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Testing of Digital Skills of Students and Teachers in Slovakia

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Abstract

In Slovakia in 2022 there was carried out already the eleventh cycle of the monitoring of the digital skills of the Slovak population. In their paper the authors pay attention to the results which in this monitoring were achieved by its participants – Slovak pupils/students and teachers of lower and upper secondary schools and higher education institutions. The authors of the present study results of these categories of the monitoring participants based on their comparison with the results which the given categories of the Slovak inhabitants had obtained in the previous years (cycles) of the monitoring. Involvement in the public testing has provided pupils of lower secondary schools (ISCED 2), students of upper secondary schools (ISCED 3) and higher education institutions (ISCED 5), or graduates of these schools, an opportunity to get a clear idea of whether they are properly prepared to work with computers and the internet. At the same time enabled lower and upper secondary teachers to assess themselves in terms of their digital skills and to identify what knowledge and skills they need to strengthen in this area to better cope with the demands placed on their teaching activities. An analysis of the test results shows that pupils and students' basic digital skills and IT knowledge, as well as their ability to apply them within different practical tasks have improved slightly and only in several cases there was recorded only the same level as which was achieved two or three years ago. However based on the comparison of the average testing success in two or three different testing cycles no explicit conclusions can be drawn, as the recorded changes have been influenced by a lot of factors which could more or less significantly influence these changes.

Keywords: digital skills, education, innovative technologies, IT knowledge, Slovakia, student, teacher, testing.

1. Introduction

Digital skills as part of information literacy have become increasingly important in the last decade. It is an important competency for life and work in the 21st century, which has been

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multiplied in particular by the rise of digitalization in everyday and working life. Digital skills, especially with the advent of artificial intelligence, should become one of the important skills receiving increased attention in schools (Ng et al., 2023). As Andres and Hrmo (2020) state in their study, schools and education must naturally adapt to the change that comes with the Industrial Revolution 4.0, as it will trigger a change in the job system as we know it today. Based on various analyses and foresight studies, we can predict (Hall et al., 2019; Herich, 2019) that the labour market demands for school graduates in the future will evolve more in the way of increasing digital skills, analytical and language skills, critical thinking and team collaboration. In this context, Leoste et al. (2022) point out that it is essential to improve education in engineering, science and mathematics in particular. In addition to soft skills, it is essential to develop STEM knowledge, which is essential for Industry 4.0. It is predicted that schools will have to change comprehensively over the next twenty years due to the changes brought about by the more invasive emergence of artificial intelligence (Giang et al., 2021).

2. Theoretical framework

For almost two years, the crisis caused by the COVID-19 pandemic has been testing the digital skills of us all, unnoticed by the main actors involved in the education sector. For the first time, teachers were left with no choice but to use digital means to deliver education and training. This pandemic was a great opportunity for teachers and students alike, challenging them to improve their use of digital teaching tools. Several recently published studies report (Antonova et al., 2021; Nilsberth et al., 2021; Pavlíková et al., 2021) that in the new conditions of lockdowns, those teachers who were able to adapt to the new situation, also thanks to better digital skills, were especially better able to overcome obstacles in their teaching activities. Despite the many extensive restrictions on face-to-face teaching in schools during the ongoing COVID-19 pandemic crisis, we believe that this situation has convinced teachers of the necessity to continuously improve their digital skills, without which they will not get far in their private and professional lives (Barnová et al., 2020). Teachers have to get used to the fact that the future will belong to a hybrid form of education in which some students attend classes in school classrooms in person, while others learn from home at the same time (Singh et al., 2021). Therefore, it is the responsibility of every teacher to be prepared for this model of teaching and learning for pupils/students and to fully exploit the potential of digital didactic tools (Perifanou et al., 2021).

As the world becomes increasingly digital in its many dimensions, European citizens need a certain level of digital skills in the application of innovative digital technologies in order to be able to manage both their private and working lives. Regarding the level of digital skills, the European area refers in particular to the European Digital Competences Framework for Citizens (DigComp in current version 2.2), which requires an adult citizen with a basic level of digital skills to be able to perform simple tasks in all the domains listed by the European Council (Carretero et al., 2018). The level of digital skills is determined by several factors. These include, for example, physical infrastructure, i.e. the availability of computers and good internet connectivity. Analysis by OECD (2019) shows that although gender differences are not particularly pronounced, the educational attainment and age of citizens have a significant impact on their digital skills levels. In most European Union (hereafter EU) countries, many low-educated adults lack basic proficiency in using digital tools in everyday private and professional life, while these digital skills are almost universal among adults with tertiary education (level ISCED 5, ISCED 6). In terms of age, the digital skills of those over thirty in the sample are gradually deteriorating. The state of this reality is also reflected in various international measurements.

Every year since 2015 (with the exception of 2018) the Statistical Office of the European Union (Eurostat) publishes a composite indicator to measure the digital skills of EU citizens in the four domains under assessment, known as the Digital Skills Indicator (DSI), which corresponds to the five domains of the European Digital Competences Framework for Citizens (DigComp), with the exception of the Safety competence area. However, since 2021, the Digital Skills Indicator (currently version 2.0) has been updated and its scope expanded by adding a fifth competency area, Safety, to the four existing areas – Information and data literacy; Communication and collaboration; Digital content creation and Problem solving, thus usefully aligning the indicator with the DigComp 2.2 framework (Vuorikari et al., 2022). According to Eurostat data, around half of EU citizens (54 %) who were students, in employment or looking for work in 2021, i.e. people aged 16-74, had at least basic digital skills, 26 percentage points below the EU's 2030 vision for

Europe's digital transformation goals (Eurostat, 2022). This proportion was higher among people with low levels of education, the elderly and the unemployed. Eurostat's European Digital Skills Survey found that the level of digital skills of the adult population is growing slowly, with significant differences between EU member states. In 2021, the share of 16-74 year olds with at least basic digital skills was highest in the Netherlands and Finland (both 79 %), followed by Ireland (70 %). On the other hand, Romania had the lowest share (28 %), followed by Bulgaria (31 %) and Poland (43 %).

OECD (2015) states that a consequence of the 'digital divide' between citizens within EU countries is that adults with lower levels of digital skills are more likely to face problems finding employment and earn less when they do enter the workforce than adults with higher levels of digital skills. OECD (2016) analysis shows that demand for basic digital skills has increased in most countries. As a result, many working adults use digital resources regularly without adequate IT skills – on average, more than 40 % of workers using Microsoft Office software applications every day do not have sufficient skills to use it effectively. In February 2020, the European Commission highlighted in its document Shaping Europe's Digital Future that more than 90 % of jobs already require at least basic digital skills, but the need for digital skills goes beyond the labour market (European Union, 2020).

Based on Eurostat's *Digital Skills Indicator*, we can observe from a long-term perspective that the level of both basic and advanced digital skills in most member states has gradually increased in recent years to the EU average. Figure 1 shows the evolution of digital skills of economically active adults captured over time from 2015 to 2019 in all EU member states. As can be deduced from the graphical visualisation, in seven member states – including Slovakia – the share of adults with at least basic digital skills decreased slightly between 2015 and 2019 (European Union, 2021).

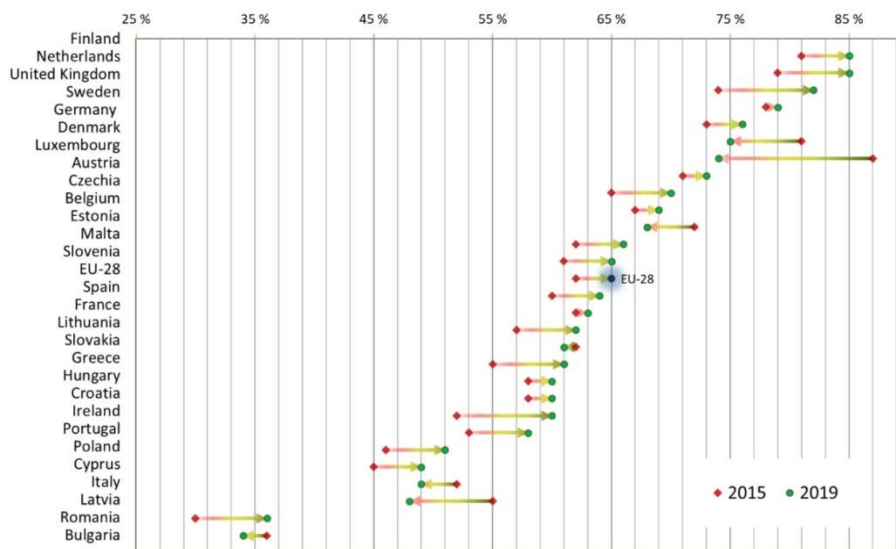


Fig. 1. Percentage of the workforce aged 25-64 (at least) with basic digital skills
Source: European Union, 2021

Other relevant measurements providing indicators in the field of digital skills of some target groups of the Slovak population include, for example, the international measurement of the level and way of developing computer and information literacy of Slovak pupils and teachers called ICILS (The International Computer and Information Literacy Study), as well as the international survey of competency profiles of teachers working at ISCED level 2 called PIAAC online. However, in the last part of the paper, we cross-sectionally map the results achieved by Slovak researchers – pupils of primary schools, students of lower and upper secondary schools, students of grammar schools over 15 years of age and students of higher education institutions and the teachers of these schools, as well as other interested parties, participating in the national measurement of digital skills in different educational contexts through the online tool IT Fitness Test. It is worth mentioning that the eleventh edition of the IT Fitness Test 2022 was available for the first time in all four V4 countries, i.e. in Slovakia, the Czech Republic, Hungary and Poland.

Based on the above literature review, as well as further extensive research of available domestic and foreign sources, we can predict that the digital skills of the entire population of Slovakia, from lower primary school pupils and eight-year grammar schools to adults, must be improved if they are to successfully face the challenges of digital transformation. Improving digital skills takes time and systematic implementation of measures. The need to educate and upskill people in Slovakia to work with and use digital technologies is supported by a number of national strategies. An example is the National digital skills strategy of the Slovak republic and the Action plan for the years 2023–2026. The need for this national document is also demonstrated by the intensive deployment of digital elements and systems in almost all areas of the economy, industry and society. This creates pressure to expand the basic literacy of the workforce with new digital skills and competences. However, this applies not only to the current workforce, but also to the future workforce. Digitalization affects the lives of all citizens, regardless of age, gender or geographical location. An adequate level of digital skills is a prerequisite for an individual's employability in an ever-changing labour market. Without adequate knowledge of digital skills, an individual's ability to communicate electronically, especially in the near future, will be severely limited, especially in terms of employment. Therefore, in acquiring this knowledge and skills, active support is necessary not only from the state, but also from other representatives of private companies and nonprofit organizations, in order to build digital literacy and competences of the general public, not only professionals, but also the general public.

At this point, we consider it necessary to note that the paper is a follow-up to a paper presented at the 19th international conference on Efficiency and Responsibility in Education 2022 (Záhorec et al., 2022). In this conference paper, the authors present some of the results achieved by the different categories of solvers in the tenth cycle of the IT Fitness Test conducted in 2021. The current paper discusses the results from the testing carried out in the last (2022), eleventh cycle of testing by comparing them with the results obtained from the previous two years, i.e. 2021 and 2020.

3. Research sample and methods

Since 2009, Slovak citizens have had the opportunity to (voluntarily) test their digital knowledge and skills through the online tool IT Fitness Test and thus get a realistic picture of their level compared to the European average. The priority target groups of the testing are pupils in the ending years of lower secondary schools and lower grades of eight-year grammar schools, respectively graduates of lower secondary schools aged from 14 to 16 years, students of upper secondary schools and higher education institutions older than 15 years of age. In addition to their pupils and students, IT Fitness test can also be taken by their teachers and educators, as well as other interested persons of any age. The IT Fitness Test is published annually on a publicly accessible portal, so anyone who has filled in the required data can take part.

For the knowledge and competence part of the IT Fitness Test, which focuses on the actual practical verification of the respondent's digital skills in various IT areas, two variants of test tools are administered.

The first test instrument is optimally designed for the age group of 14 to 16 years. This means that this variant of the IT Fitness Test is designed by the authors with a view to verifying the key digital competences of pupils in the lower grades of eight-year grammar schools, ninth grades of upper secondary schools or their graduates continuing their studies at a higher level of education, i.e. students currently in the first year of secondary school. In designing this easier variant of the test each year, the aim is to create tasks that are more interesting, more practice-based and less directly focused on the context taught in a particular school. Rather, the intention is to focus on testing the ability to analyse input information. Further, the emphasis is on understanding contexts and drawing conclusions, problem solving and critical thinking. Tasks at different, but rather higher cognitive levels (comprehension, application, analysis, evaluation) are represented in the test. Some of the tasks are more complex and are therefore designed as a cluster of dichotomous tasks.

The second test instrument is designed for test takers over 15 years of age. This group includes students and teachers of upper secondary schools and higher education institutions, as well as various age categories of other employed citizens of the Slovak Republic. This more demanding variant of the test is aimed at determining the level of their basic and more advanced knowledge and skills in the field of digital technologies, determining their competences in creating

and presenting digital information (office software, Internet), as well as determining their practical skills in searching and processing information (sources, searching and sorting, communication).

Each year, the tasks in the IT Fitness Test come from five thematic areas, namely:

- Internet,
- Digital safety and computer systems,
- Complex tasks,
- Office software tools,
- Collaborative tools and social networks.

Each topic area contains a certain number of questions/tasks depending on the age group of the test takers for which the test variant is intended. Each subject area of the test for pupils upper secondary schools, pupils in the lower grades of eight-year grammar schools or graduates of those schools aged 14 to 16 years contains four tasks. The test for those aged 15 and over contains five items in each subject area. The respondent will receive information on the achievement in each subject area at the end of the test. The content structure of the IT Fitness Test is created by a team of experts from the Technical University of Košice and educators from primary and secondary schools.

The eleventh year of the largest and most extensive IT knowledge and skills testing in Slovakia, the IT Fitness Test 2022, brought interesting results, when all target groups, for which this digital skills testing was intended, ended up with better success rates than in 2021, but on the other hand worse than in "Covid's" year 2020 (Kučera, Jakab, 2022). The improvement in performance is evident in basic IT skills and knowledge, but also in their connection to practice. From the testing results, it can be observed that the difference in the year-on-year success rate achieved by solvers in the tasks varies from 0 to 20 percentage points. However, this cannot be interpreted as an absolute improvement, as it reflects other factors, such as a change in the research sample, a slight change in the wording of the questions, or a change in the testing conditions, which may have had a more or less pronounced effect on the testing results.

Based on the results of the success rate achieved in 2021 (Kučera, Jakab, 2021), the authors of the IT Fitness Test in 2022 wanted to create both variants of the test with approximately similar difficulty of the tasks as in 2021. Behind this conceptual intention was an effort to make the final success rate of the test as close as possible to the middle of the interval of the optimal success rate of 50-60 % in the individual categories of the solvers. A success rate in this interval will help to maximise the discriminatory power of the test, i.e. the sensitivity of the test, i.e. the test will be able to distinguish between solvers with good knowledge and skills and those with poor knowledge and skills. Therefore, the authors sought to design both variants of the IT Fitness Test to contain tasks of varying difficulty, but with the aim of avoiding extremely difficult and extremely easy tasks – as stated in testing theory, the optimal task difficulty is approximately from the interval 20-80 % (Munk, 2011). When the IT Fitness Test tasks are not piloted in advance on a selected set of respondents, estimating their difficulty parameter tends to be very difficult each year.

4. Results and discussion

As part of the eleventh edition of the IT Fitness Test, 27 757 solvers took part in its more challenging variant intended for the target group older than 15 years of age (in 2021 it was 27 436 solvers; in 2020 only 13 649 solvers), what compared to 2021 means a year-on-year increase of 1.16 %, respectively, an increase of 50.83 % compared to 2020. In terms of participation by gender, there was a slight increase in female participation from 47 % to 49 % compared to the previous year of testing. Men made up 51 % of the entire corpus of respondents to this variant of the test. The overall average pass rate in this test variant is 52.55 %. There was an increase of almost 12.37 percentage points compared to 2021 (40.18 %). We were not surprised by this result; what was surprising was the lower result compared to the so-called "Covid" year of 2020 (average pass rate of 61.65 %), when there was a decrease of almost 9.1 percentage points. In terms of the test's discriminatory power, there was an increase from 58.65 % in 2021 to 66.38 % this year. So we can say that the test had an excellent resolution. We believe that the year-on-year increase in the sensitivity of the test was probably influenced by, among other things, the fact that the tasks did not have a set compulsory answer. That is, the respondent did not have to answer every task, and thus if they did not want to guess the answer and wanted real feedback, they could do so. The very good sensitivity of the test also affected the reliability of the test (Cronbach's alpha), which increased to 0.88 compared to 2021. The test for respondents over 15 years of age was attended by students from 567 secondary schools, universities and educational institutions, while in 2021 they

participated in the testing of 535 schools and in 2020 from 376 schools. The strongest age category consisted of respondents aged 16-18 (82 %), which corresponds to secondary school students (year 2021 – 82 %). The percentage of teachers in the more challenging variant of the IT Fitness Test 2022 remained the same as in the previous measurement, i.e. at the level of 9 %. More detailed basic psychometric parameters of IT Fitness Test 2022 compared to 2021 and 2020 in a group of solvers over 15 years of age are tabled at the top of [Table 1](#).

In the easier variant of digital skills and knowledge testing designed for primary schools and lower grades of eight-year grammar schools, the eleventh edition of the IT Fitness Test involved 14 193 solvers in the age category of 7 to 16 years. We therefore detect a year-on-year decline of almost 15 %, with 16 698 test takers in 2021 (in 2020 only 7 246 solver). Pupils from 701 primary schools took part in testing the digital skills of solvers in the category of 7 to 16 years of age, while in 2021, pupils from 790 schools took part (in 2020 – 445 schools, in 2019 – 496 schools). The strongest representation of respondents in the easier variant of the test were pupils aged 13, 14 and 15. The average pass rate for the easier variant of the test achieved in the primary age group of 14-16 year olds is 58.72 % (in 2021 the average pass rate was 42.53 %), which means that the result achieved is within the desired intentions of an optimal pass rate of 50-60 %. A comparison of the results shows that the success rate in the IT Fitness Test 2022 in the primary age category of pupils, i.e. those aged 14-16, has increased by more than 16 percentage points compared to the results achieved in 2021. The same positive fact regarding the optimal pass rate (50-60 %) is also observed for the whole group of test takers involved in the easier variant of the test, i.e. for the age group of pupils aged 7-16 years, when the pass rate reached 55.03 %. At the same time, it should be emphasized that the test discriminated very well the results of the respondents. The overall discriminatory power of the test was 66.97 %, which is a significant increase compared to 2021 (51.01 %). A detailed percentage picture of the average success rate in the different age categories of solvers participating in the easier variant of the test is tabulated in the lower part of [Table 1](#).

Table 1. Basic psychometric parameters of the IT Fitness Test 2022 vs. 2021

Test for solvers over 15 years old	2022	2021	2020
Number of test takers over 15 years of age	27 757	27 436	13 649
Overall average success rate of all solvers	52.55 %	40.18 %	61.65 %
Average success rate of students from secondary schools/universities	51.77 %	38.25 %	60.60 %
Average success rate of teachers	57.39 %	52.23 %	70.55 %
Average success rate of teachers – digital coordinators	78.49 %	category of respondents was not tested	
Average success rate of other employees	60.41 %	54.64 %	68.44 %
Sensitivity of the test	66.38 %	58.65 %	63.28 %
Test Reliability (Cronbach's alpha)	0.877	0.846	0.870
Test for pupils of primary and lower secondary schools and graduates aged 7 to 16	2022	2021	2020
Number of test takers aged 7-16	14 193	16 698	7 246
Overall average success rate of solvers aged 7-16 years	55.03 %	39.99 %	64.98 %
Average success rate of solvers aged 7-13	50.27 %	36.72 %	59.49 %
Average success rate of solvers aged 14-16	58.72 %	42.53 %	67.94 %
Sensitivity of the test	66.97 %	51.01 %	54.26 %
Average success rate of teachers	66.09 %	57.61 %	73.19 %
Average success rate of teachers – digital coordinators	82.06 %	category of respondents was not tested	
Test Reliability (Cronbach's alpha)	0.845	0.730	0.787

Source: own elaboration based on [Kučera, Jakab, 2021](#); [Kučera, Jakab, 2022](#)

The test for the age limit over 15 years was completed by 2 549 solvers who said they were teachers (in 2021 it was 2 396 teachers; in 2020 only 414 teachers). As mentioned in [Table 1](#), the average success rate of teachers in this test variant was 57.39 % (year 2021 – 52.23 %; year 2020 –

70.55 %; year 2019 – 73.19 %), which means that success rate In the verification of digital skills and the knowledge of this group of solvers, 50-60 % is again in the interval of the optimal test success.

The easier variant of the IT Fitness Test was completed by 637 solvers who indicated that they were teachers (in 2021 it was 547 teachers; in 2020 it was 136 teachers; in 2019 only 243 teachers). Of these, 17 were teachers who are also digital coordinators within their school. The average pass rate achieved by teachers in the easier variant of the test was 66.09 %, an increase of almost 9 percentage points (8.48 %) compared to 2021 (57.61 %). On the other hand, this is still below the average pass rate for this test variant achieved in the "Covid" year of 2020 (73.19 %). The percentage picture of the average success rate in the group of teachers in the easier version of the IT Fitness Test, differentiated according to the municipal regions of Slovakia, is presented in [Table 2](#).

Table 2. Average teachers' success achieved in the easier variant of the test administered in 2022 and 2021 differentiated by region

Autonomous Region of the Slovak Republic	Average success rate in 2022		Average success rate in 2021	
	students and absens of elementary school at the age of 7-16 [%]	Teachers [%]	students and absens of elementary school at the age of 7-16 [%]	Teachers [%]
Trenčín region	51.94	70.09	36.95	63.24
Nitra region	51.27	64.83	39.05	60.56
Bratislava region	62.47	64.90	45.58	59.20
Trnava region	53.31	65.24	40.85	58.93
Žilina region	54.87	75.26	38.65	55.96
Banská Bystrica region	53.55	63.48	38.98	55.44
Košice region	52.40	65.93	40.55	54.92
Prešov region	55.18	65.81	39.50	53.86

Source: own elaboration based on [Kučera, Jakab, 2021](#); [Kučera, Jakab, 2022](#)

As in the two previous years, the highest success rate of respondents in the regions completing the easier version of the IT Fitness Test, primarily intended for students or graduates of upper secondary schools, was in the Bratislava region in 2022, followed by the Prešov region in second place. The representation of teachers completing the lighter version of the test has increased in most cases within individual self-governing regions (the only exception is Žilina region – 2022/N = 39; 2021/N = 99). The highest representation of teachers within regions was in the Prešov (N = 124) and Nitra (N = 120) regions; in the previous year, the Nitra (N = 117) and Žilina (N = 99) regions had the highest representation. The average success rate of teachers in the regions who completed the easier variant of the test is the highest in Žilina region (75.26 %), followed by Trenčín region (70.09 %). On the contrary, the lowest success rate in this version of the test is in the Banská Bystrica region (63.48 %) and the Nitra region (64.83 %). In all groups of teachers with respect to the region, a year-on-year increase in the average testing of testing has been recorded compared to previous testing. Compared to 2021, there was the greatest increase in the average success of testing, almost 20 percentage points in the group of teachers from the Žilina region. On the contrary, the smallest increase in average success (4.27 %) was recorded in a group of teachers from the Nitra region. At this point it is worth mentioning that while in the previous cycle of testing in 2021 teachers in Trenčín region had the highest success rate of 63.24 %, in the testing in 2022 teachers in Banská Bystrica region with approximately the same success rate (63.48 %) were ranked last in the regions. This can be seen as a positive development.

[Table 1](#) shows that the best results achieved in the more challenging variant of the IT Fitness Test 2022, designed for the target group of test takers aged 15 years and over, were achieved by the category of other employed (as was the case in 2021), with a pass rate of 60.41 %. In 2022, the second and third place in the digital skills and knowledge verification were teachers and students of secondary schools/university respectively ([Table 1](#)). Teachers' overall average passing score on the test was approximately 1.11 times the overall average passing score of secondary schools/university students (in 2021 it was 1.37 times; in 2020 it was 1.16 times; in 2019 it was

1.33 times). Based on the statistical evaluation of the IT Fitness Test results obtained from the previous years, a trend was observed where the gap in the success rate of the test between secondary school/university students and teachers has been narrowing year by year. The exception is the year 2021, when the difference in success rate between the two groups was more pronounced. The percentage picture of the average success rate of the whole corpus of respondents, without their differentiation into groups categorised according to their age and according to their occupation or school (with age at least 15 years), as well as separately for the group of teachers, the group of students of upper secondary schools and higher education institutions and separately for the group of other employed citizens of the Slovak Republic of different age categories, achieved within individual self-governing regions of Slovakia (hereinafter referred to as the Slovak Republic) in the years 2022 and 2021 is presented in [Table 3](#).

Table 3. Average success rate in the variant of the test administered in 2022 and 2021 for solvers over 15 years of age differentiated by region

Autonomous Region of the Slovak Republic	Average success rate in 2022				Average success rate in 2021			
	All respondents [%]	Teachers [%]	Secondary school/ University students [%]	Others [%]	All respondents [%]	Teachers [%]	Secondary school/ University students [%]	Others [%]
Trenčín region	52.80	65.56	51.01	61.33	39.81	52.73	36.36	59.96
Nitra region	54.66	59.46	53.89	62.59	38.70	54.54	36.76	48.38
Bratislava region	52.04	56.69	50.91	64.02	41.20	61.19	39.02	52.53
Trnava region	50.55	56.74	49.48	59.49	42.41	56.14	41.01	48.96
Žilina region	51.62	58.87	50.97	64.05	39.41	52.93	37.64	59.16
Banská Bystrica region	53.85	58.26	52.85	63.28	38.18	51.29	34.86	60.37
Košice region	49.91	54.84	49.09	59.17	39.65	50.26	37.74	51.40
Prešov region	59.10	61.36	58.99	56.62	43.21	52.40	42.28	53.11

Source: own elaboration based on [Kučera, Jakab, 2021](#); [Kučera, Jakab, 2022](#)

Regarding the success of respondents in a more demanding variant of the IT Fitness Test 2022, it has achieved, as in the three previous years, i.e. also in 2022, the highest success rate was in the Prešov region (59.10 %). In the previous edition 2021, the difference between the region with the highest success rate (Prešov region) and the lowest success rate (Banská Bystrica region) was 5 percentage points. In 2022, the difference is 9 percentage points. Last year was the Nitra region (38.70 %) and the Banská Bystrica region (38.18 %) in the success of the regions in the last places, now they got to the second and third position (Nitra region – 54.66 %; Banská Bystrica Region – 53.85 %).

The highest average success rate was achieved by teachers in the Trenčín region, 65.56 %. The second highest average success rate was achieved by other employed citizens in the Žilina Region – 64.05 %. Teachers from the Košice region are significantly represented among teachers, making up 43 % of all teachers participating in the testing. The lowest success rate was achieved by students in the Košice region – 49.09 %. It may be interesting to compare other employed citizens

of different age categories and teachers within the regions. The highest difference between the success rate of other employed citizens and teachers is in the Bratislava region – 7.34 percentage points in favour of others. On the contrary, in the Prešov and Trenčín regions, the success rate of teachers is higher by 4.74 and 4.23 percentage points, respectively, in contrast to other employed citizens of the Slovak Republic in the same region.

The test for solvers over 15 years of age was divided into five thematic areas. Each thematic area contained five tasks. Table 4 shows the average success rate achieved in individual thematic areas of the test for the whole corpus of the solver, as well as for a group teachers of lower secondary schools, for a group students of upper secondary schools and higher education institutions and especially for a group of other employed Slovak citizens of different age categories. From the taboo data presented in Table 4, it can be seen that a group of teachers has achieved the highest test success in the thematic area of the Internet (70.71 %). Almost the same and at the same time the highest percentage of success (71.26 %) in the thematic area of the Internet is also mentioned in the group of secondary school/university students. Here we consider it necessary to note that in all five areas of digital skills verification was the most successful group of secondary school/university students. Within the four areas of testing, the group of teachers ranks second in the order of success after the group of students of secondary schools/universities, and finally the group of other employed citizens of the Slovak Republic who completed the test. A group of other employed citizens of different ages have achieved a better average success than a group of teachers, only in the thematic area of Collaborative tools and social networks.

From the results of the IT Fitness Test 2022 designed for solvers over 15 years of age, we can see (Table 4) that the strongest digital skills (without differentiating them into individual categories) were demonstrated by the solvers in the area of *Internet* use (65.60 %), such as searching for information in various forms on the internet, or using internet services. Based on the results obtained, we can conclude that the success rate in this area of digital skills testing has increased significantly compared to 2021, by approximately 16 percentage points (year 2021 – 49.83 %). This positive result can be stated despite the fact that the overall average success rate in the *Internet* topic area of all solvers over 15 years of age who took the more challenging variant of the IT Fitness Test is still lower by approximately 10 percentage points compared to the success rate achieved in the "Covid" year 2020 (success rate in 2020 – 75.18 %) (Kučera, Jakab, 2020).

The easier variant of the IT Fitness Test 2022 was divided into five thematic areas (as in the case of a test for solvers over 15 years of age), with each thematic area containing four tasks. In this variant of the test for lower secondary schools, primarily intended for solvers aged 14 to 16 years, are regularly the best results in a thematic area called *Internet*. In 2022, the best results were in the *Digital safety and computer systems* category. The *Internet* category had only the second highest success rate, reaching 62.72 % (year 2021 – 52.46 %; year 2020 – 79.19 %) (Table 5). Based on the analysis of the results achieved in this task area of the IT Fitness Test 2022, it can be observed that pupils are good at directly searching for specific information that is explicitly mentioned in a source. Pupils performed best in locating a place on a map from a photograph. They also regularly perform well in searching for transport links. In 2022, pupils aged 14 to 16 years of age, compared to the previous year, improved in the search for video and its content. On the other hand, we would like to proclaim that the success rate in finding information on the internet is significantly reduced if pupils are to seek a source and evaluate some information in it and opt for the truth of these claims. If the information to be retrieved is in a certain complex structure from which only a certain part needs to be selected, the success rate of the solvers in the task also decreases. Tasks are also more difficult to find the information and then work to the correct answer through several steps. As for the sensitivity of the test for lower and upper secondary schools in each category, each of the five categories reached a sensitivity value above 60 %, of which we deduce that all categories have very well distinguished the test sample for solvers with good knowledge and skills from solvers with poor knowledge and skills. Tasks in the *Internet* category very well divide the test sample, the sensitivity of the category is the third highest of all categories and is 68.19 %. In 2021, this category had a sensitivity of 58.71 %.

Table 4. Achievement in each category of solvers with respect to the queried subject area in the test for solvers over 15 years old

Testing area/Category of solvers	Average success rate in each category			
	All respondents	Teachers	Secondary school/ University students	Others
Internet	65.60 %	70.71 %	71.26 %	64.86 %
Digital safety and computer systems	62.26 %	63.30 %	68.53 %	61.72 %
Complex tasks	45.68 %	50.84 %	53.88 %	44.85 %
Office software tools	34.78 %	47.07 %	50.16 %	32.95 %
Collaborative tools and social networks	54.45 %	53.01 %	58.20 %	54.47 %

Source: own elaboration based on Kučera, Jakab, 2022

Table 5. Achievement in each category of 14-16 years old with respect to the queried subject area in the easier variant of the test

Testing area/Year of testing	Average success rate 14-16 yrs. solvers		
	2022	2021	2020
Internet	62.72 %	52.46 %	79.19 %
Digital safety and computer systems	65.24 %	37.84 %	60.70 %
Complex tasks	50.76 %	39.50 %	71.71 %
Office software tools	44.17 %	31.82 %	42.83 %
Collaborative tools and social networks	52.23 %	38.78 %	70.46 %

Source: own elaboration based on Kučera, Jakab, 2022

Based on the results achieved in a more demanding variant of the IT Fitness Test 2022, we can state (Table 4) that in the field of Digital safety and computer systems, solvers from the global aspect (without differentiating them into individual categories according to occupation or school), solved the tasks with an overall success rate of 62.26 %, the same as in 2021 (46.52 %), the second highest success rate compared to other testing areas. The second best success rate in the implementation of test tasks in the area of Digital safety and computer systems was also achieved within the individual partial groups of solvers – teachers – 63.30 %; students of secondary schools/universities – 68.53 %; other employed citizens of the Slovak Republic – 61.72 %. At the same time, we can say that tasks in this category were very well distributed by better and weaker students when its sensitivity reached 63.83 % (the second highest sensitivity). The authors of Kučera and Jakab (2022) state in the final IT Fitness Test 2022 report that respondents are well oriented in the field of safety in the common knowledge they often encounter. In less standard situations, they navigate better than in the past. Respondents can understand safety settings and predict the behavior of the system. They can link basic knowledge and apply them to a less standard situation.

In the easier variant of IT Fitness Test 2022 in the group participating in the age category from 14 to 16 years of success, the success of solving Digital safety and computer systems tasks 65.24 % (year 2021 – 37,84 %; year 2020 – 60,70 %), which represents the highest level of success in this year compared to other areas of testing. In the past, this area of verification of digital skills and knowledge waved the second lowest success rate compared to other testing areas (Table 5). IT safety pupils can respond appropriately to basic safety situations and we can see the trend of year-on-year improvement of the entire corpus of respondents. In the past, the worst results in this area of testing and probably focusing on this issue in the context of the creation of various educational and test activities for teachers as well as pupils helped to change the knowledge of IT safety.

The thematic area Complex tasks included tasks aimed at solving problems of an algorithmic nature, i.e. tasks requiring higher cognitive thinking, also tasks aimed at complex skills in working with files, tasks to find information in an interactive graph and then evaluate it, and last but not least, tasks to discover the control and setup of a certain sequence of commands in the program notation. The overall success rate of solver filling the more demanding test variant was recorded at 45.68 % (in 2021 – 31.30 %), which is the second lowest result compared to four other areas of digital skills verification (Table 4). Similarly, the second lowest success rate in the more difficult variant of the test was also achieved within the different categories of solvers, teachers – 50.84 %, students – 53.88 % and other employed citizens of the Slovak Republic – 44.85 %. On the other hand, compared to 2021, we can observe a very slight improvement in the average success rate achieved within the individual groups of solvers – teachers 2021/39.86 %; students 2021/29.68 %; other employed citizens of the Slovak Republic 2021/46.44 %. The discriminatory ability of the test achieved in the thematic area of Complex tasks is very good, namely 66.43 %.

Although the success rate in the Complex task topic area is higher compared to 2021, we see that secondary school and university students completing the more challenging variant of the test are deficient in solving algorithmic problems with higher cognitive demand, where problem solving is required at a complex level. In solving, students prefer answers resulting from a quick decision. In the final report of the IT Fitness Test 2022, the authors Kučera and Jakab (2022) state that solvers from a global perspective, i.e. without differentiating them into individual categories according to occupation or school, are less willing to investigate the features of the system in more detail, to doubt the correctness of the result, and then to verify the answers that are quickly offered. Also based on the comments made on the tasks, it can be observed that there is a tendency towards less acceptance of the defined rules in the task and that it is cognitively more comfortable for the respondent to solve the task in the context of his/her own ideas. We share the opinion of the authors of the IT Fitness Test 2022 that there is still a lot of room for improvement and refinement of respondents' skills in solving complex algorithmic tasks. We believe that in order to improve testing results in the future, it is necessary to include tasks of this nature more often in the teaching process in primary school.

In the easier variant of the IT Fitness Test 2022, designed primarily for students aged 14 to 16 years, the average pass rate in the Complex tasks topic area was 50.76 % (Table 5). From the analysis of the results obtained, it can be deduced that pupils in the ending years of lower secondary schools or eight-year grammar schools and the graduates of those schools aged between 14 and 16 years have reserves in evaluating the sequence of commands when debugging a program, in deciding whether a given sequence of program commands performs exactly what it was programmed to do.

The IT Fitness Test 2022 again revealed large reserves in the field of work with Office software tools, understanding and working with data in some structure, working with tables and charts, while digital skills in this area are today one of the basic conditions for successful enforcement conditions to the labor market. This area of testing has long been one of the categories with the lowest success rate achieved, whether within a more demanding test variant (year 2022 – 34.78 %; year 2021 – 37.17 %), as well as a variant of the test for lower and upper secondary schools, primarily intended for solvers of age agencies from 14 to 16 years (year 2022 – 44.17 %; year 2021 – 31.82 %). Tasks in the Office software tools area focus on formatting and copying text, or copying set format properties of text paragraphs within the structure of a large text document. This area of digital skills verification also contains tasks aimed at processing tabled data through mathematical expressions and their graphic visualization. We believe that this topic is probably less attractive for pupils/students, so it is necessary to look for suitable methods and context that will be more interested in pupils/students.

Despite the lower success rate, the sensitivity of the thematic area was the Office software tools in the more demanding test variant very good, namely 59.59 %. This means that we also have very clever respondents and vice versa, respondents who have significant reserves on the subject. In this area, especially other employed citizens of the Slovak Republic have significant reserves, when the average success rate of respondents is 32.95 %. A large proportion of teachers and students of secondary schools and universities also had problems with the tasks of this area of testing (average teachers' success: 47.07 %; average success rate of secondary school/university students: 50.16 %) (Table 4). Based on the results achieved from the IT Fitness Test 2022, it seems that these groups of solvers have little practical experience with the characteristics of the formatted

text and its copying, and that they are little understanding of the structure of a large textual document. The results of the IT Fitness Test from previous years have been observed for a long time, when in this area of verification of digital skills was achieved the biggest difference in success between the teachers and a group of pupils of 14-16 year olds of lower secondary schools filling the easier variant of the test, respectively among the teachers and a group of students of upper secondary schools and higher education institutions filling in a more demanding test variant of the test, of course upper, for the benefit of teachers – in the past more than 15 percentage points. From the results achieved in 2022, it can be noted that the differences in the success of solving tasks from the thematic area of Office software tools among these groups of solvers who have completed one of the test variants are beginning to shrink. This can be considered a minor positive.

The overall average success rate of pupils aged 14-16 years as part of the easier variant of the IT Fitness Test 2022, the Office software tools reached a level of 44.17 %. Although the Office software tools topic area had the lowest achievement of all five areas of digital skills testing, we see a slight year-on-year improvement of 12.35 % in this area compared to 2021. In the actual work with tabulated data and its graphical visualisations, we see a significant improvement compared to 2021 for the group of pupils aged 14-16 (year 2022 – 44.17 %; year 2021 – 31.82 %), as well as for teachers completing the easier variant of the test (year 2022 – 58.72 %; year 2021 – 42.53 %). We observe that if the task tests some knowledge only theoretically or by inducing a model situation, the results are better, but not sufficient. As the authors Kučera and Jakab state in their final report (2022), the difference in the success rate achieved in the individual tasks is whether the respondents have to understand the tabulated data, the information visualized through a graph and evaluate it, or whether they have to work further with these structured data objects, for example, to search for specific information according to a given criterion, or to use spreadsheet tools to arrive at certain calculations and only in a subsequent step to evaluate the obtained data. Significant reserves in the group of pupils aged 14-16 filling in the easier variant of the test are also seen in critical thinking, in the need to express themselves accurately and to focus on a precise description of the information. Slight improvement is seen in tasks aimed at understanding graphical visualisation of data and in identifying the source data belonging to the graph produced. In the words of the authors of the IT Fitness Test 2022, based on the unflattering result achieved by the above group of solvers, there is room for improvement. Looking at the sensitivity of 70.33 % achieved in the more challenging version of the test (the category with the second highest sensitivity), we can see that the tasks from the Office software tools topic area distributed the sample of test takers very well. It appears that it is in this area of digital skills testing that the scissors between the high achievers and the low achievers are significantly blurred. Perhaps this is also due to the difference in the quality of teaching in individual schools. We believe that it is in schools with higher quality teaching in the area of applying digital tools to the solution of educational activities that they have enough time to address this topic at an appropriate cognitive level.

In the area of testing called Collaborative tools and social networks, the success rate for the group of teachers (53.01 %) completing the more challenging version of the IT Fitness Test 2022 was within the intent of the optimal average test pass rate (50 % to 60 %). However, this is still almost 18 percentage points lower than the success rate achieved by teachers in the Internet subject area (70.71 %). The average success rate falling within the range of the optimal average success rate can also be observed within the group of students of secondary schools/universities (58.20 %) or the group of other employed citizens of different age groups (54.47 %) who completed the test (Table 4). Based on testing the same digital skills compared to 2021, we see a slight improvement in the category of teachers (year 2021 – 47.63 %). In the past, the success rate of teachers in this area of testing has been higher than or at least comparable to that of students. This year, student achievement was 5 percentage points higher than teacher achievement. Nevertheless, we still see space for a significant improvement in the level of digital skills in a group of teachers, as well as students over 15 years of age (students of secondary schools and universities) filling in a more demanding test variant of the test. At this point, we consider it necessary to note that it is precisely the tasks of Collaborative tools and social networks that best distributed a sample of tested respondents, when the sensitivity in this area reached an excellent value of 76.29 %. In the category of pupils of the ending years of lower secondary schools or eight-year grammar schools and graduates of these schools aged 14 to 16 years filling the easier variant of the test, an average test success rate of 52.23 % was achieved 2021 (38.78 %) falls into the intentions of optimal average test success (50-60 %) (Table 5).

From the results of the IT Fitness Test 2022, we can conclude that the solvers of both variants of the test are proficient in questions focused on searching for specific posts on the social networks Instagram and Facebook, but still this year they had small reserves when it comes to verifying the required information on the social network Twitter. On the other hand, this cannot be considered a surprising result, as it is a less used social network among pupils/students. In the group of solvers completing the more challenging variant of the test (i.e. over 15 years old), the file sharing task had the highest success rate in this area of testing (66.18 %). Its success rate was comparable to previous years (year 2021 – 58.09 %; year 2020 – 57.25 %). Although similar skills have been tested in previous editions of the IT Fitness Test, the results do not see a significant improvement in these skills. Overall, we see that respondents are well versed in this area of testing. They have experience of Instagram and Facebook, and can search, identify basic information and interpret it. Based on the results obtained, we can conclude that the basic knowledge and working with cloud-based tools designed for collaboration in the field of creation and management of electronic online documents are also at a good level (Kučera, Jakab, 2022). In the group of solvers aged 14 to 16 years completing the easier variant of the test, the results in tasks aimed at working with shared files are slightly better (the average success rate of all four variants of tasks from the Cloud group within the category Collaborative tools and social networks reached 66.18 %) compared to the previous year 2021 (61.13 %), but not better than in previous years (e.g. year 2020 – 83.49 %). The situation is similar for searching for video files in the YouTube online database. Pupils also have some reserves when it comes to evaluating the veracity of information presented on social networks or searching for it themselves. Similarly to other categories of solvers completing the more difficult variant of the test, we see that the skill level of the solvers has decreased, with 14 to 16 year olds struggling with tasks that require higher cognitive operations and linking contexts. We share the view of the authors of the IT Fitness Test 2022 stated in the final report (2022) that pupils in the 14-16 age group still need to be engaged in the development of critical thinking, evaluating information and assessing its quality, credibility and veracity.

5. Conclusion

We share the view of Frolova et al. (2020) that digital competences are nowadays essential not only in studies or work, but also in everyday life. The IT Fitness Test is a tried and tested method of testing digital skills and knowledge, which has provided the graduates of lower and upper secondary schools a clear idea of whether they can work with computers and the internet at the level commonly demanded by employers in today's labour market. It gave teachers of regional education, i.e. teachers of primary (ISCED 1) and of lower (ISCED 2) and upper secondary schools (ISCED 3), a relevant picture of where they stand in terms of digital skills and where they need to strengthen in this area in order to be better able to overcome obstacles in their teaching activities in the future.

The results of the descriptive measurement statistics achieved in the IT Fitness Test 2022 clearly show us that we cannot stay satisfied with the proven level of digital skills and knowledge of the target groups of solver – pupils of the ending years of lower secondary schools and eight-year grammar schools or graduates of these schools between the ages of 14 to 16, students of upper secondary schools and higher education institutions preparing for their future professional application within the company, as well as last but not least in a group of teachers of lower and upper secondary schools. Obviously, it is necessary to focus more on the circumstances of developing digital literacy of pupils in primary and lower secondary schools and addressing investment in this area of education.

Based on the above measurement results achieved in the IT Fitness Test 2022, we believe that one of the main conceptual goals of the Department of Education of the Slovak Republic in the near future is to prepare educational institutions in the field of regional education for the implementation of concrete steps towards their digital transformation into schools that develop digital competencies of their students and teachers, effectively use digital technologies in communication with the community of educational actors, in teaching and in active student cognition, assessment and self-assessment. Overall, these are comprehensive materials that include a strategy for developing digital skills not only for young people but for society as a whole through lifelong learning.

6. Recommendations

We are convinced that schools should focus more on linking knowledge from several IT areas, but also on linking theoretical knowledge with practical skills of pupils, experience, to encounter various new problems in different context. Teachers should, to a greater extent, award project educational activities requiring higher cognitive operations that engage pupils in longer-lasting open issues or problems. The aim of these projects is to point out some possibilities of linking digital skills and knowledge with practice. Pupils should be more creative to solve tasks and analyze the problems more thoroughly. It is also necessary to start more actively on raising awareness of students of secondary (vocational) and universities, as it is constantly confirmed that the extent to which the students at school acquire digital skills will later have a high impact on their life chances to assert themselves on the market work (Hrmo et al., 2016). Already today, surveys among employers indicate that for most of them the ability to work with digital means at the basic level is expected and key skill of a potential employee with secondary education (Khuraisah et al., 2020; Feijao et al., 2021). At the same time, part of them states the lack of preparedness of school graduates in this area.

The presented outcomes from the measurement of the IT Fitness Test 2022 suggest to us that there is a need to emphasize the undergraduate preparation of future teachers. In this context, we agree with the assertion of the authors Nagyová (2016) and Napal Fraile et al. (2018) that it is essential to focus attention in the area of academic disciplines that, in the context of undergraduate education, prepare future teachers to be erudite in the application of digital didactic tools and software applications in the teaching of the subjects of their apprenticeship. Therefore, it remains for discussion and assessment by the relevant experts how to adapt the teaching of the relevant educational disciplines – in their content, time allocation and the way of their inclusion in the curricular structure, to the study programmes of teaching at the tertiary level of education in the context of the current needs of pedagogical practice with regard to the formation of professional digital skills of teachers.

We are convinced that, to further increase the level of digital skills of Slovak pupils/students and teachers of lower and upper secondary schools and higher education institutions, European investments from the plan for renewal of Slovakia will also contribute in the near future, where considerable funds are intended not only for digitization of teaching, but also improving the education itself in this the area of the area. We consider a modern and innovative approach to the way of providing education and training in individual areas in the process of smooth digital transformation of education in Slovakia.

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