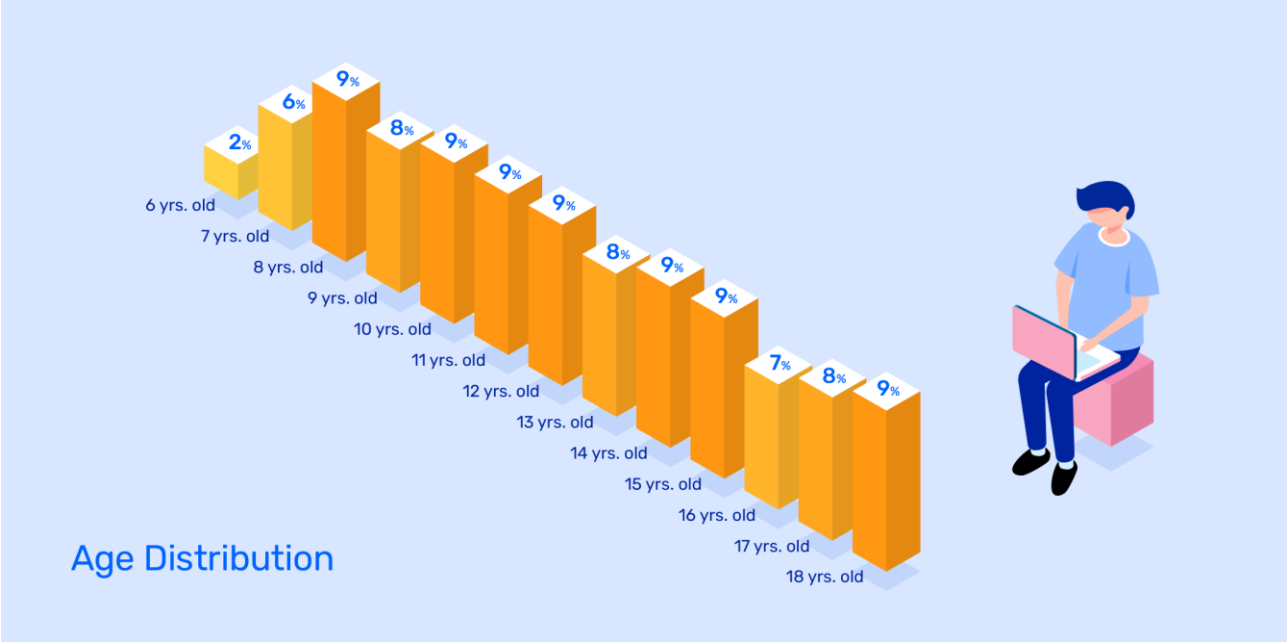
4.1. Age-based distribution

The sample underlying the scores obtained from the application of the test is represented by students aged 6-18, enrolled in the public education system, active from an educational point of view. As can be seen in Figure 3, the distribution of students by age is almost uniform, except for the extreme minimum representation for the age of 6 (2%). The difference between the next age groups is up to 3

percent: 6% for students age 7, 8% for students age 9 and 13, respectively age 17 and 9% for students in the categories 8, 10, 11, 12, 14, 15 years, respectively 18 years.

If we relate the age categories to the levels of the test classes available in the Brio digital literacy test, we identify an average representation of 34% for grades I-IV, 34% for grades V-VIII and 32% for grades IX-XII. At the level of primary education, the major differences are between the ages of 6 years (2%) and 8 years, respectively 10 years (9%). At the level of lower secondary education, with an average representation equal to primary education, we observe a constant interest in testing, while the major differences are between the ages of 16 years (7%) and 15 years, respectively 18 years (9%).

Figure 3. Age-based distribution



4.2. Development regions-based distribution

Figure 4 reflects the percentage of the sample for each development region included in it, and in this context we present the following descending order: 17% from the North-East region (Bacău, Botoșani, Iași, Neamț, Suceava, Vaslui), 15% - South-Muntenia region (Argeș, Călărași, Dâmbovița, Giurgiu , Ialomița, Prahova, Teleorman), 13% - South-East region (Brăila, Buzău, Constanța, Galați, Tulcea, Vrancea) and North-West (Bihor, Bistrița Năsăud, Cluj, Maramureș, Satu Mare, Sălaj), 12% - the Centre region (Alba, Brașov, Covasna, Harghita, Mureș, Sibiu), 11% - Bucharest-Ilfov region

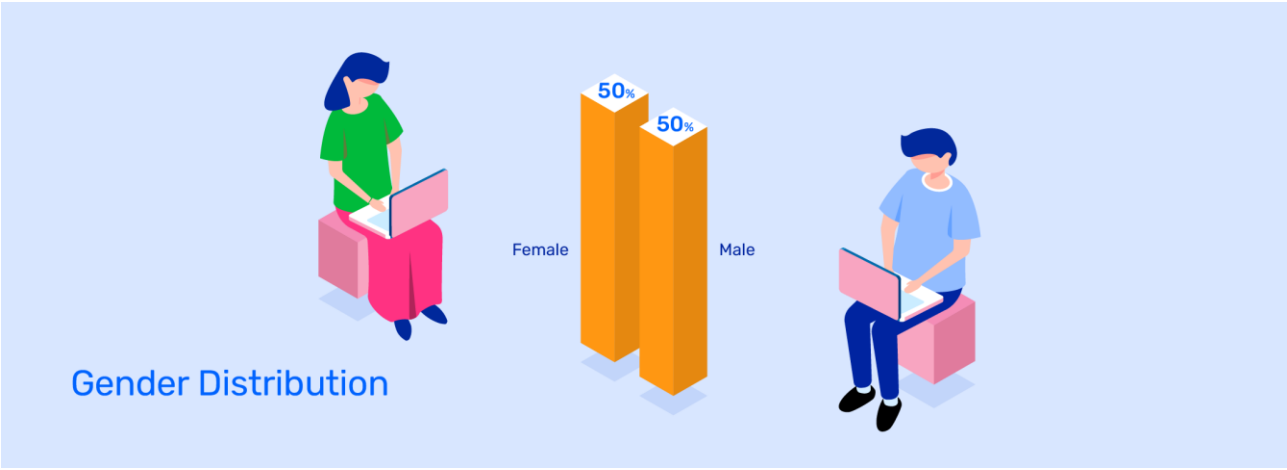
(Bucharest, Ilfov), 10% - South-West Oltenia (Dolj, Gorj, Mehedinți, Olt, Vâlcea) and 9% - West region (Arad, Caraș Severin, Hunedoara, Timiș).

Figure 4. Development region-based distribution

4.3. Gender-based distribution

Figure 5 presents the percent for each gender category included in the sample, where we observe an equality between girls and boys.

Figure 5. Gender-based distribution



5. Data collection and processing

Data collection for preparing this report was carried out during 7 months, between October 2021 and April 2022, being facilitated by the possibility of freely accessing the digital literacy test. All test sessions without checked answers were excluded, but test sessions with received answers were included in the analysis, the *pattern* of which demonstrated a *bona fide* answer, even if the total score was zero. We reiterate that the sample is one of convenience, collected by calling the platform by the tested students, with all the limitations arising from this situation.

The Brio testing system provides students with the tool for measuring digital literacy skills both independently (independent accessibility by the teacher or the school, from the parent's own account on the platform) and collectively (teacher-dependent accessibility), by generating the test for the entire class of students from the teacher account registered in the platform). Test sessions from both approaches were used to prepare this report.

6. Scores

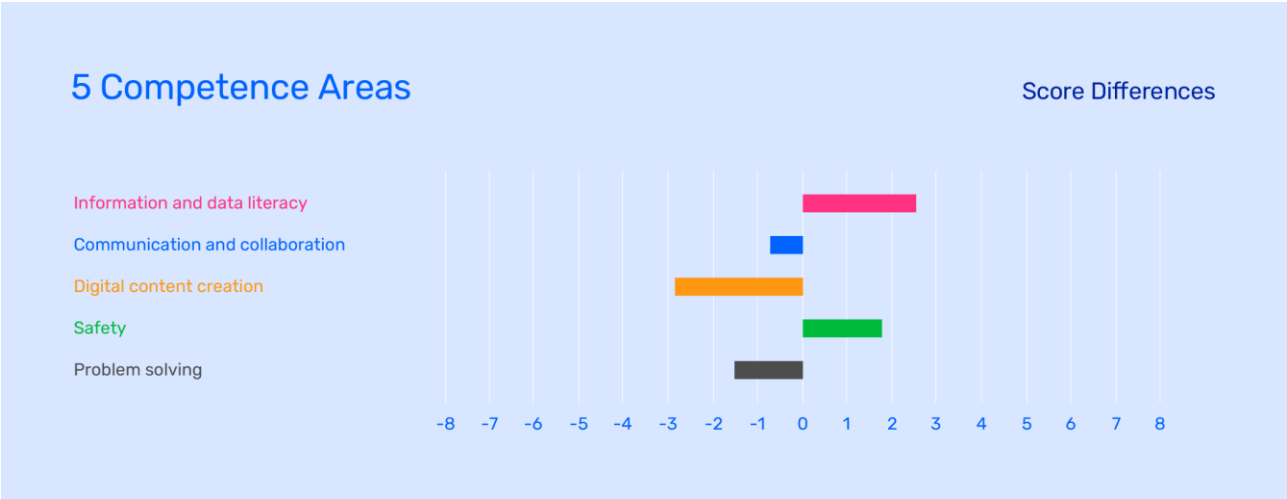
The average digital literacy score obtained for the entire sample is 65.93 points - an average that reflects a MINIMUM FUNCTIONAL level of digital skills.

Therefore, we can say that, on average, students in grades I-XII between the ages of 6 and 18 in Romania use the technology well enough on their own, without being guided, in the case of well-defined tasks (i.e., when they exactly know what the result should be, such as sending an email or finding out specific information).

On average, this score places the Romanian students at about 16 points above the non-functional level of digital literacy (between 0-50) and at 10 points below the fully functional level of digital literacy (between 75-100).

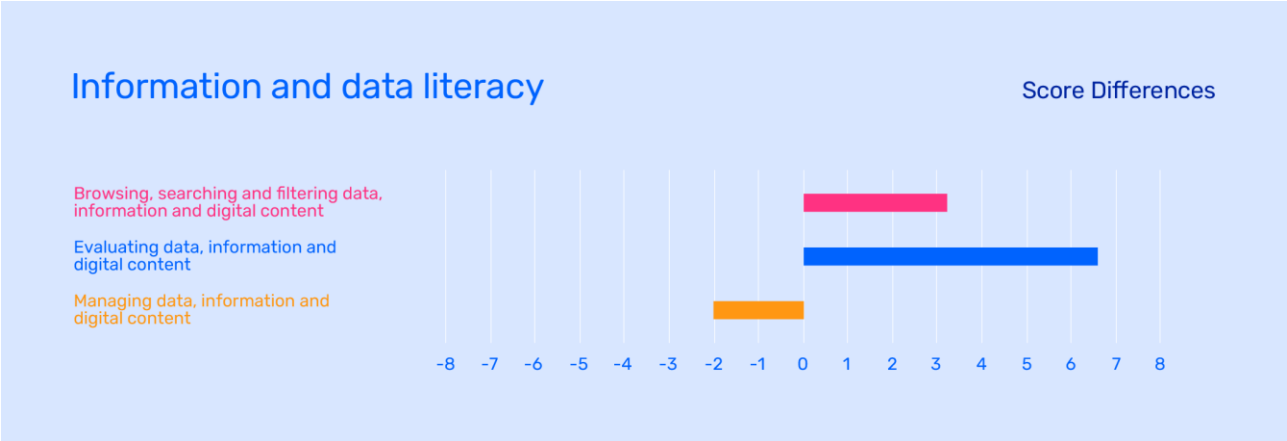
Figure 6 shows the deviations from the average score for each competence cluster. The lowest score is for digital content creation skills (2.68 points below the average score), and the highest for information and data literacy skills (2.53 points above the average score).

Figure 6. Score differences for 5 areas of competence



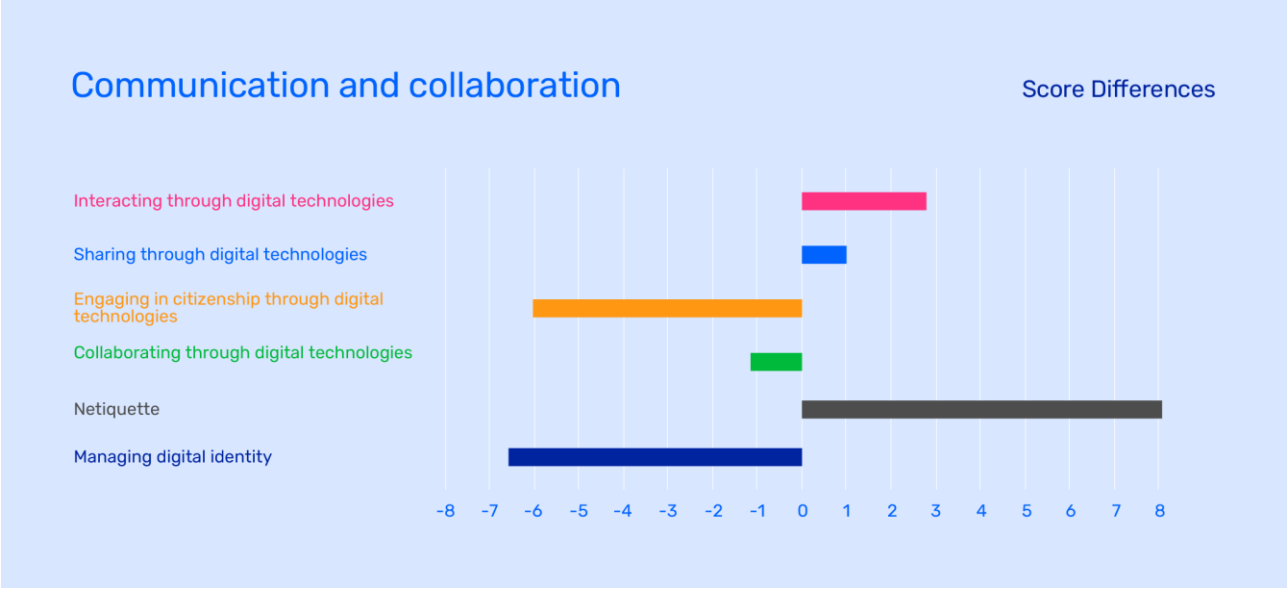
In terms of information and data literacy skills, we note the low scores for managing data, information and digital content (at a difference of 2.03 points below the average score) and the high scores for evaluating data, information and digital content. (6.60 points above the average score).

Figure 7. Score differences for information literacy and data literacy components



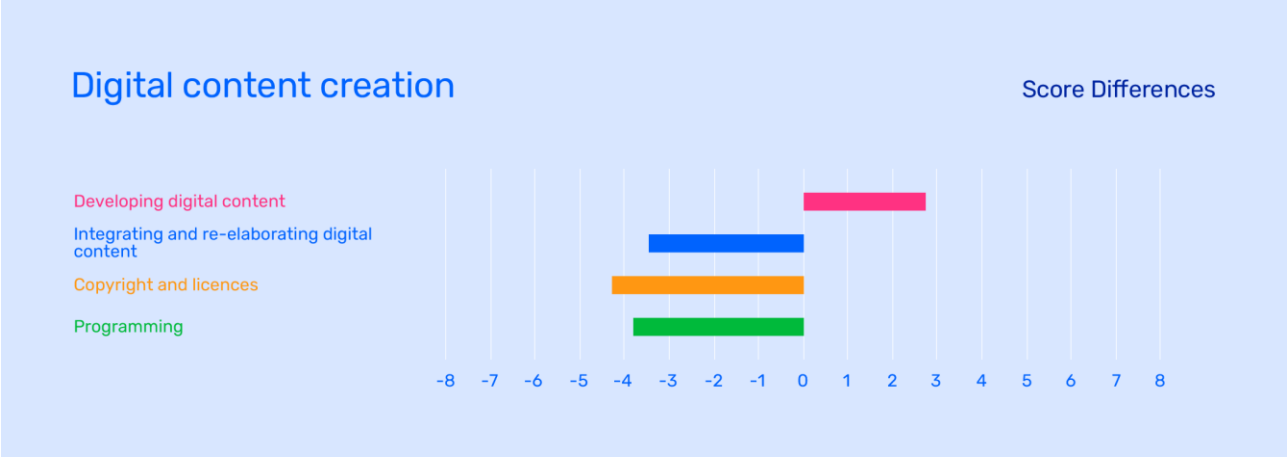
For the skills related to communication and collaboration skills, the extremes of the scores in relation to the average are noted for digital identity management (at a difference of 6.65 points below the average score) and for etiquette (8.09 points above the average score).

Figure 8. Score differences for the communication and collaboration competence components



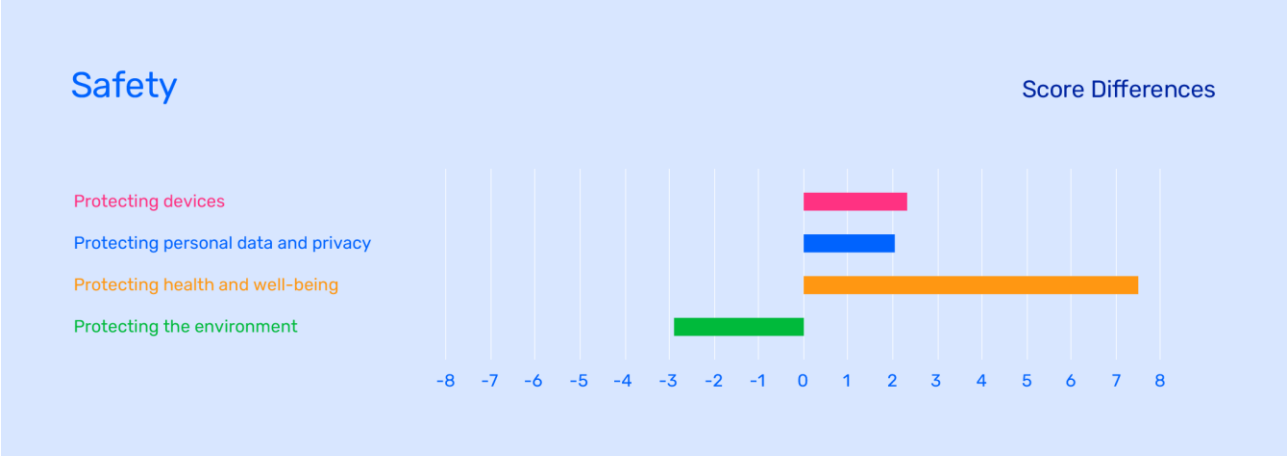
Regarding the competencies regarding the creation of digital content, we note the competencies related to copyright and licenses (at a difference of 4.32 points below the average score) and those related to the development of digital content (the only competency above the average score in this category, 2.74 points above average).

Figure 9. Score differences for the components of the digital content creation skill



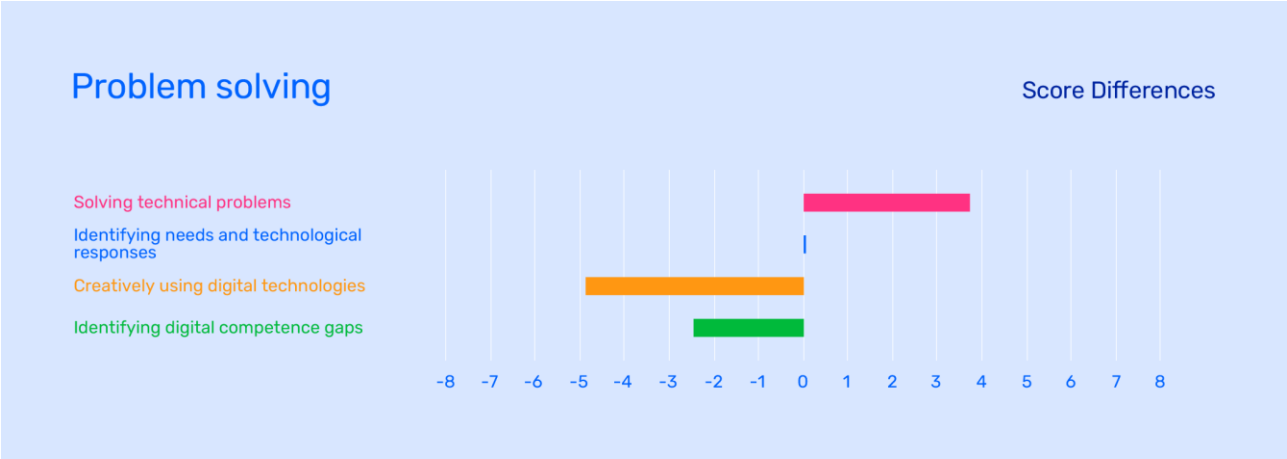
For the competencies that measure security, we note data protection (the only competency below the average score in this category, at a difference of 2.91 below average) and the protection of digital devices (7.52 points above the average score).

Figure 10. Score differences for safety competency components



In terms of problem-solving skills, we highlight the ability to use digital technology creatively (at a difference of 4.89 points below the average score) and the ability to solve technical problems (3.72 points above average).

Figure 11. Score differences for problem-solving competence components



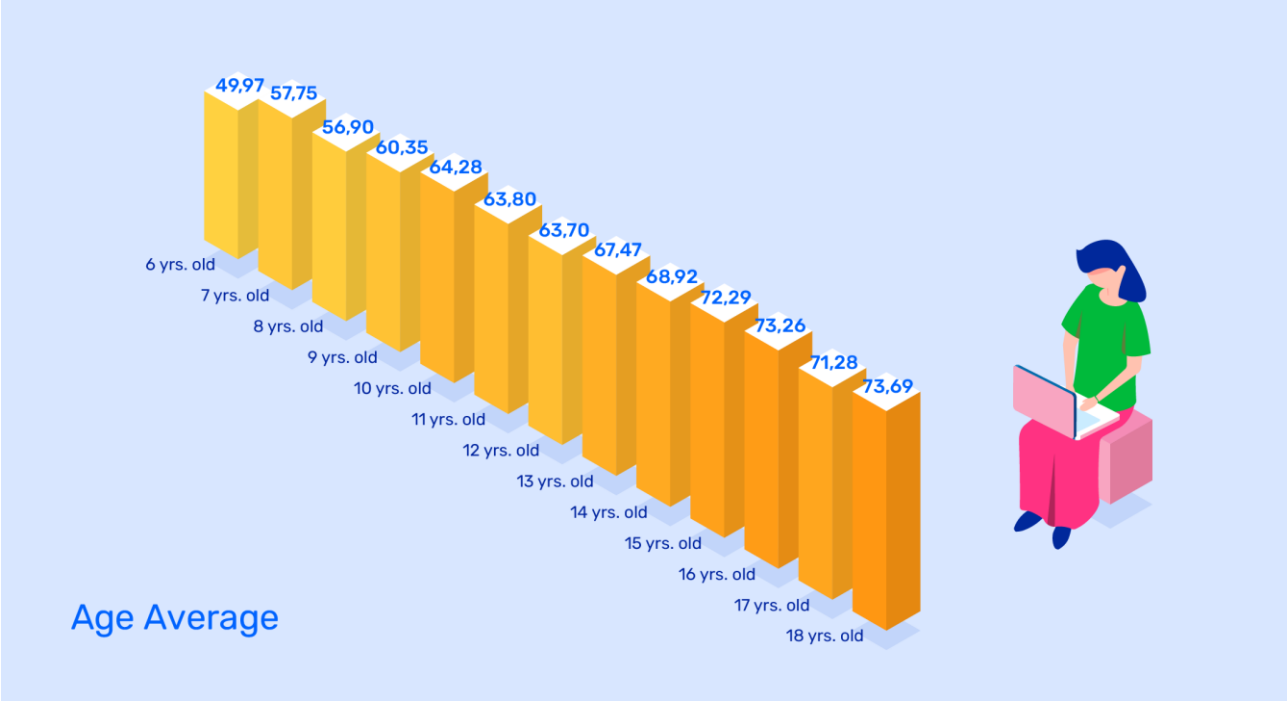
6.1. Averages for specific groups

Age-based differences

Figure 12 presents the score obtained from the measurement of digital skills at the level of each age category; here we identify a gradual increase from one age category to another, except for the age of 8 years, 11 years, 12 years, respectively 17 years (probably data effects).

If we relate the age categories to the levels of the classes, we identify an increase of 14.31 points between the extremes of the scores for grades I-IV (6-10 years), 5.22 points between the extremes of the scores for grades V-VIII (11-14 years) and 2.41 points between extreme scores for grades IX-XII (15-18 years).

Figure 12. Age-based differences

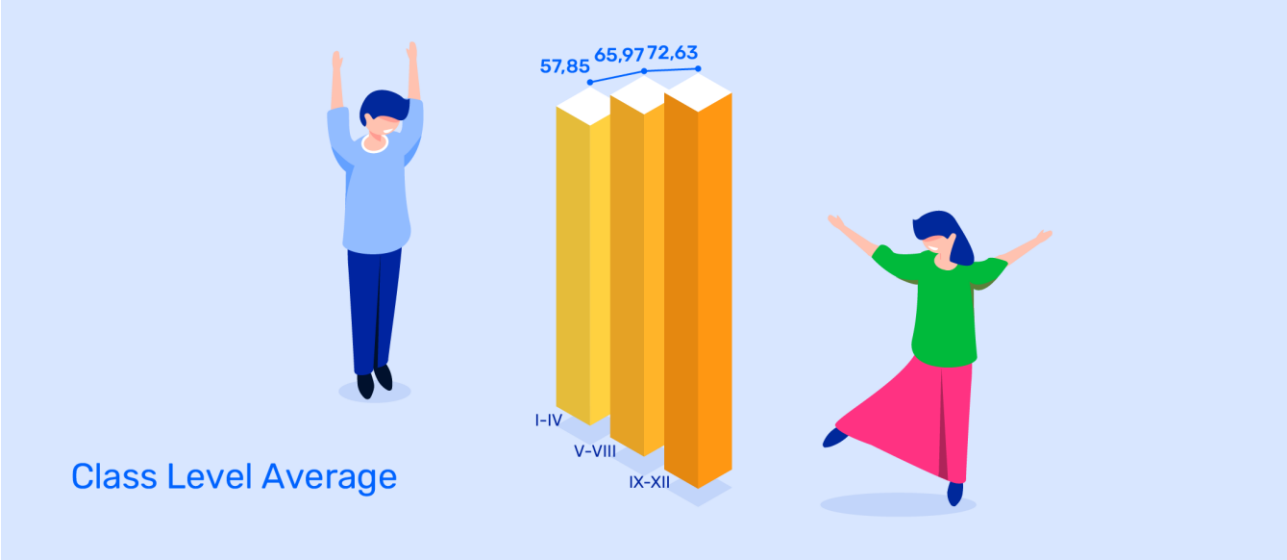


Class level-based differences

For primary education, the average score for digital literacy is 57.82 points, for secondary education the average score for digital literacy is 65.98 points, while for high school, the average score for digital literacy is 72.63 points.

Therefore, the average score for grades I-IV is only 7.82 points above the non-functional level of digital literacy, and the average score for grades IX-XII is only 2.37 points below the functional level of digital literacy, while the average score for grades V-VIII is 15.98 points above the non-functional level of digital literacy and at a difference of only 9.02 points from the functional level of digital literacy.

Figure 13. Class level-based differences



Gender-based differences

The average score of 65.93 in digital literacy skills is calculated in relation to the scores of girls (64.57 points) and boys (67.29). In Figure 14, we can see that the total score of digital literacy is higher among boys than girls. The difference of 2.72 points marks the average progress that boys have in terms of digital literacy skills - an advance of about 4-5%.

Figure 14. Gender-based differences

Region-based differences

Figure 15 shows the average digital literacy score for each of the 8 regions included in the sample, with an almost uniform distribution of digital literacy skills. We identify a difference of only 4.07 points between the extremes of the scores (*Region 7 Centre and Region 4 South-West Oltenia*) in relation to the dynamics of the representation in the sample. In conclusion, all eight development regions maintain a relatively equal level of performance.

Figure 15. Geographical region-based differences

6.2. Frequency tables

Media is a synthetic indicator, but it often hides the structure of reality. For this reason, we have further dealt, in line with the typical approach of the European digital literacy model, with the percentages in the sample that fall within a certain competence threshold - in our case non-functional, minimally functional and functional.

Percentage scores obtained for each level and competence of digital literacy

Non-functional level (score 0-50)

1) A percentage of 18% of students in grades I-XII fall into the non-functional level of digital literacy. They can only use technology guided by others in order to perform simple and clearly

explained tasks at a rudimentary level, having difficulties in using the internet and other digital media in order to participate in society.

2) In regard to the 5 areas of measured digital competences, 15% of students are non-functional from the informational and data literacy point of view, 24% of students are non-functional from the communication and collaboration point of view, 21% of students are non-functional from the creation of digital content point of view, 22% of students are non-functional from the security point of view, and 18% of students are non-functional from the problem-solving point of view.

Minimum functional level (score 50-75)

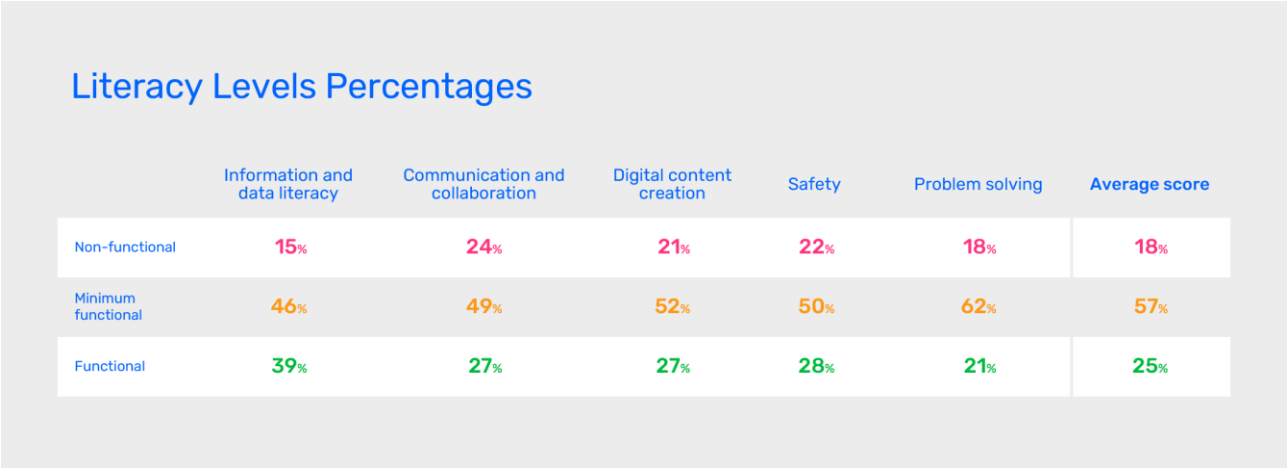
1) 57% of students in grades I-XII meet the minimum functional level of digital literacy, which means that they are able to use the technology well enough to do so on their own, without being guided, in the case of well-defined tasks (i.e., when they exactly know what the result should be, such as sending an email or finding out specific information).
2) In regard to the 5 areas of measured digital competences, 46% of students are non-functional from the informational and data literacy point of view, 49% of students are non-functional from the communication and collaboration point of view, 52% of students are non-functional from the creation of digital content point of view, 50% of students are non-functional from the security point of view, and 62% of students are non-functional from the problem-solving point of view.

Functional level (score 75-100)

1) 25% of students in grades I-XII are at the functional level of digital literacy, which means that they can competently work with information and digital content, can communicate formally and informally online, and adapt to the audience, they understand the many opportunities that the internet offers to benefit from services that they could not access without the help of technology, they can create and edit different forms of content at an advanced level (for example: Microsoft Office), they know what are the best platforms from which to continue learning and can understand the importance and usefulness of programming skills; they also know specific and innovative rules about the protection of devices and personal information (for example: using a VPN) and can solve complex problems (even if they are not clearly defined).

2) In regard to the 5 areas of measured digital competences, 39% of students are non-functional from the informational and data literacy point of view, 27% of students are non-functional from the communication and collaboration point of view, 27% of students are non-functional from the creation of digital content point of view, 28% of students are non-functional from the security point of view, and 21% of students are non-functional from the problem-solving point of view.

Figure 16. Percentages of the sample placed at different levels of digital literacy



Percentage scores obtained at the level of the areas of digital competences and at the level of age groups

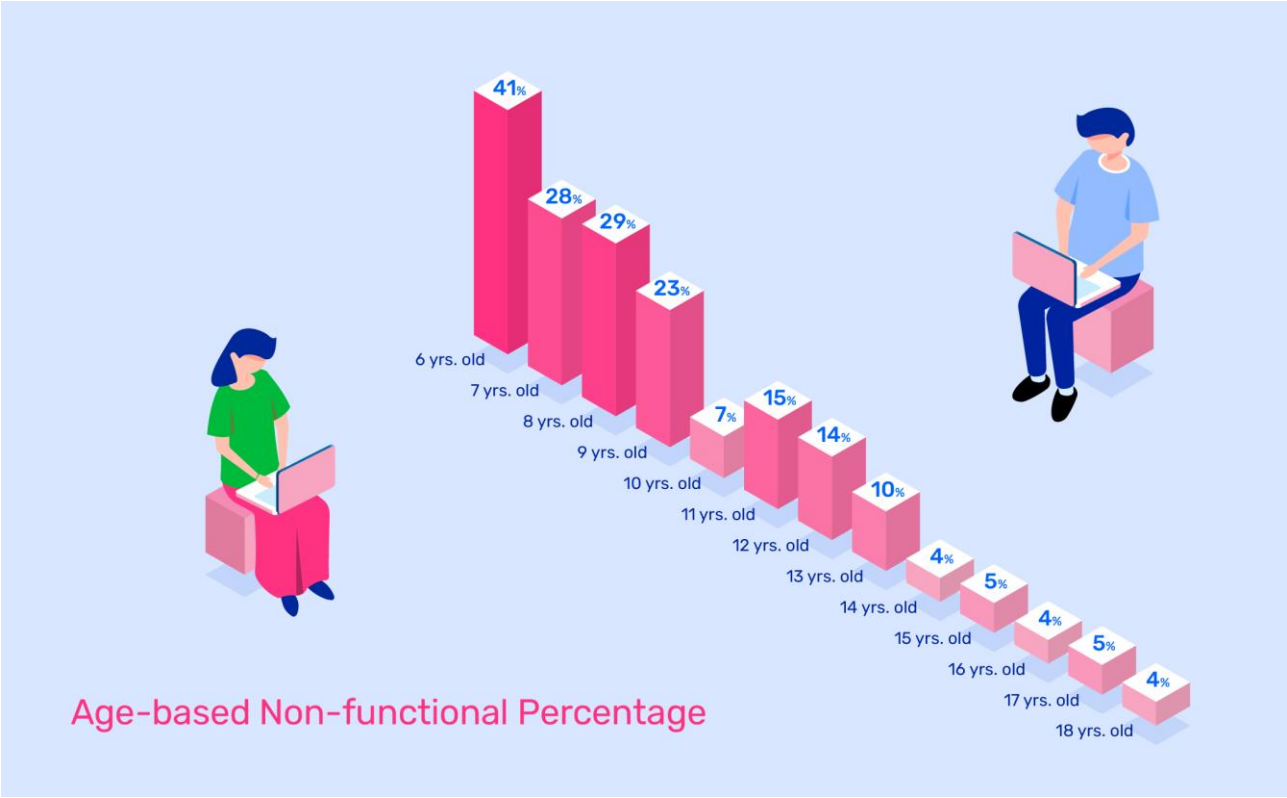
The scores presented so far show a relatively uniform distribution according to age, gender and development regions, but their deepening for each of the 21 measured digital competencies shows discrepancies between the sample categories in relation to the 3 levels of digital literacy: non-functional, minimum functional and functional. Therefore, below we present the percentage of students in the extreme levels (non-functional and functional), depending on the measured competence.

Non-functional level of digital literacy (0-50)

We know that 18% of students fall into a non-functional level of digital skills, and Figure 17 shows that the highest representation for non-functional digital literacy is in grades I-IV (6-10 years), decreasing for grades V-VIII (11-14 years), while grades IX-XII (15-18 years) have the lowest

participation at the non-functional level. Specifically, this gradual minimization of the percentage of representation for each age group indicates a development of digital skills from one school level to another (primary-secondary-high school).

Figure 17. Percentage scores for the non-functional level

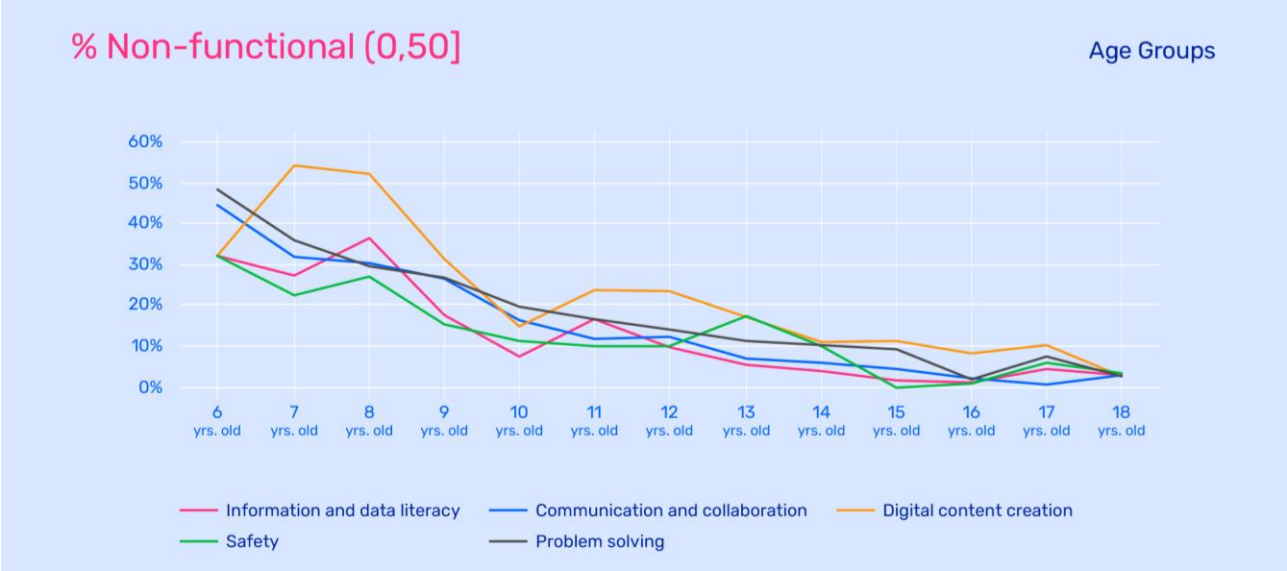


The decreasing percentage by class persists for each of the 5 major areas of measured digital skills (Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Security and Problem Solving), and we see major changes from the age of 11 years old, the lower threshold of the gymnasium level.

In terms of skills: for information and data literacy and communication and collaboration, the percentages are significantly lower for the middle school level compared to the primary level, while for skills such as digital content creation, security, and problem solving, the percentages remain higher big.

The high school level has the lowest representation in the non-functional area, while the primary level has the highest representation, and they persist for each of the 5 major competencies measured.

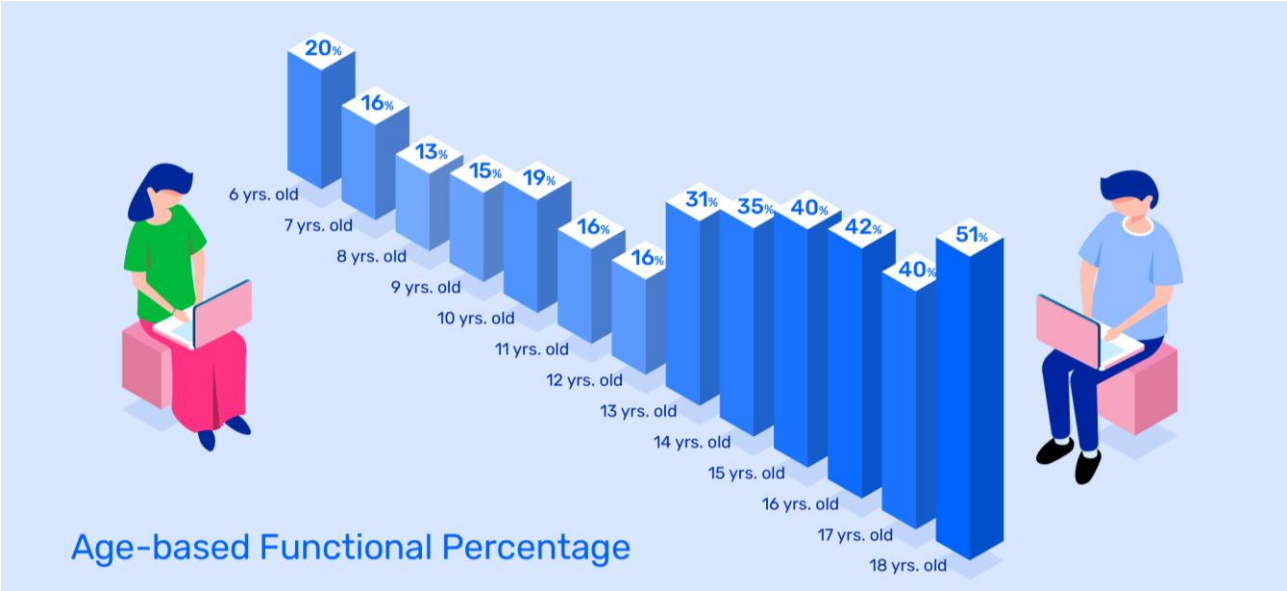
Figure 18. Non-functional level percentage scores for the 5 competences



Functional level of digital literacy (75-100)

The average percentage of 25% of students enrolled in the functional level of digital skills shows differences between age categories consonant with an increase from one school level to another. Grades I-IV have the lowest representation in the functional area, the peak being recorded at the age of 6 years (20%), being increasing for grades V-VIII, where the peak is reached at the age of 14 years (35%), in while grades IX-XII have the highest representation with the peak reached at 18 years (51%).

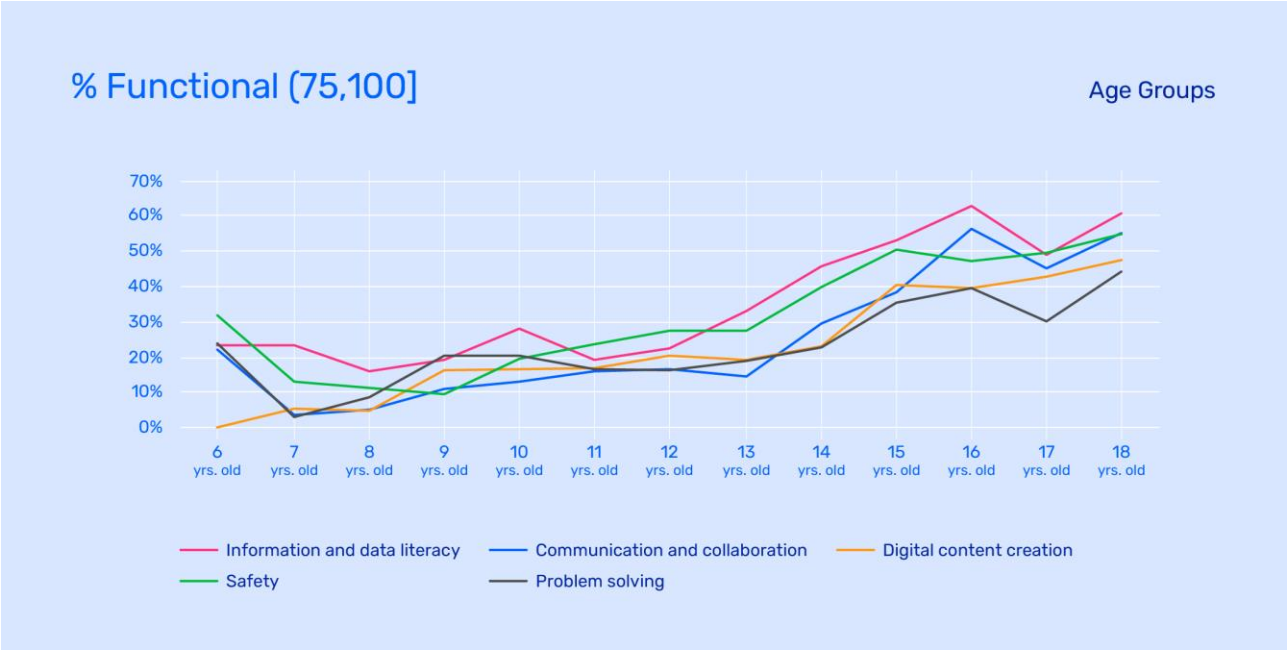
Figure 19. Percentage scores for functional level



The percentage increase with the grade level persists for each of the 5 major areas of digital competency measured (Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Security and Problem Solving), where we see major changes from the age of 14, the lower threshold of the high school level.

In the case of Communication and Collaboration and Digital Content Creation skills, the percentages are significantly lower at the primary level compared to the middle school level, while at the level of Information and Data Literacy and Security and Problem Solving the percentages remain higher. The high school level has the highest representation in the functional area, while the primary level has the lowest representation, and they persist on each of the 5 major competencies measured.

Figure 20. Functional level percentage scores for the 5 competences



Percentage scores obtained for each digital literacy skill based on age

In order to understand the depth of the scores contained in this report, we will further address each digital competence (Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Security and Problem Solving), measured at each level of literacy. We will present the scores only for the extreme levels (non-functional and functional).

Non-functional level of digital literacy (0-50)

As we can see in the tables below, the percentages of representation in each category and subcategory of digital skills in the non-functional level of literacy are constantly decreasing, with significant differences between ages and thresholds between primary, secondary and high school.

Table 1. Percentage of students placed at a non-functional level for information and data competence

Age	Navigating, searching and filtering data, information and digital content	Data, information and digital content assessment	Data, information and digital content management
6 years	27%	41%	48%
7 years	36%	33%	42%
8 years	31%	32%	56%
9 years	23%	13%	28%

10 years	13%	10%	28%
11 years	18%	25%	34%
12 years	13%	16%	26%
13 years	12%	10%	19%
14 years	4%	10%	16%
15 years	4%	3%	5%
16 years	4%	2%	7%
17 years	4%	5%	13%
18 years	3%	8%	12%

Table 2. Percentage of students placed at the non-functional level for communication and collaboration competence

Age	Interaction through the agency of digital technologies	Content distribution through digital technologies	Civil implication through digital technologies	Collaboration through the digital technologies	Etiquette in technology	Digital identity management
6 years	33%	33%	33%	69%	33%	33%
7 years	40%	22%	39%	43%	22%	40%
8 years	27%	43%	53%	26%	12%	52%
9 years	20%	33%	53%	35%	10%	38%
10 years	17%	25%	42%	30%	9%	32%
11 years	16%	24%	43%	24%	14%	39%
12 years	15%	28%	40%	21%	13%	30%
13 years	14%	9%	32%	16%	7%	40%
14 years	13%	13%	14%	22%	5%	23%
15 years	9%	9%	19%	13%	6%	12%
16 years	5%	0%	8%	4%	1%	20%
17 years	14%	4%	11%	14%	0%	23%
18 years	6%	4%	14%	6%	7%	23%

Table 3. Percentage of students placed at the non-functional level for the creation of digital content

Age	Development of digital content	Integration and re-elaboration of digital content	Copyrights and licensing	Programming
6 years	33%	67%	33%	67%
7 years	40%	63%	56%	41%
8 years	48%	69%	61%	45%
9 years	36%	35%	30%	35%

10 years	23%	23%	26%	21%
11 years	25%	37%	37%	37%
12 years	19%	32%	32%	23%
13 years	22%	17%	20%	23%
14 years	9%	30%	20%	27%
15 years	4%	18%	21%	13%
16 years	6%	11%	15%	22%
17 years	3%	14%	14%	14%
18 years	6%	9%	9%	21%

Table 4. Percentage of students placed at the non-functional level for security competence

Age	Protection of digital devices	Protection of personal data	Protection of health and wellness	Environment protection
6 years	33%	33%	33%	33%
7 years	38%	38%	25%	19%
8 years	31%	35%	28%	31%
9 years	29%	25%	16%	32%
10 years	20%	27%	8%	25%
11 years	15%	23%	6%	18%
12 years	18%	11%	10%	23%
13 years	17%	23%	12%	28%
14 years	11%	12%	6%	20%
15 years	8%	1%	1%	18%
16 years	3%	3%	0%	22%
17 years	12%	5%	3%	17%
18 years	7%	4%	9%	21%

Table 5. Percentage of students placed at the non-functional level for problem-solving competence

Age	Solving technical issues	Identifying the issues and the adequate technological solutions	Creative use of digital technology	Identifying the limitations of the own digital competence
6 years	50%	27%	27%	27%
7 years	52%	42%	38%	48%
8 years	31%	34%	36%	44%
9 years	23%	20%	50%	32%
10 years	15%	24%	31%	27%
11 years	14%	22%	35%	25%
12 years	15%	17%	34%	19%
13 years	17%	15%	20%	19%

14 years	14%	20%	27%	16%
15 years	3%	13%	18%	16%
16 years	10%	4%	12%	12%
17 years	6%	6%	25%	15%
18 years	4%	4%	10%	6%

Functional level of digital literacy (75-100)

In the following tables we identify the percentages of representation in the case of each category and subcategory of digital skills in the non-functional level of literacy as being constantly increasing, with significant differences between ages and thresholds between primary, secondary and high school.

Table 6. Percentage of students placed at functional level for information and data competence

Age	Navigating, searching and filtering data, information and digital content	Data, information and digital content assessment	Data, information and digital content management
6 years	45%	45%	38%
7 years	30%	34%	18%
8 years	30%	29%	13%
9 years	33%	47%	24%
10 years	40%	53%	25%
11 years	33%	45%	19%
12 years	38%	46%	22%
13 years	34%	52%	35%
14 years	52%	58%	38%
15 years	62%	67%	54%
16 years	67%	77%	51%
17 years	62%	68%	57%
18 years	58%	71%	60%

Table 7. Percent of students placed at the functional level for the communication and collaboration competence

Age	Interaction through digital technologies	Content sharing through digital technologies	Civic implication through digital technologies	Collaboration through digital technologies	Etiquette in technology	Digital identity management
6 years	0%	0%	33%	23%	67%	33%

7 years	17%	18%	17%	19%	24%	10%
8 years	31%	15%	12%	20%	32%	11%
9 years	38%	33%	18%	34%	46%	19%
10 years	39%	25%	20%	26%	51%	17%
11 years	30%	22%	21%	26%	55%	26%
12 years	47%	28%	14%	31%	46%	23%
13 years	43%	33%	19%	29%	59%	34%
14 years	48%	47%	38%	36%	69%	25%
15 years	54%	56%	41%	36%	68%	39%
16 years	70%	72%	61%	56%	74%	38%
17 years	60%	68%	47%	49%	78%	25%
18 years	74%	67%	64%	64%	72%	28%

Table 8. Percent of students placed at the functional level for the creation of digital content

Age	Development of digital content	Integration and re-elaboration of digital content	Copyrights and licensing	Programming
6 years	33%	0%	33%	33%
7 years	23%	16%	15%	5%
8 years	13%	9%	7%	9%
9 years	25%	25%	26%	10%
10 years	37%	31%	36%	28%
11 years	31%	26%	19%	22%
12 years	40%	29%	25%	29%
13 years	38%	36%	18%	19%
14 years	48%	37%	28%	25%
15 years	68%	55%	33%	36%
16 years	61%	54%	44%	49%
17 years	62%	47%	30%	46%
18 years	72%	65%	51%	45%

Table 9. Percent of students placed at the functional level for safety competence

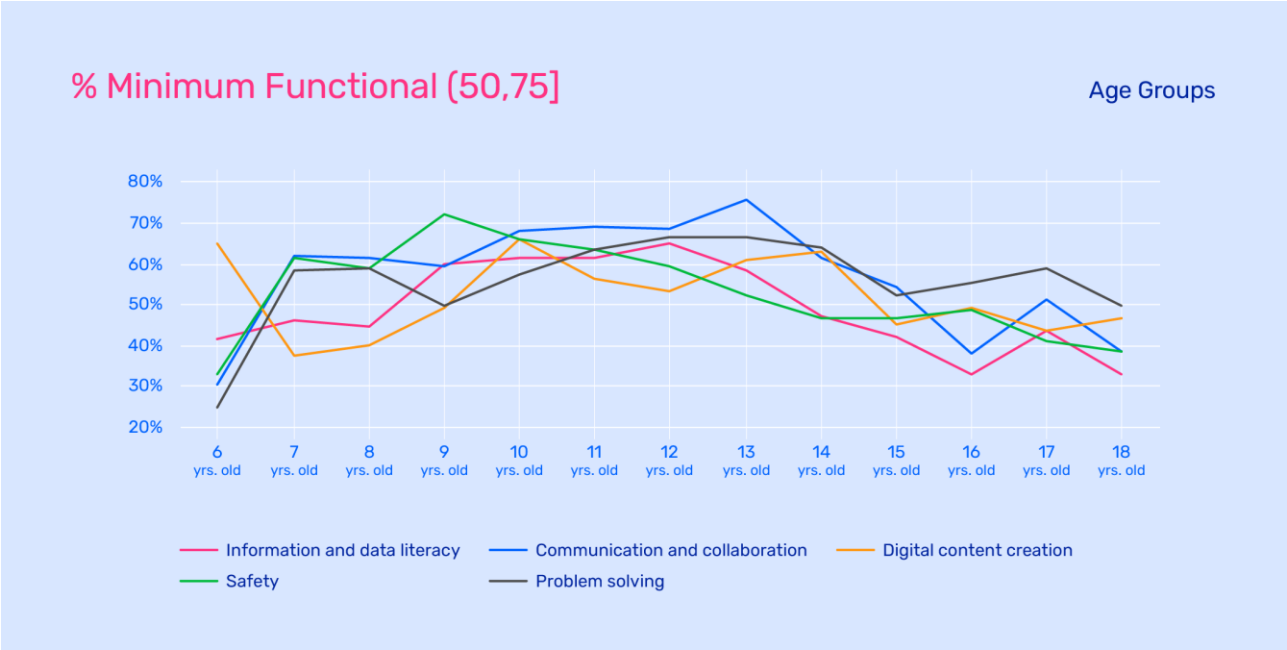
Age	Protection of digital devices	Protection of personal data	Protection of health and wellness	Environment protection
6 years	0%	33%	33%	33%
7 years	11%	26%	28%	35%
8 years	22%	29%	28%	14%
9 years	27%	23%	30%	26%
10 years	32%	30%	49%	23%
11 years	47%	28%	55%	26%

12 years	47%	40%	58%	29%
13 years	49%	50%	60%	17%
14 years	49%	54%	71%	39%
15 years	57%	65%	80%	33%
16 years	60%	68%	74%	53%
17 years	64%	58%	78%	38%
18 years	69%	70%	73%	37%

Table 10. Percentage of students placed to the functional level for problem-solving competence

Age	Solving technical issues	Identifying the issues and the adequate technological solutions	Creative use of digital technology	Identifying the limits of own digital skills
6 years	44%	73%	9%	9%
7 years	12%	8%	12%	6%
8 years	23%	22%	9%	17%
9 years	30%	31%	25%	28%
10 years	37%	29%	24%	26%
11 years	39%	32%	21%	25%
12 years	43%	28%	18%	28%
13 years	49%	26%	27%	34%
14 years	52%	32%	22%	24%
15 years	60%	40%	36%	45%
16 years	68%	60%	43%	54%
17 years	54%	59%	41%	35%
18 years	66%	60%	39%	52%

Figure 21. Evolution of the percentage of minimally functional students for the 5 categories of digital skills, based on the students' age



Percentage scores based on gender

The average score of 64.57 points obtained by the female group is distributed as a percentage 12% in the non-functional level, 64% in the minimum functional level and 24% in the functional level of literacy.

The average score of 67.29 points obtained by the male category is distributed as a percentage 13% in the non-functional level, 56% in the minimum functional level and 32% in the functional level of literacy.

Therefore, we observe in *Figure 22* that both boys and girls in the analysed sample have a similar volume of students in the non-functional category, boys being a higher percentage (32% compared to 24%) of students in the functional category.

Figure 22. Percentages of the sample placed at different literacy levels, for each gender

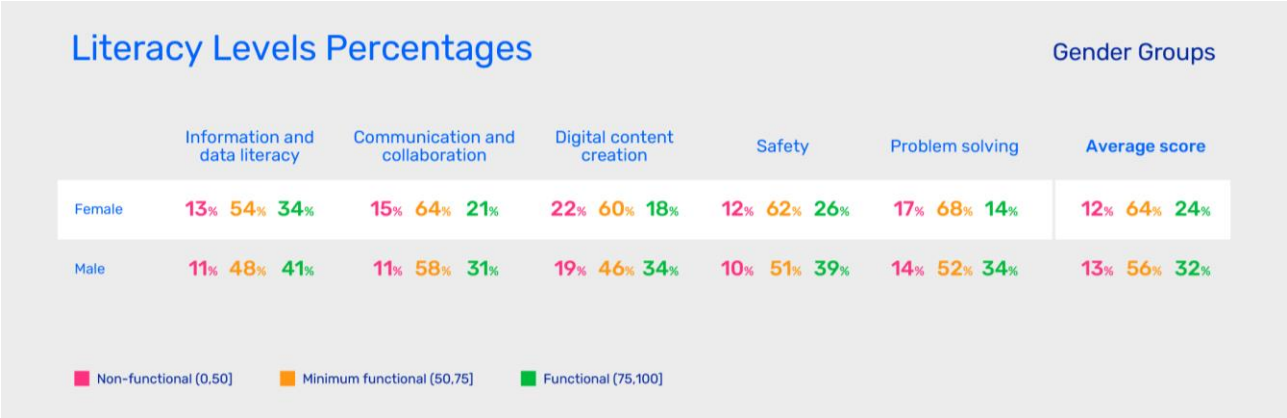
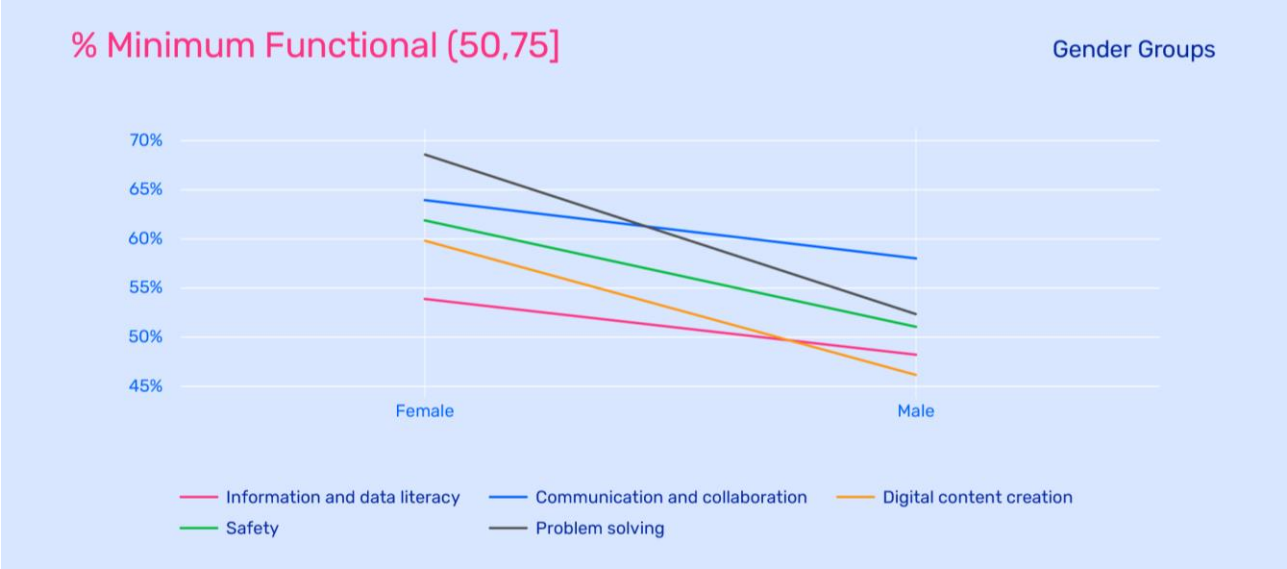


Figure 23. Evolution of the percentage of minimally functional students for these 5 categories of digital competences, based on gender



Percentage scores obtained for the development regions

The non-functional level varies quite a lot between the 8 development regions, the biggest differences being 11% (between the Centre region and South-Muntenia region vs. Bucharest-Ilfov region). However, overall, the regions are remarkably similar.

To *Figure 24* we can see the visual representation of these percentage scores for each development region, in relation to the 5 major areas of measured competences.

Figure 24. Percentages of the sample placed at different literacy levels, for each development region

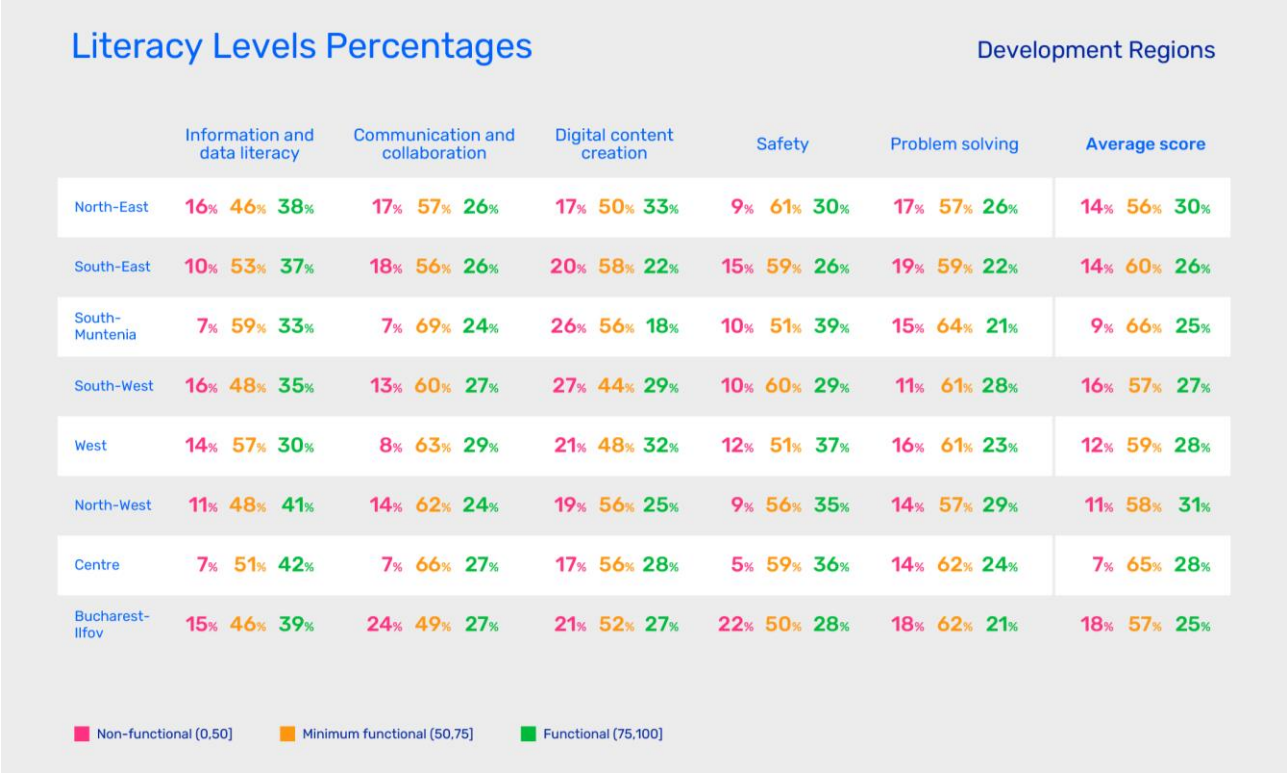
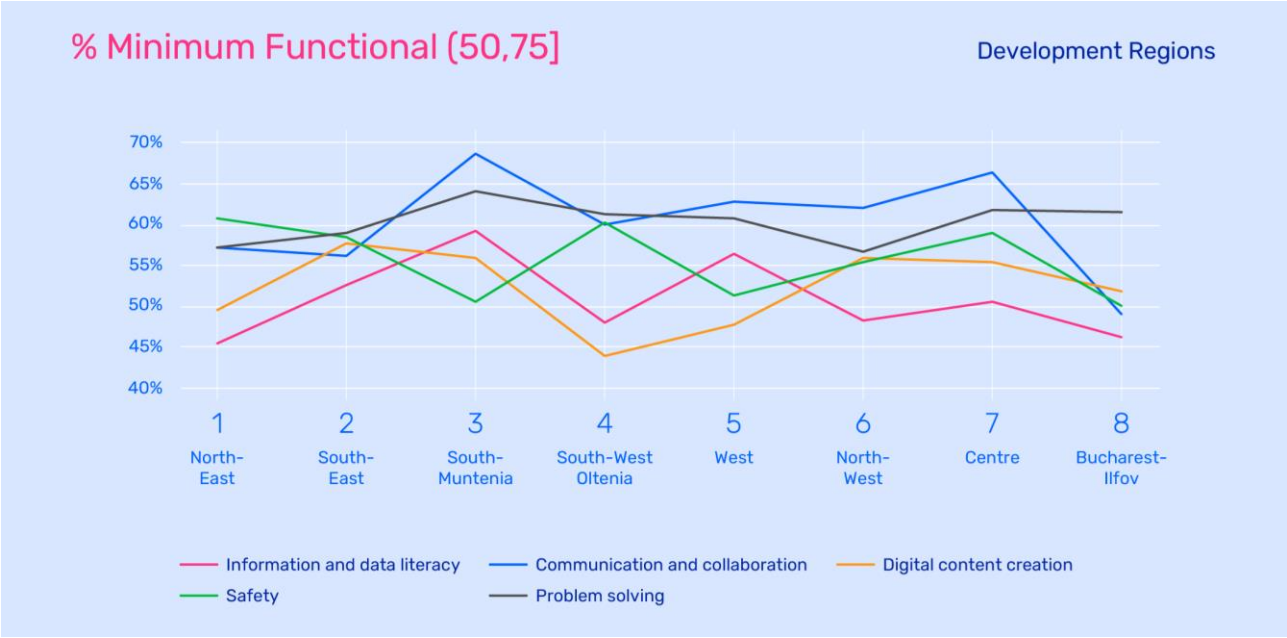


Figure 25. Evolution of the percent of minimally functional students, for the 5 digital competency categories, based on the geographical area



7. General conclusions

The total average score obtained for the entire sample is 65.93 points - an average that reflects a MINIMUM FUNCTIONAL level of digital skills for the assessed school population.

The percentage of students in the 6-18 age range employed at a high functional level of digital literacy is only 25%, this being (at this moment) the talent pool that Romanian employers will have in order to generate digital performance and productivity.

The primary level (grades I-IV) has the most non-functional students, the middle level (grades V-VIII) has the most minimally functional students, while the high school level (grades IX-XII) reflects the most functional students in terms of digital skills.

The digital skills increase significantly with age, with significant differences between primary, secondary and high school scores. The increase is remarkable: from a total score of 49.97 for 6 years to a total score of 73.69 for 18 years. The percentage of children from the "severely dysfunctional" category decreases: from 41% of the school population at 6 years old to only 4% at 18 years old. The percentage of children in the "functional category" increases: from 20% of the school population at 6 years old to 51% at 18 years old.

The average score has a relatively uniform distribution for the 8 development regions, without significant differences on geographical criteria.

Boys have an average lead of about 5% over girls in digital skills.

The best developed skills are:

- those in the area of information and data literacy (due to its superior ability to navigate, search and filter data and evaluate digital data and information);
- those in the area of safety (due to the unexpectedly high score on health protection and well-being, especially at older ages).

The most underdeveloped skills are:

- those in the area of digital content creation (with problems in developing skills related to programming, copyright and licensing, digital content development);
- those in the area of problem solving (with problems in developing skills related to the creative use of technology and the identification of limitations in their own competence);
- those in the area of communication and collaboration (with problems in developing skills related to digital identity management and those related to civic involvement through technology).

8. Limitations

This report, like any study, has a number of limitations. The most important are due to the sample we rely on, which is not a representative sample but is a sample of convenience, being obtained during the administration of the digital literacy test among children who have chosen, out of self-interest, urged by parents or as part of educational programs, in school or otherwise, to complete this test. Some of the administrations were comprehensive administrations, which tested all the components of the model, other evaluations chose to test only some of these components. At the same time, the sample is voluminous, containing 3.000 participants and may reflect, even in the absence of representativeness, interesting conclusions, which can be corroborated with data from other existing studies, or which can be verified directly in dedicated research.