

THE LEVEL OF PROBLEM-SOLVING SKILLS IN A TECHNOLOGY-RICH ENVIRONMENT AND THE USE OF ICT AMONG ESTONIAN ADULTS

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It is an accepted understanding in Europe that ICT skills are absolutely necessary for people to function as proper citizens in an information-intensive environment and information society: only the all-round use of ICT enables each person to benefit from opportunities offered by technology to the maximum extent. Furthermore, ICT literacy and the active and versatile use of ICT based on such skills are considered as an excellent opportunity to harmonize different social and demographic backgrounds and create a more coherent and equal society. However, the assessment of ICT skills is difficult. Due to this reason, discussions of this topic have often focused on a digital divide. On the one shore of this divide are ICT users and on the other are non-users. In Estonia, not a great deal of attention has been paid to what exactly ICT users do or can do. However, with the rising Internet penetration rate a realisation has grown that access as such is not sufficient – the notion of digital stratification has been brought into the discussion and, in its turn, the notion of types of Internet users. Thus, the usual distinction between the Internet and computer users and non-users has been broadened.

Proceeding from the aforesaid, the fifth thematic report of the PIAAC study analyses ICT skills and the need for their use, explores measurement methods for ICT skills and their use on the basis of the PIAAC data and attempts to answer the question how ICT skills and their use are distributed among Estonian adults. Although it has been tried to keep the ICT component separate from the problem-solving indicator measured in PIAAC, attempts to overcome this challenge, unfortunately, have been unsuccessful. Thus, the results of problem-solving skills in a technology-rich environment are treated exactly as they are defined and compared with the scope of ICT use, its diversity and types of computer users. Moreover, links between ICT skills and ICT use and various economic indicators are analysed both at the individual and macro-level. Regarding national indicators, the focus is on comparing productivity in various production sectors and on the search for links to the types of computer use and skills. In the report Estonia is compared with five countries with similar computer use indicators: Austria, Finland, the Czech Republic, Slovakia and Ireland.

Because of methodological reasons, the list of computer users' activities on which the PIAAC typology of computer users is based has considerable limitations and the broader use of ICT in various machine tools, machines, etc. has not been addressed in the study. However, the identified use types allow drawing clear parallels with the types of Internet users identified in earlier studies. General structural similarities exist regardless of the fact that PIAAC data describe only a very limited number of activities mostly characteristic of office computer users.

The analysis produced the following results in different categories:

Methodology or how to measure digital literacy

Until now PIAAC reports mostly used **the scale of problem-solving skills in a technology-rich environment** to measure ICT skills. This report also uses the four skill levels according to Halapuu and Valk¹ and, additionally, groups of basic ICT skills for those who failed the ICT core test, who 'opted out' of taking computer-based assessment and who do not use a computer. In addition, **types of computer users** have been created in this report to analyse

¹ Halapuu, V., Valk, A. (2013). *Täiskasvanute oskused Eestis ja maailmas. PIAAC uuringu esmased tulemused*. Tartu: Haridus- ja Teadusministeerium.

ICT use. **To define the types**, information about the types and purpose of computer use (work-related or non-work) provided by people themselves has been used. The PIAAC study asked about the frequency of use in seven different areas: e-mail; the use of the Internet for information search; purchasing, selling, banking and other transactions via the Internet; spreadsheet calculations; word processing; programming; participation in real-time discussions on the Internet, e.g., in online conferences or chatrooms. The types of computer users were identified by the cluster analysis method on the basis of work-related and non-work types of computer use named by respondents in the European countries participating in PIAAC (Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Poland, Russia, Slovakia, Spain, Sweden and Great Britain). Seven types of computer users have been identified as the optimal solution. **In Estonia, user types had a good correlation with the skills scale and a better correlation with the majority of labour market indicators (except income) than skills.**

The following user types have been identified:

1. **Versatile users** use a computer in the most versatile manner both for work-related and non-work purposes; their skills level is the highest in all the domains.
2. **Active non-work computer users** use a computer for non-work activities in the same versatile manner as the first group, but they almost never use a computer at work.
3. **Active work-related computer users** occupy the second place by the versatility of work-related types of computer use, but they have a more limited use of a computer for non-work activities.
4. **Passive non-work computer users** almost never use a computer for work, but they use a computer for non-work activities, on average, in three or four ways. They mostly search for information, make online transactions and use e-mail.
5. **Passive work-related computer users** mostly use a computer for work and only in a few ways.
6. **Occasional users** usually use a computer only for non-work purposes and, on average, only in two or three ways.
7. **Non-users** do not use a computer either at work or at home.

The results have shown that **the distribution of problem-solving skills in a PIAAC study that has been widely used so far – respondents who ‘opted out’ of taking the computer-based assessment, non-users of a computer, respondents who failed the test of basic ICT skills, skills below the 1st level, 1st level skills, 2nd level skills and 3rd level skills – is an effective scale suitable for Estonia.** This scale is also a good match for the scale of computer user types.

The skills are also correlated with the versatility of computer use types. In all the compared countries it was clear that people who used a computer at work in a more versatile way also demonstrated a higher level of skills. People with better skills also used a computer for non-work purposes more often and in various ways.

Computer users in Estonia and their skills

According to the results of the analysis, 10% of Estonian adults use a computer in a versatile way and the total share of active computer users (both non-work and work-related) is 39%. However, 51% of Estonian adults use a computer very little or in a very limited number of ways or not at all.

It has been confirmed that **people who use a computer more extensively and have better computer skills mostly earn a higher salary** compared to those who use a computer less or have lower skills. **People with better skills also face a lower risk of losing a job.** At the same time, the benefit received from computer skills and computer use varies among different social groups. **Older people, non-Estonians, people with a lower level of education and people doing simpler jobs receive fewer benefits from opportunities offered by computer use.**

Estonia's population is distributed by the level of problem-solving skills in a technology-rich environment as follows:

1. **3rd level (4%).** This group has a larger share of men and young people (the average age is 29) with good education; 50% have higher education; the average monthly income is EUR 1,680. This group also has an above-average share of people speaking Estonian as a home language.
2. **2nd level (23%).** This group also consists of younger people (the average age is 32), many of whom have higher education (57%). The income level is somewhat lower than in the first group (on average, EUR 1,200 per month).
3. **1st level (28%).** Compared to the preceding groups, people belonging to this group are older (the average age is 38) and have had a shorter educational path (12 years). This group also has a medium score by income, employment, nationality and gender.
4. **Below the 1st level (14%).** This group has a somewhat larger share of women; people belonging to this group are older, and it includes more non-Estonians and fewer people with higher education. The income level in this group is lower, surpassing only those who do not use a computer at all or refused to answer through a computer.
5. **People who failed the test (3%)** are a small but interesting group. This group has a higher share of men and non-Estonians and, leaving aside those who do not use a computer at all, it has the smallest proportion of respondents with higher education. At the same time, surprisingly, it consists of people with a relatively high income (EUR 1,300 per month, on average).
6. **The group of respondents who 'opted out' of taking the computer-based assessment (17%)** has the highest share of women. This group consists of people with low income and has a larger proportion of non-Estonians.
7. **Never used a computer (11%).** This group has had a shorter education path and has lower income. At the same time, this group has the highest share of unemployed and older people, a higher proportion of women and a significantly higher proportion of non-Estonians.

The seven computer user types in Estonia are characterised by the following indicators:

1. **Versatile users** (10% of the respondents in the 16-65 age group) are well-educated (on average, 14 years of education). Sixty-five percent have a higher education, but 20% are currently continuing their studies. Forty-four work as professionals and 31% are employed in the public sector. In Estonia, this group has a somewhat higher share of men and lower share of non-Estonians.
2. **Active non-work computer users** (13%) are younger (the average age is 26 years) and their education path has been shorter compared to the previous group (on average, 11 years of education). Students constitute 57% of this group. Their level of problem-solving skills in a technology-rich environment is next only to the versatile users, but their average literacy and numeracy is lower compared to both versatile users and active work-related computer users. Twenty-five percent of this group work as service personnel, 25% are craft and related trade workers and approximately 20% are elementary workers (some of them are working and studying at the same time or have not had enough time to advance their careers yet).
3. **Active work-related computer users** (26%) are also well-educated – 65% of this group have higher education. This group has a smaller proportion of women and a somewhat higher average age compared to other active computer users (the average age is a little over 40). This group also has fewer non-Estonian respondents. People in this group in Estonia are next only to the versatile computer users by literacy and numeracy, but their problem-solving skills in a technology-rich environment are lower compared to active non-work computer users. A third of active work-related computer users are professionals, a fifth are managers and a fifth are technicians and associate professionals; 42% of them are employed in the public sector.
4. **Passive non-work computer users** (22%) have had the similar average length of education path compared to active non-work computer users (on average, 11 years of education); the share of people with higher education is 23% and the average age is 38 years. On average, all the skills of the respondents in this group are relatively low. This group is also characterised by a higher-than-average proportion of non-Estonians and a somewhat higher share of unemployed. Almost half of the passive non-work computer users are craft and related trade workers and a fifth are clerical support workers. Approximately one third (31%) are employed in mining and quarrying, and manufacturing.
5. **Passive work-related computer users** (22%) are an average age of 49 years. This group has a slightly higher share of women and a significantly lower proportion of non-Estonians. The length of their educational path has been relatively long (on average, 13 years of education) and half of them (53%) have higher education. They demonstrate an average skills level. Respondents in this group occupy relatively high job positions: 20% are managers, 29% are professionals and 20% are technicians and associate professionals.
6. **Occasional users** (9%) have had the average length of educational path of 11 years; 21% have higher education and their average age is 46 years. This group occupies the next-to-last place in all the skills. This group has a higher share of women and non-Estonians, and the income level is low.

7. Non-users (18%) do not use a computer either at work or at home and their educational path has been the shortest, but about a tenth of the respondents in this group (13%) still have higher education. Their average age is the highest (53 years) and their skills level is the lowest compared to all the groups. A half of them work as craft and related trade workers and a fourth as elementary workers. Their incomes are the lowest. This group has a significantly higher share of non-Estonians.

A correlation has been also identified between **occupation and types of computer use**. **Professionals** are characterised by frequent and versatile computer use and they mostly belong to the groups of versatile and active work-related computer users (86% in total). In terms of computer use by professionals, Estonia is significantly below Finland and close to Austria. **Managers** are also characterised by versatile computer use and they belong to the groups of versatile or active work-related computer users (87% in total). In Estonia, the use of computers by managers is below Finland and similar to Austria. The use of computers by **technicians and associate professionals and clerical support workers** is quite similar to that of managers and professionals; this group includes over 60% of active or versatile computer users. In the comparison of the six countries, Estonia occupies the middle position among these groups of workers.

Service personnel in Estonia more often use e-mail outside work and, in the whole, they use a computer in fewer ways (34% of them are passive non-work users). Finland is again leading in computer use in the services sector.

Skilled agricultural workers more often use a computer at work and do so in many different ways. For example, in Estonia 37% of them use a computer for work-related purposes, whereas in Finland there are 24% of such users, in the Czech Republic 23% and an even smaller share in the other countries. In computer use, Estonia is also leading in this sector in the comparison between the six countries.

Craft and related trade workers are mostly passive non-work computer users (40%) with a very small share of more versatile and sophisticated computer users. In terms of work-related computer use, Estonia is firmly below Finland, the Czech Republic, Ireland and Austria in the comparison between the six countries. **Plant and machine operators and elementary workers** in Estonia more often belong to the groups of non-work and occasional computer users.

The report disproves the argument that computer use and skills originate from a work-related environment. Earlier analyses of the PIAAC study already showed that approximately one third of workplaces in Estonia do not use a computer at all². This report has, in addition, found that the middle level of computer skills (word processing, spreadsheet calculations or work with databases) is required at 46% of workplaces, the low level of computer skills (data entering or sending/receiving e-mails) is required at 15% of workplaces and the high level of computer skills (software development or modifying computer games, programming, computer network administration) is required at 5% of workplaces.

2 Halapuu, V., Valk, A. (2013). *Täiskasvanute oskused Eestis ja maailmas. PIAAC uuringu esmased tulemused*. Tartu: Haridus- ja Teadusministeerium, pp. 116.

In Estonia, work-related and non-work computer use differ for many people. Non-work computer use is more active and versatile than work-related computer use: 34% of people use computer for non-work purposes. At the same time, only a very small proportion (2%) uses a computer exclusively for work. **At work** people most often use e-mail (70% of the employed persons use e-mail daily), followed by information search (used approximately by 60% of the respondents). The biggest difference between work-related and non-work computer use is in online transactions: almost all the computer users make such transactions in a non-work environment, but in a work environment it obviously depends on the job specifics. To sum up, the greater activity and versatility of non-work computer use give grounds for the belief that **economic activity and the structure of workplaces in Estonia are developing at a different speed and with a different level of variation than general services and opportunities offered through the use of ICT.**

There is a general correlation between the frequency of computer use and the level of problem-solving skills in Estonia. **Computer use at home has a stronger correlation with problem-solving skills in a technology-rich environment than computer use at work.** A cross-sectional study does not allow a clear analysis of causal links between the results: does non-work computer use polish and develop user skills? Are people with already better skills able to better fulfil themselves outside work? The third option is also possible when opportunities and development are being fulfilled simultaneously. To sum up, it appears that **the potential of people skills in the work environment is not being fully realised in Estonia. It seems that the driver behind an improving ability to cope in a technology-rich environment in Estonia is computer use at home.**

- According to the study, 43% of Estonia's population in the 16-65 age group have problem-solving skills in a technology-rich environment below the 2nd level and they do not use a computer for work-related purposes. Among the employed, the share of such people is 31%. It mostly includes plant and machine operators and elementary workers, as well as people employed in agricultural and manufacturing industry, and people over 55 years of age.
- 18% of the working-age population have good skills and they use them at work. Among the employed, the share of such people is 25%. This group mostly includes people employed at positions requiring ICT skills, workers in financial, insurance and information and communication sectors, managers, professionals and people working in public administration, people with a bachelor's or higher degree, and people with higher income.
- 9% have good skills but do not use them in their current work (3% of the employed). This group largely consists of young people under the age of 24.
- 30% claimed that they used a computer at work, but their measured skills were below the 2nd level. Among the employed, the share of such people was 41%.

Also, 89% of people whose work requires the use of a computer considered their computer skills as sufficient for successful job performance. The lack of skills needed for work is mostly felt by computer users whose work requires good computer skills and who have a good education; they are mostly older and more often work at managerial positions. Ten percent of them took part in formal education during the last 12 months and 65% received additional training outside the formal education framework. Nine percent believed that

they had lost a job, promotion or salary raise because of poor computer skills. Such people are more often older than people without higher education and non-Estonians. The results of the study allow for the argument that Estonia also has a need for a higher level of training in the area of computer skills. **It is also remarkable that the experience of losing a job or promotion because of poor computer skills was evenly distributed among people with different levels of skills** – approximately 10%. Such cases were slightly more frequent among people employed at positions that require a high skills level – 14%.

The level of problem-solving skills and computer use by economic sectors in the international comparison

The results of the PIAAC studies received so far allow us to presume that the availability of better skills in a technology-rich environment has a positive impact upon economic development. This conclusion is valid for organisations, sectors and nations as a whole. **This report also identified a positive correlation between the skills and productivity of workers in the comparative evaluation of countries by production sectors, but it might be explained as the result of a higher general level of a specific country. The analysis has not found a correlation between the productivity in a sector and the level of ICT skills and ICT use among the workers of the sector in Estonia.** Several other economic factors probably have a greater impact on productivity than said skills. **As could be expected, there is a positive correlation between the computer skills and use among workers in a specific area.**

In the country-by-country comparison, comparing Estonian workers by the frequency of computer use at work gives a better result than comparing Estonian workers by the level of problem-solving skills in a technology-rich environment. **Thus, although computers are widely used in Estonia (in the comparison of various production sectors), the skills of Estonian workers in this aspect are lower compared to their counterparts in the same production areas.**

Estonian entrepreneurs and employees have the same average level of skills, but **Estonian entrepreneurs have better skills compared to entrepreneurs from other countries than Estonian employees compared to employees from other countries.** Entrepreneurs use a computer more extensively than employees. Estonian employers are especially advanced – they use a computer more frequently than their foreign counterparts and firmly hold the middle position in terms of skills.

The international comparison of ICT use and problem-solving skills in a technology-rich environment in selected areas of activity produced the following results:

- **In the public health sector** Estonian public health workers use a computer rather actively, but their skills are not especially high. In terms of use Estonia is next only to Finland among the six countries, but this area produces less added value per worker in Estonia compared to the public health sector in countries with lower skills and less extensive computer use.
- **In education** the situation is even more drastic. In terms of computer use at work Estonia is next only to Finland among the compared countries, but the level of problem-solving skills in a technology-rich environment among educational workers

in Estonia is one of the lowest in the country-by-country comparison in the PIAAC study. In the comparison of other sectors Estonia has medium results. There is a correlation in this area between the work-related use of ICT and problem-solving skills in the compared countries. Actually, a higher computer use compared to one's skills is a distinctive feature of Estonia.

- Workers employed in Estonia's **manufacturing industry** undoubtedly have the lowest level of problem-solving skills in the comparison of European countries and in terms of computer use at work. Only Slovakia (and Italy) are behind Estonia. The manufacturing industry is one of few sectors where a correlation between the frequency of computer use at work and problem-solving skills becomes apparent in the comparison of European countries. The more computers are used in the manufacturing in a specific country, the better are the workers' problem-solving skills. In Estonia, the frequency of computer use and the level of skills are both low compared to the other countries.
- Although the **energy sector** has the highest added value in Estonia's economy, Estonia occupies the last place in Europe in terms of computer use for performing job tasks and the level of problem-solving skills (the level of skills is similar to Poland's). In the comparison with other areas of activity Estonia has medium results.

The following recommendations regarding research methods have been proposed on the basis of this study:

1. Analysing the PIAAC results, **the distribution of people by computer-related activities should be used** alongside or in parallel to the skills scale. Planning new studies, the collection of information about computer-related activities can be used as an alternative to the collection of information about skills, because the analysis has shown the close relationship between the two. An especially telling indicator is the versatility and frequency of computer use at home. In favour of this indicator also speaks the fact that the collection of information about skills is more work-intensive and expensive.
2. In Estonia it makes sense to **compare various user types. For this purpose, it is sufficient to measure different types of use in a study. These types are based on the versatility of computer use types** and have a relatively good correlation with skills. The benefit of such approach is the opportunity of a more clear interpretation and operationalisation of various groups. Although the PIAAC skills scale is a valuable tool, it does not give a clear and unambiguous answer about various skills levels. Types of use are easier to measure. The analysis has shown that **in Estonia it is methodologically possible to use indicators of computer use versatility instead of skills scores. An especially useful indicator in Estonia is the versatility of computer use for non-work purposes.**
3. Internationally, **the analysis of the correlation between skills and types of use should be continued.** This study has been focused on the analysis of the six countries, including Estonia. In these six countries there has been a correlation between the versatility of use types and skills, but other countries should be also analysed before drawing final international conclusions.

4. In subsequent studies **skills (and activities) should be also analysed by the type of tasks and areas of activity** (e.g., state-related tasks, home tasks such as vacation planning, etc.). Since it can be presumed that skills may be related to proficiency in various environments and general abilities, there is reason to believe that levels of skills may be different in various environments.

Recommendations for the development of better national policies based on this study are as follows:

1. **Continue to provide support for improving workplace efficiency through the use of opportunities offered by computers. The analysis has shown that a new generation of workers is entering the labour market with much better skills**, who use computers frequently in daily life and have good problem-solving skills, but are currently employed in positions where the extensive use of computers is not required.
2. In Estonia, the use of a computer at home appears to be a main factor improving results in a technology-rich environment and it should be developed in all the age groups. **Thus, the offer of computer courses to various population groups, especially the unemployed, should be continued. It will improve individual prospects in finding a job and advancing one's career.** Training is also needed for people with average computer skills to advance their careers. It is also important to offer computer courses developing computer skills needed in daily life, especially to those who do not use a computer at work or use it very little.
3. In computer courses and in the development of competencies attention should be paid not only to the acquisition of basic skills, but also to the development of competencies and the improvement of the skills level. The analysis has shown that in some sectors computers are indeed used very actively at work, but the workers demonstrate rather mediocre problem-solving skills in a technology-rich environment – e.g., in the areas of education and public health Estonia's results in work-related computer use are much higher than problem-solving skills.