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ADULT SKILLS: THEIR USE AND USEFULNESS IN ESTONIA

Summaries of thematic reports on the PIAAC study



Adult skills: their use and usefulness in Estonia. Summaries of thematic reports on the PIAAC study

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Between these covers you will find summaries of the seven thematic reports published in Estonian on the PIAAC (Programme for the International Assessment of Adult Competencies) study. The reports were completed as part of the PIAAC Estonia programme in 2014 and 2015. This publication is a précis of the two years of analysis conducted after the study, which was carried out in the country for the first time and whose main focus was key themes in education and the labour market – areas of importance to Estonia. The full versions of the reports, as well as the initial results of the study published in 2013 in the report 'Adult skills in Estonia and the world: Initial results of the PIAAC study', are available on the website of the Ministry of Education and Research (MER). Details of completed international reports and those in progress can be found on the websites of both the OECD and the Nordic Council of Ministers – the latter of which has also published the Nordic PIAAC report, which analysed the results of five countries, including Estonia¹. In addition, short reports, scientific articles and a number of graduation theses have been published on the basis of PIAAC data (the reports being available on the website of the MER). The data can be downloaded from the OECD website for further analysis.

The PIAAC study

Advances in technology have markedly increased the amount of information around us, having already changed and continuing to change our everyday lives at work and at home. Information-processing skills are therefore taking on ever-greater importance, as they help us cope in these changed conditions. PIAAC – an international survey of adult skills – represented the first opportunity for Estonia to compare the main information-processing skills of its population in the 16–65 age bracket both nationally and with those of people in other countries. The study measured three types of skills: literacy, numeracy and problem-solving in technology-rich environments. It also measured reading components that form the basis for literacy. Previous studies have shown that these skills are needed in order for people to be actively and successfully involved on the labour market, for them to participate in lifelong learning, to ensure their good health and for them to contribute to society as active citizens. These information-processing skills are broad-ranging, can be transferred to a variety of situations and can be learnt, which is why they can be influenced by shaping policy.

The PIAAC study was initiated by the Organisation for Economic Cooperation and Development (OECD) in the mid-2000s, with data collected in 24 countries between August 2011 and April 2012. Analogous studies that predate PIAAC – the International Adult Literacy Survey (IALS) and the Adult Literacy and Life Skills Survey (ALL) – were conducted in the mid-1990s and mid-2000s, respectively. The PIAAC study is likely to be repeated in 10 years' time. Estonia did not take part in previous studies, making the PIAAC results unique. Internationally, PIAAC itself is unique in a number of ways, since it involves more countries than previous studies in the same area: the data of the 24 countries that took part in the first round will be supplemented in 2016 by data from a further nine countries (Chile, Greece, Indonesia, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey). Furthermore, adult skills had never before been measured using computers, and the substantial part of the study measuring the use of skills at work and at home is also new.

Five countries lead the way in all of the skills areas measured in the study: Japan, Finland, the

Netherlands, Sweden and Norway. The lowest results in all areas were achieved by Spain, Ireland, Italy, Cyprus, France and Poland. Estonian adults are notable for their literacy and numeracy: in both cases our results are above the average of the countries involved in the study, and our youngsters in particular stand out in international comparison. In the case of problem-solving skills in technology-rich environments, however, the results of Estonian adults are below the average of the participating countries. An additional surprise is the insecurity felt by many Estonian adults when using a computer. The low level of problem-solving skills (especially among those with higher education) and this uncertainty in the use of computers were among the most unexpected results of initial analysis.

Skills are clearly linked to age. The link is non-linear and for the most part negative: leaving aside other factors, the level of skills among older people is significantly lower. The biggest difference here is in the problem-solving skills of younger and older people – a gap of 48 points between those in the 20–24 age bracket and those in the 60–65 age bracket. Theoretical literature proffers a number of explanations for such a link: the time that has passed since the skills were learnt; the less frequent use of skills among older people; the different opportunities for work and study available to different generations; et al.

Differences in information-processing skills are also clear to see at the regional level. In Estonia, skills are concentrated in the densely populated areas in the north and south of the country. The lowest level of skills measured by PIAAC is found among the residents of north-eastern Estonia. This can be explained by the location of both jobs and universities, as well as the living, studying and working conditions in these regions. The level of information-processing skills among adults with a home language other than Estonian is consistently lower than among Estonian-speaking adults, with the differences being more marked in literacy and among people with higher education and less pronounced in problem-solving skills and among people with basic education. This difference is partly explained by education; among other things, there are more people with secondary specialised education among those with tertiary qualifications who have a home language other than Estonian.

In summary, the study revealed that the level of primary information-processing skills of our adult population is competitive and should not be the main obstacle to performing more complicated work. In fact, the Estonian labour market demands or enables more limited application of skills than elsewhere. Clearly troubling is Estonian people's problem-solving skills in technology-rich environments and computer skills generally, in particular where older people and people with higher education are concerned, who are among the worst-performing in these areas in international comparison. Differences in skills in Estonia between people from different educational and family backgrounds and of different genders are relatively small compared with the other countries involved in the study, which is to say that there are no major gaps regarding skills. However, the other side of this coin, which at first glance appears very attractive, is a dearth of top performers – we have half as many as the foremost skills countries. Initial analysis also showed that in the case of both employment and salaries, level of education is given more importance in Estonia than acquired skills i.e. the labour market also values the educational level you have reached. This is important information for those who are highly skilled but whose education remains incomplete.

¹ PIAAC results online: Estonia www.hm.ee/piaac; OECD www.oecd.org/site/piaac; Nordic countries <http://norden.diva-portal.org/smash/get/diva2:811323/FULLTEXT02.pdf>

Definitions and abbreviations

Adult – the study sample i.e. people in the 16-65 age bracket. Analysis is performed in regard to this target group unless clearly indicated otherwise.

Literacy is the ability to comprehend, assess and use written texts so as to cope in society, achieve your goals and develop your knowledge and abilities.

Reading components are skills connected to the comprehension of vocabulary, sentence meaning and passages.

Numeracy is the ability to acquire, use, interpret and pass on mathematical knowledge and ideas so as to engage in and cope with situations in life that require mathematical knowledge.

Problem-solving skills in technology-rich environments represent the ability to use digital technology, communication tools and computer networks to acquire and evaluate information, communicate with others and perform practical tasks. Tasks that measure problem-solving skills assess a person's ability to resolve issues related to everyday life, work and involvement in society. In order to solve a problem a person must set themselves appropriate goals, devise a plan and use the information they are able to obtain by using computers and their networks (e.g. the Internet) (OECD 2012).

Skills levels

A 500-point scale was used to assess skills levels. However, in order to gain a better understanding of what people with one or another skills level are able or unable to do, continuous scales are in turn divided into levels and described using the tasks of the relevant level. Five levels have been defined for literacy and numeracy, and three for problem-solving in technology-rich environment (plus lower than Level 1 in both cases). When interpreting the results it should be borne in mind that a person with a specific points score is 67% likely to be capable of correctly solving tasks that match the level of difficulty of the level in question. In the case of more complex tasks the likelihood of finding the right answer is smaller for such a person, but not non-existent; while in the case of simpler tasks it is greater. It is important to emphasise that dividing the scale into levels only serves a descriptive purpose. No level should be treated as a fixed yardstick. More details about the levels can be found in the initial PIAAC report (Halapuu, Valk 2013).

Basic i.e. Level I education – a basic or lower level of education, including up to two years of vocational training on the basis of basic education; the group with this education is also referred to as 'people with basic education'.

Secondary i.e. Level II education – a secondary level of education, including more than two years of vocational training on the basis of basic education and vocational training following secondary education; the group with this education is also referred to as 'people with secondary education'.

Higher i.e. Level III education – a higher level of education, including a Master's degree and doctorate; the group with this education is also referred to as 'people with higher education'. Secondary specialised education on the basis of secondary education is included in this group in Estonia.

Participating countries and their abbreviations

The names of countries are used in the following forms and with the following abbreviations:

Australia	AU	Norway	NO
Austria	AT	Poland	PL
Belgium ^a	BE	France ^c	FR
Estonia	EE	Sweden	SE
Spain ^c	ES	Germany	DE
Netherlands	NL	Slovakia	SK
Ireland	IE	Finland	FI
Italy ^c	IT	United Kingdom ^a	UK
Japan	JP	Denmark	DK
Canada	CA	Czech Republic	CZ
South Korea	KO	United States	US
Cyprus ^{bcd}	CY	Russia ^d	RU

^a Belgium and the United Kingdom did not take part in the study as a whole. In the case of Belgium, only one of its three autonomous regions – the Flemish-speaking part of the country (Flanders; the other two regions being Brussels and Wallonia) – was involved. Flanders is home to 6.4 million people, which is slightly more than half of the total Belgian population. Only two parts of the United Kingdom (or more precisely the United Kingdom of Great Britain and Northern Ireland) took part in the study: England and Northern Ireland. Wales and Scotland were not included. England is home to 53 million people i.e. 84% of the total population of the United Kingdom; Northern Ireland is home to 1.8 million people or 3% of the total British population. In terms of area they measure ca 130,000 km² and 14,000 km², respectively, representing almost 60% of the total area of the United Kingdom.

^b The data for Cyprus presented in the study represent the southern part of the island under the control of the government of the Republic of Cyprus. Turkey, however, recognises the Turkish Republic of Northern Cyprus. The OECD Member States that belong to the European Union note that the Republic of Cyprus has been recognised by every Member State of the United Nations with the exception of Turkey. It should also be taken into consideration in the case of Cyprus that a significant amount of data was lacking (more than 17%), which renders their results less reliable than those of other countries.

^c Problem-solving skills in technology-rich environments were not measured in Cyprus, France, Italy and Spain.

^d Cyprus and Russia are the two countries involved in the study that are not Member States of the OECD.

USEFULNESS OF SKILLS ON THE LABOUR MARKET

Sten Anspal, Janno Järve, Anne Jürgenson, Märt Masso, Indrek Seppo

The data collected as part of the PIAAC study enable us to analyse the links between people's skills and their ability to cope in different areas of life. One of the most important areas of life in this context is the labour market. Participation in the labour market is the main source of income for the vast majority of people, and the ability to cope on the labour market is one of the most significant factors influencing people's living standards. Whereas to date it has been possible to analyse links between labour market outcomes and people's education level, gender, age and other attributes on the basis of the data collected by Statistics Estonia, the PIAAC data makes it possible for the first time to investigate the role of information-processing skills against the backdrop of other attributes and whether taking such skills into account in analysis helps us better understand what influences people's ability to cope on the labour market. Since a large proportion of people obtained their education many years ago and may have forgotten much of what they learned – or vice versa, have gained in knowledge as part of their work – level of education alone inevitably measures people's actual skills and knowledge somewhat inaccurately. The data collected as part of the PIAAC survey regarding people's information-processing skills help to resolve this problem in part.

Nevertheless, it is important to bear in mind that information-processing skills form just one part of the skills set implemented on the labour market and that in a certain sense comparing the importance of information-processing skills and education which provides specific skills is not fair – for example, ICT-sector workers are more likely to be paid a higher than average salary not because they can read text and understand it, but because they have gained (via education or independently) the professional skills required for their work, which PIAAC did not directly study. It should also be borne in mind that information-processing skills and education are closely connected and have a reciprocal effect: with better information-processing skills a person is more likely to succeed academically and thereby attain a higher level of education, while at the same time significantly improving the very same skills when studying. In such a situation it is often difficult to differentiate between the extent of the impact on labour market outcomes that information-processing skills have, what role education plays and how much success on the labour market is determined by general ability (which affects education, information-processing skills and labour market outcomes alike). The authors of this report have done their best to ensure that the assessments presented are reliable, but it is nevertheless important to keep in mind that the links evaluated do not necessarily have the causal direction presumed in analysis.

The report seeks answers to the following questions:

- Is it beneficial for those in employment to obtain better information-processing skills i.e. are information-processing skills rewarded on the labour market?

- Are information-processing skills connected at the higher level to unemployment and the speed with which people return to employment, and if so, how?
- Is the quality of people's working lives (measured through job satisfaction and autonomy) connected to information-processing skills, and if so, how?
- What are the connections between information-processing skills and entrepreneurship?

Analysis revealed that:

A frequent topic of discussion in Estonia is that people in the country tend to overestimate the value of academic higher education and that sometimes parents herd their children (and universities accept them) into the tertiary education system when they would be better placed at a slightly lower level of formal education wherein they acquired the practical grounding needed to join the labour market.

The analysis did not support this claim. If we compare those who have acquired higher education with those whose education is limited to a lower level, then **irrespective of how good their information-processing skills are, those with academic tertiary education enjoy a clear advantage in terms of salaries** (which are around one-third higher than those of people with a lower level of education; the gap between them and those with applied higher education is smaller, but still notable). As such, from the point of view of this analysis at least, at the individual level it is recommended to acquire the highest level of education possible, since obtaining academic tertiary education – even if your information-processing skills are not as honed as they might be – means, on average, that you will earn a higher salary than those whose education is limited to the basic or secondary levels.

The foregoing does not mean, however, that levels of education lower than academic tertiary education produce the same labour market outcomes in terms of other indicators. Those with secondary education do not necessarily enjoy a marked advantage over those with basic education in terms of salaries, although they *are* far more likely to find work: **any level of education higher than basic significantly reduces the risk of unemployment, and does so to a statistically important extent, regardless of the level of people's information-processing skills.**

It is important to bear in mind that decisions which prove beneficial from the point of view of a specific individual will not necessarily benefit the state overall. A greater number of people continuing on to higher education means greater expenditure on education, and if it emerges that skills acquired at university are only implemented in working life to a limited extent, such expenditure may prove unjustified for the state as a whole.

The correspondence of work place and education level is important and is easy to intuit: if a person with higher education does work of little or no complexity, they are unable to make use of a significant part of their knowledge, and there is no reason for their employer to pay them for knowledge they are not implementing. Our analysis confirms that **those who are employed in positions for which a lower level of education would suffice earn less (ca 7%) than colleagues with the same level of education.** As such, skills are only rewarded if they are actually used, and from society's point of view and the point of view of the person in question it is likely considered a waste to work in a position that requires a lower level of education than the person has¹.

¹ This conclusion should nevertheless be treated with a certain amount of caution, since at the beginning of a person's career it is quite normal for them to work in one or more positions in which not everything they learnt at university or in vocational education is needed.

On the other hand, if we recall the salary advantage enjoyed by those with academic higher education (*ca* one-third), it appears that **even if a tertiary-educated person takes up a position requiring a slightly lower level of education, their salary advantage ahead of someone with secondary education remains considerable**. This is most likely due to the fact that marked disparity between the level of education required for a job and the level of education actually acquired is limited. Of course, this does not rule out salary nosedives at the case-by-case level due to a person being overqualified.

If we compare people at the same level of education whose information-processing skills range from high to low, those with higher skills (in particular those with academic tertiary education) have certain advantages in labour market outcomes (for example, additional remuneration being attributed to them as a point estimate), but statistically important differences cannot be seen between people with higher and lower levels of skills.

Skills do seem to take on a somewhat greater role, however, during a recession. Looking at registered unemployment it was noted that there were statistically significant differences by skills level primarily in years when the unemployment rate was high (2009). In conditions of high unemployment, taking skills into consideration more effectively highlighted the contrasts between basic education and higher levels of education in terms of their effect on the duration of unemployment. In other words, this means that **among the unemployed with tertiary and post-secondary vocational education it was primarily those whose level of information-processing skills was higher who more quickly found work during the recession**.

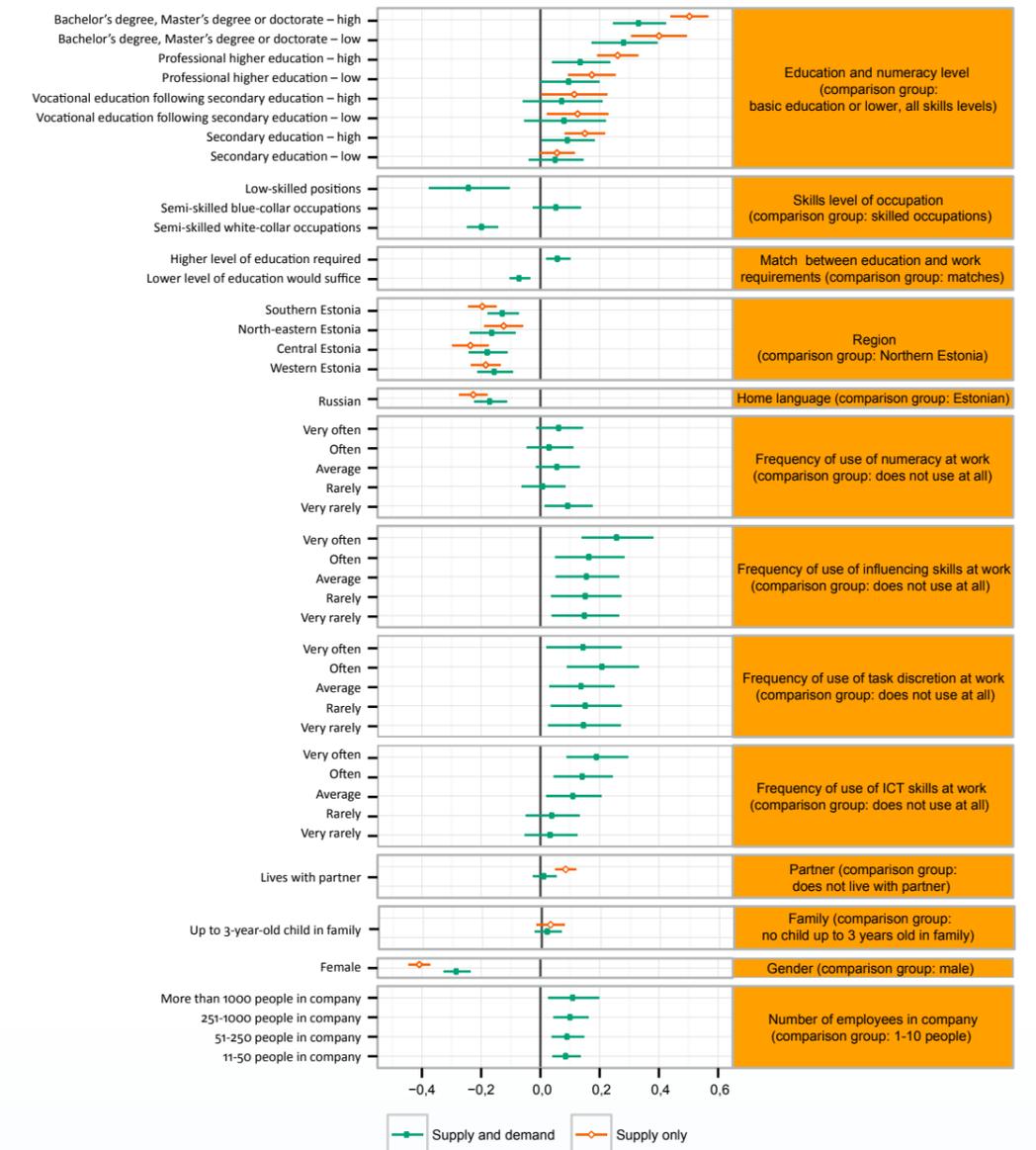
There are without doubt a number of facets to high-quality working life. Two of these were examined in this report: how satisfied people are with their jobs; and how much freedom people have in terms of deciding how to do their jobs. There does not seem to be a clearly discernible connection between people's job satisfaction and their level of information-processing skills. This applies not only to Estonia, but to the majority of the countries that were analysed based on the PIAAC data.

At the same time, it was found that **people employed in highly skilled occupations and those whose skills and knowledge match the skills and knowledge required of the position are more satisfied with their jobs**. It can therefore be said that job satisfaction does depend on working conditions but that the level of information-processing skills is not a factor that directly influences satisfaction – rather it is more important that skills in broader terms be at a good level and in line with the needs of the position.

In terms of autonomy the results were not as uniform: analysis of the Estonian data revealed that **employees with better problem-solving skills in a technology-rich environment are more likely to make choices affecting their work**. It also emerged that in terms of information-processing skills generally, those employed in highly skilled occupations and those in positions requiring management skills are more likely to make choices affecting their own work. In this sense the analysis shows that information-processing skills are to a certain extent connected to greater autonomy among employees, although this does not apply to all information-processing skills.

It can be concluded from the analysis that the **working life quality of an employee tends not to depend on their level of information-processing skills but is more closely connected to the use and development of their skills**.

Figure 1.1. Link between salaries and education, numeracy and background factors



Note: The regression coefficients presented on the horizontal axis of the figure and evaluated using the ordinary least square method indicate the differences in logarithm salaries between the base level and the value of interest to us, which (multiplying it by a value of 100) can be considered approximate with a percentage difference in the case of smaller values. The points denote the point evaluations; the lines passing through them the 95% confidence limit. The colours distinguish the two different salary equation constructions: orange indicates coefficients solely from the supply half of the equation, while green indicates coefficients from the equation containing both supply and demand components. So we see, for example, that the salaries of people who live in Southern Estonia are, depending on the salary equation construction, 12-20% lower than those who live in Northern Estonia (i.e. the comparison group). In the 'Education and numeracy level' box, combinations of education level and the words 'high' or 'low' mark combinations of education level and a high (Level 3-5) or low (lower than Level 3) level of numeracy. Intensity of use of skills is found based on an intensiveness index devised on the basis of answers to questions on the use of skills, which is divided into five groups (between the first quintile of frequency of use – 'Very often' – and the fifth quintile – 'Very rarely'). Highlighted as separate category are those who responded to all of the questions related to use of skills negatively ('Not at all'). Age and the age square and area of economic activity were added to the equation in addition to the variables depicted in the figure.

On the whole it can be claimed that **as far as information-processing skills are concerned, entrepreneurs are in no way different from employees.** Rather, **entrepreneurs are distinguished by their characteristic way of thinking: compared to employees, entrepreneurs are more likely to gather new information, process it and connect it to the knowledge they already have i.e. to exhibit metacognitive skills.** The more frequent connection of new ideas with actual situations and the fitting together of different ideas mark out entrepreneurs in Estonia and many other countries.

At the same time, from the point of view of success (if this is measured in terms of the income of the entrepreneur) three things are important: functional reading skills, mathematical writing skills and problem-solving skills in a technology-rich environment. Interestingly, information-processing skills play a more significant role than level of education in determining incomes among entrepreneurs, which tended to become unimportant in regression analysis. It can therefore be seen that **in terms of the success of entrepreneurs the level of information-processing skills is important and that a significant proportion of these skills are acquired outside of the education system.**

If our aim is to foster the spirit of enterprise, the results of this analysis suggest that more needs to be contributed to teaching methods that are seen to have a greater impact on shaping enterprising ways of thinking – without forgetting that if we want entrepreneurs to be successful, this must be balanced out in such a way that the entrepreneurs have adequate information-processing skills.

SKILLS AND LIFELONG LEARNING: WHAT DOES ESTONIA HAVE TO LEARN IN TERMS OF IMPROVING SKILLS AND WHO CAN WE LEARN IT FROM?

Ellu Saar, Marge Unt, Kristina Lindemann, Epp Reiska, Auni Tamm

The understanding of learning as an obligation and a privilege of youth does not tally with the needs of today's rapidly changing world. Both Estonia and the European Union as a whole have actively started promoting adult learning and set increased involvement in lifelong learning as a key priority. Behind this is the understanding that taking part in adult learning is beneficial in both social and economic terms for those taking part and for society more broadly, since it boosts productivity and employment on the labour market. Within European education terminology the categorisation of learning as formal, non-formal or informal is widespread. The PIAAC dataset enables us to analyse involvement in formal and non-formal learning. Formal learning mostly takes place in schools. It aims to achieve set goals and is led by qualified teachers, and both the learning process and its results are assessed. Non-formal learning also aims to achieve set goals but is voluntary in nature. It is led by a specific performer and is characterised by flexibility and a learner-centred approach².

This report compares involvement in lifelong learning in Estonia with the results of five other countries (Finland, Germany, the United Kingdom, the Czech Republic and Russia) and with the average of the 21 OECD countries³ involved in PIAAC (hereafter referred to as the OECD average). Selection of the countries for comparison was based on the assumption that lifelong learning takes place within, and forms part of, the broader economic, social and cultural system. Opportunities and motivation to participate in lifelong learning arise in accordance with the state of the education system, employment, the welfare society and more. As such, countries with different institutional frameworks were selected for comparison, since previous results have shown that no single existing system is necessarily effective because of its individual parts, but because of the way they work together.

The report seeks answers to the following questions:

- Is the rate of participation in formal and non-formal learning in Estonia high or low compared to the other countries and the OECD average?

² In this report, lifelong learning refers to non-formal studies and formal adult (aged 24+) education. The PIAAC survey sample comprised respondents aged 16-65. This is different from the Eurostat Adult Education Survey, which involved adults aged 25-64.

³ In calculating the average of the OECD countries involved, data pertaining to Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, Slovakia, Spain, Sweden, the United Kingdom and the United States were taken into consideration.

- Which socio-demographic groups take a more active role in learning and which take a less active role?
- How is participation in learning affected by work and workplace characteristics?
- How is participation in learning affected by skills level?
- To what extent do characteristics typical of people and workplaces enable the likelihood of participation in learning to be predicted?
- What are people's main reasons for taking part in lifelong learning?
- What financial support do employers provide to participants in learning?
- To what extent do participants in learning consider it useful to their work?
- Which groups feel a greater need to participate in training in order to more effectively cope with their work?
- What proportion of the population would like to take part in lifelong learning but have been unable to for some reason?

Comparing the six countries, the results indicated the following:

Of the countries under study, those whose adult populations are most actively involved in formal learning are Finland and the United Kingdom (15% in the year preceding the survey). A variety of special programmes designed to increase the participation of adults in formal learning have evidently contributed to this, such as 'Skills for Life' in the United Kingdom and 'Noste' in Finland. **One-tenth of adults in Estonia are involved in formal learning.** It is reassuring to see that PIAAC data from 2011 and 2012 and data from the 2007 Adult Education Survey allow us to claim that in the period between the two studies **the proportion of adults taking part in formal learning in Estonia increased significantly.**

The country whose adult population is most actively involved in non-formal learning is Finland, where almost two-thirds of people had undertaken studies in the year preceding the survey. **Around half of all adults in Estonia have participated in non-formal learning.** Since **the proportion of working people in Estonia who feel that they need training in order to cope with their existing duties is significantly higher than the average of the OECD countries involved in PIAAC,** there is a disconnect between training needs and actual participation in training. In all of the countries analysed, including Estonia, those who take part in training are most commonly those who have taken part in training previously (in a perfect example of the Matthew effect). The primary objective of supporting lifelong learning should be to significantly reduce the number of people who have never taken part in training.

In order to reach these groups we must first know who and where they are. In Estonia, **participation in learning is substantially influenced by age, home language (with those who speak Russian at home taking part to a considerably smaller extent) and level of education (the higher this is, the greater the involvement).** In the case of older age groups, participation in formal learning in Estonia remains markedly lower than the relevant indicators in Finland and the United Kingdom. Involvement in non-formal learning also varies by region: it is highest in northern Estonia and lowest in north-eastern Estonia. The reason for the differences between regions is first and foremost employment structure: whereas highly skilled positions predominate in northern Estonia, the north-east is marked out by semi-skilled blue-collar and elementary occupations. The 'Work-related training and development for adults' programme financed by the European Social Fund

was implemented in Estonia. It aimed to open up opportunities for the adult population to participate in lifelong learning and to boost people's ability to compete professionally via high-quality training offered by institutions of vocational education and institutions of professional higher education providing vocational training in all Estonian regions, but the impact of the programme has yet to be analysed. It would perhaps be useful to learn from the experiences of the 'Noste' programme in Finland. A key result of the programme that is highlighted in the final report is close trilateral cooperation between employers, employees and training providers. Adults would be encouraged to take up secondary and vocational studies with grants and loans. For example, anyone over the age of 20 in Sweden who is studying at the basic or secondary levels of education at least part-time is eligible to apply for a student loan and for grants.

In the case of women, participation in lifelong learning is significantly influenced by the age of their children: the proportion of mothers of young children taking part is substantially lower than that of women without children or women whose children are older. **Family duties are the biggest barrier to involvement in learning among women in the 25-34 age bracket with one or more children under the age of 2.** The problem here lies between the very liberal labour market and the long period of parental benefits characteristic of our conservative system. We can surmise that young mothers recognise all too acutely the need not to be left behind in terms of labour market developments, but that limited childcare options before children turn 2 make it difficult to flexibly combine family life with professional development.

Although the proportion of the unemployed who are taking part in training has increased markedly in Estonia in recent years, this figure still remains significantly below the same indicator for those in employment (with the difference being substantially greater than in Finland or the United Kingdom and somewhat higher than the OECD average). One of the biggest obstacles to participation in training for the unemployed in Estonia is the cost. As such, an even broader range of free training should be offered to this particular target group and the mechanisms designed to cover the costs involved in taking part in training should be made more effective. **The fact that the unemployed are unaware of training opportunities can also be considered a problem.** More than one-tenth of unemployed people who feel a need for training highlight a lack of information as an obstacle. At the same time, there is no way we can measure a lack of information that is *not* perceived: jobseekers will not necessarily be aware of training opportunities or know to highlight this as a reason.

In Estonia, as in the OECD countries on average, **it is those whose skills level is higher that tend to take part in formal learning.** However, it is difficult to make a justified connection on the basis of the PIAAC data (since the data in question are not longitudinal) as to whether the skills level favours the continuation of learning or whether it is higher due to participation in formal learning. Since the majority of adults who take part in formal learning in Estonia do so at the level of higher education, the reason for major disparities dependent on skills could in fact be that continuing with studies in higher education guarantees an adult learner improved skills. In Estonia, the skills level most notably affects the participation of adults with secondary education in both formal and non-formal learning. We therefore see a cumulative effect in the event of involvement in adult learning that in fact fosters inequality rather than mitigating it.

The survey revealed that **work and workplace characteristics significantly influence participation in learning.** Involvement in both formal and non-formal learning in Estonia

depends on how skilled a position is, with the differences here being somewhat higher than on average in the OECD countries. **Participation is highest among those in highly skilled occupations (managers and specialists) and lowest among semi-skilled blue-collar workers. The sector, the branch of the economy and the size of the company also influence participation in learning.**

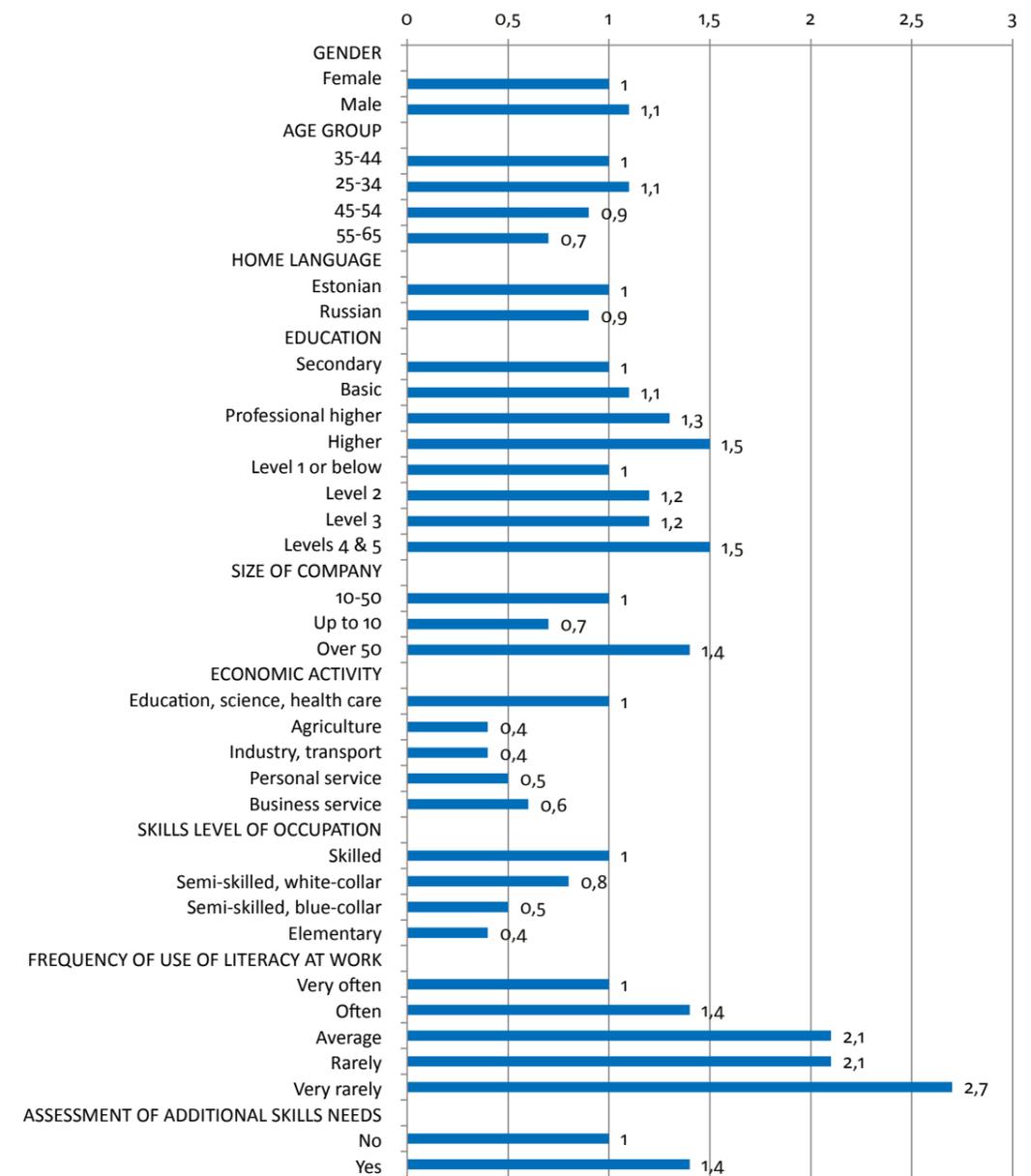
The most important result of the analysis is the conclusion that work content and workplace characteristics have substantially more impact on involvement in lifelong learning in Estonia than personal characteristics (including education and skills levels). Therefore, the aspect of demand is more important in participation in learning; new skills and/or a higher level of education gained from training or studies are not considered values in themselves if there is no opportunity to implement them. As initial analysis of the PIAAC data (Halapuu and Valk 2013) showed, Estonia remains below the international average in terms of skills implemented in work. People in Estonia have more skills than there is application for them on the labour market. As a result, a rise in the level of a person's skills will not necessarily lead to their more active involvement in adult learning (as presumed, for example, by the human capital theory and upon which a number of policy documents and related programmes are based). **If there is no real demand for skills on the labour market participation in adult learning is correspondingly low.**

The large proportion of employees without professional education is considered a significant problem on the Estonian labour market. Unfortunately, one-fifth of young people also lack vocational or professional education. During the year preceding the survey less than half of them participated in non-formal learning, which is significantly lower than the indicator for young people with higher education. Moreover, **just one-tenth of young people without professional education feel they need a higher level of education than the one they currently have. The reason for this is that the majority of them are employed in elementary- or semi-skilled occupations.** There is no pressure on them to continue their studies and improve their level of education. Somewhat surprisingly, comparison with young people who have vocational education shows that these two groups are relatively similar in terms of participation in training, social background, jobs, skills level and use of skills in work – which is to say that vocational education (compared to a lack thereof) does not improve young people's prospects significantly. Although the state has set vocational education as a priority, the foregoing comparison reveals that formal promotion alone is not enough: vocational education must ensure in fact the teaching of skills that are needed on the labour market and thereby a rise in the skills level of young people. Here it depends on employment structure whether these skills are needed on the labour market.

In terms of reasons for taking part in learning, Estonia is quite close to the average of the OECD countries. **In all of the countries under comparison the most common reason for participating in learning is people's desire to be better at their jobs.** In the OECD countries on average and in Estonia around half of all people undertake training for this reason. **The second most common reason given is a desire to increase knowledge and skills in a particular field of interest. The most obvious difference with other countries is the fact that there are very few people in Estonia who listed 'obligation' as a reason for participation.** Nevertheless, it is also observable that instrumental reasons (obligation or certification) are relatively important to those few semi-skilled blue-collar workers who have taken part in in-service training. Whereas less than one-tenth of employees in highly skilled occupations gave this as their main reason for taking part in learning, for as many as a quarter of people employed in semi-skilled blue-collar work and one-fifth of those employed in elementary occupations it is the most important reason. Similar

differences emerge when comparing groups in terms of education: external pressure is a much weightier reason for those with basic education to take part in learning than it is for those with higher education.

Figure 2.1. Comparison of probability of participation in non-formal studies of different groups, 25-65 age bracket, odds ratios



Note: Only key differences are presented in the figure. The comparison group is the group for which the odds ratio is 1.

those who have taken part (compared to 32% on average in the OECD countries). By far the highest level of support for formal learning is provided in the United Kingdom, where as many as 61% of participants have received it. The reason for such marked differences between countries is clearly whether adults are required to pay tuition fees or not, i.e. the organisation of education. **In the case of non-formal education, three-quarters of participants in Estonia receive financial support from their employers. At the same time, the support of employers is smallest in regard to those groups who need it the most** (for example, adults with a low level of education, workers in elementary occupations and those employed in small companies).

It is a cause for concern that the assessment given of the usefulness of formal and non-formal learning in Estonia (in the work or business with which the respondent was connected) is the most negative compared to the OECD average and the other countries studied. **Just 36% of those involved in formal learning and 29% of those involved in non-formal learning consider training to be very useful in work or business.** This problem could be considered minor if the assessment had only been given by those involved in training which was not connected to their jobs (language, art and other courses which are not necessarily expected to be useful to the job or business), but the assessment of usefulness among participants in work-related non-formal learning was also significantly lower than in the other countries under comparison. **Formal learning is considered least useful in Estonia by people with basic education. Since the majority of them studied at the basic or general educational levels, they tended to acquire general skills rather than the vocational skills needed for work.** Within the framework of learning, the provision of general skills and skills directly connected to work should therefore be better connected. Clearly, the fact that studies are too general and that people see them as being disconnected from their work duties is also one reason why the usefulness of learning is assessed as being so low.

Despite the fact that the usefulness of specific training to work receives a lower than average assessment, adults in Estonia consider training to be far more necessary than the OECD average. As such, people's interest in self-development can be considered noteworthy. Here the need for training depends primarily on the extent to which skills are needed in work. **What sets Estonia apart from most of the other countries under comparison is the fact that the need for training is felt by a quarter of people working in elementary positions (compared to around 10% in the majority of countries studied), whereby fewer than half of them had actually participated in non-formal learning in the year preceding the survey.** As such, it is this very group of people – those working in elementary occupations – that are the most hard done by. **Compared to the other countries analysed, a greater need and desire to participate is felt in Estonia among older blue-collar workers with basic education who are employed in semi-skilled occupations and among workers in elementary occupations.** More learning opportunities should be offered to these particular groups.

Based on the analysis of the PIAAC data a number of policy recommendations can be made. The three most important recommendations are the following:

- Firstly, measures and programmes designed to boost participation in learning should be targeted at specific groups. The analysis indicated that these groups are those with basic education, blue-collar workers, employees of small companies, the unemployed, those without professional education, mothers of young children and older people.
- Secondly, under liberal market conditions Estonia should increase cooperation between parties (employers, the state and unions) in offering training and raising the skills level of the population. One way of doing this would be to reorganise unemployment insurance as employment insurance, part of which would then be used as a fund for the training of important and/or weaker target groups (including employees of small companies) in cooperation with unions, employers and employees.
- Thirdly, in planning special programmes the focus should not merely be on raising the skills level, but also taking demand for skills into account. As such, a programme to boost the skills and knowledge of people with a low skills level should be connected to programmes aimed at job innovation (working culture, organisation of work etc.). One way of addressing labour market needs more precisely would be to implement labour market monitoring and forecasts and a coordination system for skills development⁴. Training aimed at work process innovation should also be included in programmes.

⁴ The coordination system of the surveillance and forecasting of the labour market and the development of skills (the OSKA system) was created in 2014. In the near future, the OSKA system should create a regular cooperation platform in order to plan the structure, volume and content of educational services between employers and parties offering educational services. It also combines and analyses information on trends on the labour market and in the economy, as well as forecasts of labour needs, ensures relevant regular outreach activities and supports the education system in planning training places in order to take into account professional and occupational needs in a better way.

LOW AND TOP PERFORMERS OF INFORMATION PROCESSING SKILLS IN ESTONIA

Märt Masso, Janno Järve, Mart Kaska

Earlier international surveys of adult competencies⁵ have shown that countries with a larger proportion of people with high level of literacy and smaller proportion of people with a lower level of skills have a higher GDP per capita. Hanushek and Woessman⁶ have also found that both the share of people with low skills and the share of people with good skills affects the economic growth of any country. In addition, it has been demonstrated that countries with a larger proportion of people with a higher level of literacy have a larger share of people with higher income. Previous works also suggest that the level of information processing skills is not only associated with the economic indicators of a country – for instance, it has been found that the life expectancy of the population is higher in the countries with a larger proportion of people with a higher level of literacy.

Although the studies referred to above focus, among other things, on the so-called tails of the distributions of skills, many earlier analysis have concentrated on mean values characterising the distributions of skills. However, in the light of the results referred to, this report focuses on the former ones: adults with good and poor skills in literacy, numeracy and problem-solving in technology-rich environments established as a result of the PIAAC survey, who are hereinafter referred to as the top and low performers of information processing skills, respectively.

The aim of the analysis is to observe the following:

- how many adults have poor and good information processing skills in Estonia;
- who are they or which socio-economic factors are associated with the poor and good information processing skills of adults;
- how do adults with poor and good information processing skills cope and prosper in the socio-economic sense or why is it necessary to have top performers and which problems are connected with low skills.

Low performers of information processing skills are defined as follows:

- **people with low literacy level** – literacy at or below Level 1;
- **people with low numeracy level** – numeracy at or below Level 1;

- **people with low level of problem-solving skills in technology-rich environments** – problem-solving skills in technology-rich environments below Level 1, plus people who had no previous experience in using computers, who did not wish or dare to solve tasks in the computer⁷ or who “failed” a simple test of their ability to use the functionality to undertake the assessment in computer-based form (the ICT core test).

Reading component skills are separately observed in the analysis to characterise the low level of literacy in more detail. According to the PIAAC methodology, reading component skills are those associated with understanding vocabulary, meaning at the level of the sentence and passages of text. Reading component skills are a prerequisite to understand the text being read and the lack of those skills can impact on the coping and well-being of adults.

Top performers of information processing skills are defined as follows:

- **people with high literacy level** – literacy at Level 4 or 5;
- **people with high numeracy level** – numeracy at Level 4 or 5;
- **people with high level of problem-solving skills in technology-rich environments** – problem-solving skills in technology-rich environments at Level 2 or 3⁸.

Analysis revealed that:

Estonia has just slightly fewer top and low performers of information processing skills than the countries participating in the survey on average. The greatest shortcomings are seen in the problem-solving skills in technology-rich environments. According to the PIAAC survey, in 2012 the proportion of top performers of information processing skills formed 5-6% and of low performers 8-10% of the Estonian population aged 16-65, which was a little less than the average of countries that have taken part in the survey. However, there are some differences in individual information processing skills. On the one hand, the share of top performers of literacy and numeracy in Estonia is comparable to the international average and the share of low performers is even smaller than the international average. On the other hand, Estonia has fewer top performers and clearly more low performers of problem-solving skills in technology-rich environments than the average of other countries. Thus, in order to reach at least the average level of information processing skills of countries that have participated in the PIAAC survey, the problem-solving skills in technology-rich environments of Estonian adults need to improve.

The level of education is not the only factor that affects the share of top or low performers. The level of information processing skills is different by socio-economic and demographic factors. The proportion of top performers is larger and the proportion of low performers is smaller among adults who are highly educated and younger, whose home language is Estonian, who participate in cultural events more often and who are employed in highly skilled occupations. In addition, groups with a larger share of top performers stand out among respondents using information processing skills on a daily basis and having parents who have a higher level education. In comparison to women, men form a larger proportion among top performers of numeracy skills. It should also be highlighted

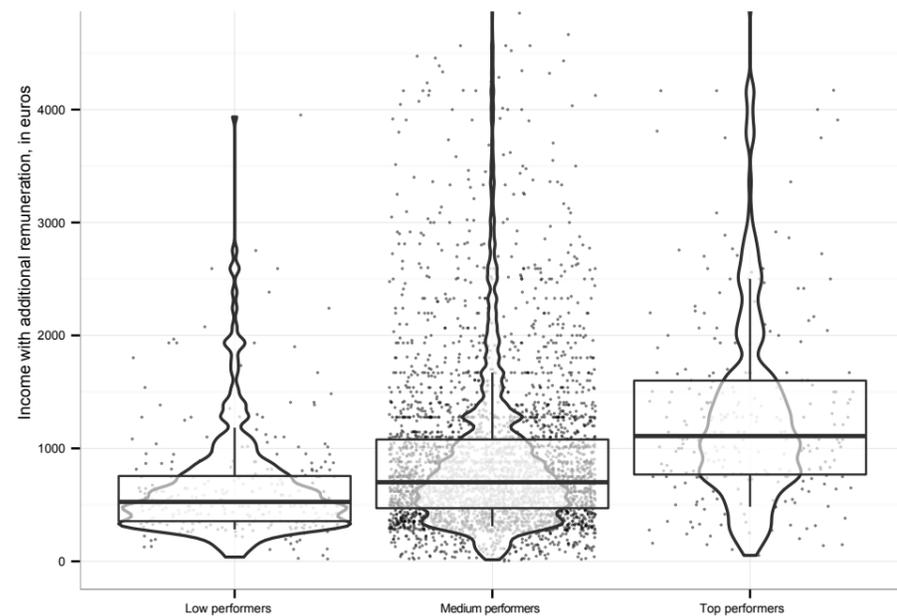
⁵ OECD, Statistics Canada. (2000). Literacy in the Information Age Final Report of the International Adult Literacy Survey: Final Report of the International Adult Literacy Survey. OECD Publishing.

⁶ Hanushek, E. A., Woessmann, L. (2011). Chapter 2 - The Economics of International Differences in Educational Achievement. In: Hanushek, E. A., Machin, S., Woessmann, L. (Eds.) Handbook of the Economics of Education, Volume 3, 89-200. Elsevier.

⁷ The participants in the survey who opted out of taking the computer-based assessment for whatever reason are also considered people with a low level of problem-solving skills in technology-rich environments in this report. It is thereby presumed that most probably they opted out because they did not have sufficient computer skills or felt unconfident in using a (unfamiliar) computer.

⁸ It is justified to argue here that under the PIAAC methodology the tasks solved at Level 2 need not be very complicated and this level might not characterise a very high level of problem-solving skills in technology-rich environments. The level of skills of people scoring at Level 2 is still higher compared to a large proportion of the population and the decision to consider those scoring at Level 2 top performers has mostly derived from methodical considerations of the data analysis.

Figure 3.2. Distribution of monthly incomes of salaried workers (EUR) among top, medium and low performers in information-processing skills



Note: The thicker horizontal black line in the box-whisper plot marks the median of the distribution of incomes; the lower edge of the box the 25th percentile and the upper edge the 75th percentile. Within the box therefore are 50% of observations; higher than the box 25% and lower than the box 25% of observations. Unlike an ordinary box-whisper plot, the whiskers' extending above and below the box indicate the 10th and 90th percentiles. The violin plot below the box-whisper plot shows the distribution even more accurately: the wider the violin at an income level, the higher the number of people who receive that income. The dots mark individual observations of income at the respective level of information-processing skills.

The analysis leads to the following conclusions:

In connection with the results of the PISA survey, the lack of top performers has frequently been discussed in Estonia and the results of the PIAAC survey also seem to confirm the foregoing to some extent – Estonia has fewer top performers of information processing skills than countries that have participated in the survey on average. At the same time, the backwardness is modest in comparison with other countries and it does not point to any tragic consequences. The greatest backwardness has been observed in the problem-solving in technology-rich environments and this is the area that needs most attention among information processing skills.

The advantages (and disadvantages) of being a top (or low) performer has been discussed to a lesser extent than the lack of top performers. Do top performers cope obviously better in the society in comparison with people with a medium level of skills? Do low performers cope clearly worse? This analysis shows that although the inclusion in top and low performers of information processing skills is correlated with different labour market outcomes, such as wages and the probability of being employed, the participation in the labour market, level of income and health are much more explained by other indicators, especially education, than the level of information processing skills. This means that besides information processing skills the labour market needs other (perhaps even more important) skills and the improvement of only information processing skills will probably

not lead to any substantial changes with regard to coping in the labour market. Arising from that, it is unclear whether the measures targeted at the improvement of information processing skills of adults can bring about more successful coping in the labour market – rather it might be rational to pay attention to the improvement of practical skills. However, the foregoing does not mean that in some instances the prerequisite for acquiring these skills could not be the higher level of information processing skills.

In addition, it cannot be excluded that the usefulness of being a top performer or disadvantage of being a low performer for an individual or the impact of a larger share of top performers and a smaller share of low performers on the country as a whole results from other outcome indicators that were not analysed in this report. In other words, the achievement of a larger proportion of top performers and a smaller proportion of low performers of information processing skills can still be important for the country. In order to reach at least the average level of information processing skills of countries that have participated in the PIAAC survey, the problem-solving skills in technology-rich environments of Estonian adults need to improve. However, the modest results of problem-solving skills are not unambiguously clear today and an additional analysis is required to make more specific proposals for intervention measures (another report is prepared for this theme).

Nevertheless, this report also provided a hint with regard to a target group that needs the improvement in the level of problem-solving skills. The results of the analysis has showed that, in addition to other socio-economic and demographic factors, health is correlated with the ability to acquire the skills to use technology: over half of the persons with poor health, loss of capacity for work or disability whose daily life could be simplified by IT-solutions belong to low performers of problem-solving skills in technology-rich environments. As people with poorer health, disability or incapacity for work may have limited access to hardware and software customised to their needs, a question of how to provide various groups with equal opportunities to develop and use their skills must be dealt with.

The employment possibilities of low performers of information processing skills are also primarily associated with health and income mostly with age, gender and health. As the employment possibilities and income are generally different depending on health, gender and age, the results do not require specific measures for low performers of information processing skills. Measures that create equal opportunities and contribute to the improvement in employment and income of different socio-economic and demographic groups should rather be developed.

The level of education is the indicator that affects the inclusion in the top performers of information processing skills to the greatest extent, as expected, but the home background also plays a pretty important role – the probability that people who have a mother with a higher level of education and come from an Estonian home belong to the top performers is considerably greater than in the case of people whose parents do not have higher education and who do not speak Estonian at home. Although the association between belonging to the group of top performers and education of parents is expected, such conspicuous differences cause doubt that they do not just reflect differences in mental abilities, but background factors that could be improved also play their role. The analysis has not explored which measures would lead to the desired changes most efficiently, but these should supposedly be looked for among the activities targeted at the increase of awareness of parents and strengthening of cooperation between home and school.

4

THE ROLE OF INFORMATION PROCESSING SKILLS IN DETERMINING THE GENDER AND LINGUISTIC WAGE GAP IN ESTONIA

Vivika Halapuu

Based on data from the PIAAC study, several overviews have been compiled regarding the relationships between skills and different labour market outcomes, including wages/salaries. The role of skills in explaining wage gaps has not been dealt with as actively. Nevertheless, Estonia has for many years stood out from other European countries due to its higher gender wage gap indicator, and some authors have also highlighted the unequal positions of ethnic Estonians and non-Estonians on the labour market. Among other conclusions, the OECD in its Economic Survey of Estonia recently reprimanded Estonia for the high gender wage gap¹⁰. Due to the extent and salience of the problem as well as the opportunity to overcome the limitations of the analyses performed thus far, it was decided that the PIAAC study's fourth thematic report would namely be on the topic of the wage gaps.

This report focuses on the question of whether and to what extent the information processing skills measured by PIAAC¹¹ can shed light on hitherto unexplained components of the gender and linguistic wage gap. The need for a linguistic instead of ethnic treatment of the wage gap stemmed from the fact that the PIAAC study did not collect data on ethnicity. Instead, it ascertained the person's native language and primary language spoken at home; a third possible linguistic indication was the language in which the respondent solved tasks and/or filled in the background questionnaire in the study. Of these options, the language spoken at home most often was ultimately used, based on the categories "Estonian as the language spoken at home most often" (hereafter Estonian-speakers) and "Russian as the language spoken at home most often" (hereafter Russian-speakers). In addition, descriptive analyses showed that the conclusions drawn regarding the size of the wage gaps between Estonian- and Russian-speakers varied when tackling the Russian-speakers with different level of Estonian language skills, and thus this dimension was also added to the analysis.

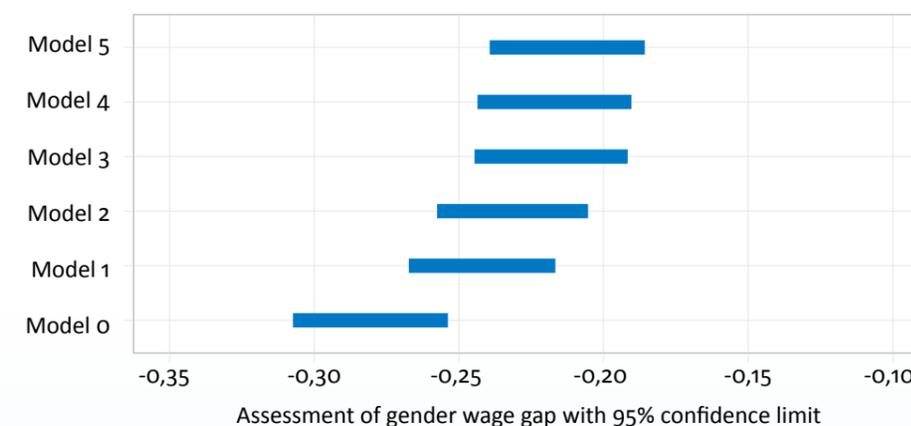
Besides the role of numeracy, literacy and problem-solving in a technology-rich environment, which is studied using three different model specifications, the role of the usage of information processing skills (literacy, numeracy, and ICT skills, and solving complicated problems) and other skills (e.g. persuasion and planning skills), as well as the level of Estonian and English proficiency in explaining wage gaps is analysed. The latter

were not measured directly in the study; rather, information was gathered from the respondents through self-assessment questions. The language proficiency characteristics were country-specific and lacked international comparability.

The results of analysis showed that:

According to PIAAC data, the gender wage gap in Estonia in the last two quarters of 2011 and the first quarter of 2012 (the period during which the data for the PIAAC study were gathered) was 25.4-30.7%¹² from the vantage point of females – in other words, women earned an average of 25.4-30.7% less than men. By adding all of the so-called conventional control variables and additional PIAAC dataset indicia to a Mincer-type wage equation, it was possible to explain 27.4% of the entire unadjusted gender wage gap. The point-estimate of the gender wage gap determined on the basis of a model that used all control variables is lower than the estimate found on the basis of a model that only includes conventional controls, but because of the impreciseness of the scores due to the relatively low number of observations in contrast to such a large set of control variables, this could not be considered a statistical reduction of the gender wage gap. Numeracy, where an increase of one standard deviation is associated on the basis of a comprehensively controlled model with a 1.7-9.1% higher wage, reduces the point-estimate of the gender wage gap by 5% on the basis of comparison of various regression models.

Figure 4.1. Gender wage gap by models with varying set of explanatory variables



Note: Model 0 indicates the model where the only explanatory factor of the salary equation is gender; Model 1: A model with so-called ordinary explanatory variables: gender, age, education, place of residence, marital status and whether there are any small children in the family, assessment of health, level of Estonian language skills and characteristics related to workplace such as area of activity, occupation, management of other people's work, length of service, number of work hours per week, format of employment contract, size of company and sector (public vs private); Model 2: Model 1 + information-processing skills proficiency; Model 3: Model 2 + intensity of use of information-processing skills at work; Model 4: Model 3 + frequency of use of other skills at work. Model 5: Model 4 + English language skills

¹⁰ OECD. (2015). *OECD Economic Surveys: Estonia 2015*. OECD Publishing.

¹¹ Programme for the International Assessment of Adult Competencies

¹² Instead of point-estimates, 95% confidence intervals are reported.

The remuneration of various characteristics is different for men and women. Among men, higher wages are more strongly related to the numeracy proficiency¹³ and work autonomy; in the case of women, to frequency of ICT use at work and the educational attainment. Of these differences, numeracy and educational attainment may well raise the most questions in terms of their relationship with income. One can only suppose that these skills may be acquired differently and that, due to the different channel of acquisition, the skills may be different in content. Analysis by Ishikawa and Ryan (2002) supports this interpretation, finding that in the case of men, cognitive skills acquired outside of school are correlated with income, while for women it is skills acquired in school. The correlation of skills acquired via different channels with wages has not been analysed in Estonia, but the results of this research signal that there might be a possible correlation here. As to why this relationship exists in such a form, this remains an open question. Presumably skills acquired outside of school were picked up during practical work, perhaps also on the job; and presumably because of their more practical nature, they are seen by employers as meriting higher remuneration.

The results of Oaxaca-Blinder decomposition showed that numeracy contributes positively to the explained component of the gender wage gap. The model, constructed using literacy proficiency, did not indicate that literacy contributed to the explained component of the wage gap. Problem-solving skills in technology-rich environments contribute negatively to the explained component. In the case of all of the constructed models, it became evident that positive contributions to the explained part of the wage gap also stemmed from the distribution of men and women in occupations, managing positions, different industries and different sectors. The gender wage gap would be even greater if women were similar to men in terms of use of literacy skills at work, educational attainment and work hours. **As a result of Oaxaca-Blinder decomposition, it was possible to explain 30.2% of the unadjusted gender wage gap.**

The unadjusted wage gap based on home language fell within a range of 13.2-19.8% based on regression analysis performed on PIAAC data, showing that the wages of Russian-speakers were on average this much lower than the wages of Estonian-speakers. Yet it emerged from the analysis that **the incomes of Russian-speakers clearly vary depending on how proficient they are in Estonian.** As a result, the wage gap based on home language was examined more closely, in three segments:

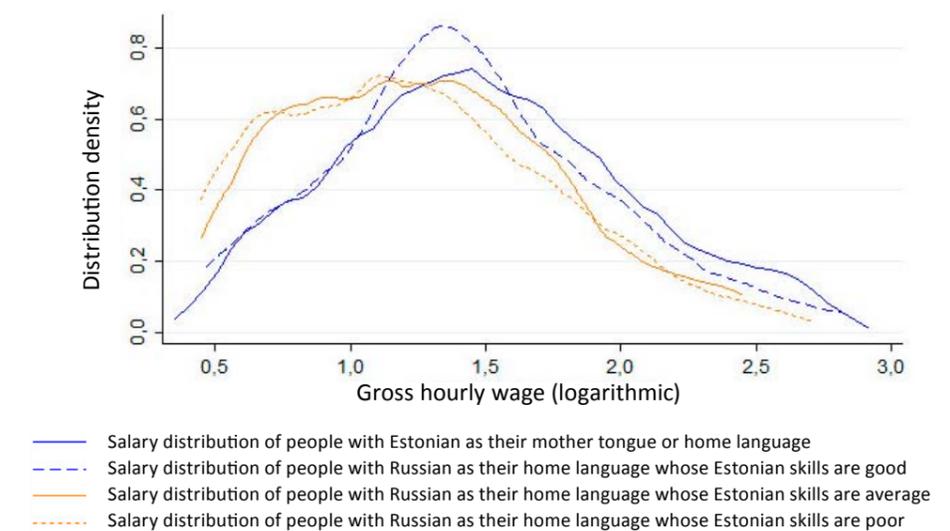
- 1) the wage gap between Estonian-speakers and Russian-speakers with very good Estonian proficiency;
- 2) the wage gap between Estonian-speakers and Russian-speakers with average Estonian proficiency;
- 3) the wage gap between Estonian-speakers and Russian-speakers with poor Estonian proficiency.

Analysis conducted in these groups showed that **the incomes of Russian-speakers with very good Estonian proficiency were no different to those of Estonian-speakers.** In other words, there is no real wage gap between these two groups. There were wage gaps in the other two comparisons, however. Russian-speakers with average Estonian proficiency earned an average of 5.9-15.9% lower wages than Estonian-speakers; and Russian-speakers

¹³ Still, the results should be interpreted with the understanding that although the correlation between numeracy and wage is positive and statistically significant for men, it is relatively modest. Numeracy higher by one standard deviation is correlated with 3.1-16.1% higher wages, but it should be kept in mind that one standard deviation on the numeracy scale corresponds to about seven years of schooling.

with poor Estonian proficiency earned 7.5-20.1% less than Estonian-speakers. By plugging the so-called conventional control variables and additional PIAAC dataset indicia into a Mincer-type wage equation, it is possible to explain 26.7% and 35.6% of the wage gaps between these groups, respectively. Adding numeracy to the model reduced the point-estimate of the wage gap between Russian-speakers with average Estonian proficiency and Estonian-speakers by 5.6%, and between Russian-speakers with poor Estonian proficiency and Estonian-speakers by 6.7%.

Figure 4.2. Logarithmic salary distributions of people with Estonian and Russian as their home language



The results also showed that alongside Estonian proficiency, **English proficiency is at least as important (if not more) when it comes to wages.** However, the descriptive overview presented by home language showed that the share of people with good English proficiency is lower among the Russophone population than it is among people with Estonian as their home language, pointing to the need to raise English proficiency among this group.

Detailed analyses by regions and age groups point to a correlation between Estonian proficiency with wages first and foremost in regions where the share of people with Russian as their home language is greater – Tallinn, northern Estonia in general, and north-eastern Estonia. In central Estonia and Tartu, the wages of Russian-speakers did not vary from the wages of Estonian-speakers at any Estonian proficiency level. **English language proficiency is important in northern Estonia (including Tallinn), southern Estonia (including Tartu) and central Estonia.** The models assessed on the basis of regional samples indicate no correlation between English language proficiency with wages in western and north-eastern Estonia. For all of these analyses, potential imprecision should be assumed, stemming from the relatively small size of the sample against the number of control variables included in the analysis.

A comparison by age groups indicates that low English proficiency correlates negatively with wages in all groups besides the oldest one (55-65). The same is true for the proficiency in Estonian – no statistically significant differences could be seen in this age group between people with Estonian and Russian as their respective home languages. However, Russian-

speakers aged 25-54 with average or poor Estonian proficiency clearly earn lower wages than Estonian-speakers with otherwise similar background characteristics.

The results of quantile regression showed that the correlation of both numeracy and literacy with income is relatively modest in all parts of wage distribution, and statistically insignificant at the upper end of wage distribution. On the other hand, problem-solving skills in a technology-rich environment were more strongly correlated with wages at the upper end of distribution. The same is true of English and Estonian proficiency: at the upper end, lacking or very low English proficiency level is associated with a greater wage 'penalty' and Russian-speakers with very good Estonian proficiency even have a slight wage advantage over people with Estonian as their home language. As regards the estimates of the gender wage gap, the analyses confirmed the findings of previous research: **the gender wage gap is greater at the upper end of wage distribution**. Whereas at the 10th percentile, women earn 11.4-19.2% lower wages than men, the difference at the 90th percentile is 21.6-29.7%.

The most important policy recommendations are as follows:

- Mathematics education and, more broadly, other scholastic knowledge should be adapted to give them a clearer value on the labour market and make employers see them as meriting higher pay. Analyses conducted showed that women with higher educational attainment do not acquire sufficiently good (or sufficiently applied) mathematical skills or are unable to productively apply the skills on the job market. Both scholastic mathematics education and teaching strategies for success in a technology-rich environment should make a stronger move 'into real life' so that women with a lengthy educational path acquire maths skills valued on the job market.
- This research did not devote separate study to the selection of men and women, including men and women with different numeracy proficiency, for various occupations. As career choices can be strongly influenced by gender roles (with the share of male students in the sciences continuing to be higher than that of women in spite of the general popularisation of the subjects), the low remuneration of maths skills among women can stem from the fact that a large share of women are hired for positions where such skills are used less frequently. The descriptive overviews of this report showed that women use maths skills less frequently at work. A 2013 Praxis study on actions popularising science and technology in Estonia¹⁴ also showed that when boys and girls are compared and other background characteristics are kept constant, young men have a 29% greater probability of wishing to continue studies in the fields of science and manufacturing and construction. As a result, the importance of public awareness efforts aimed at scrapping gender roles should not be underestimated.
- As a separate topic, the intergenerational transfer of wage gaps should be analysed, as this can stem from a similar transfer of gender roles. In other words, study should be devoted to whether women who were raised according to traditional family models (where the mother did the housework and received lower wages and with the father being the main breadwinner) are also more likely to choose an analogous profession, thus deepening the continuation of the trend of women receiving lower wages.

¹⁴ Kirss, L., Haaristo, H.-S., Nestor, M., Mikko, E. (2013). *Teadust ja tehnoloogiat populariseerivad tegevused Eestis*. <http://www.praxis.ee/tood/teadust-ja-tehnoloogiat-populariseerivate-tegevuste-tulemuste-ja-valjundite-uuring/>.

- Even though the PIAAC study lacked information on people's risk aversion and other non-cognitive skills, earlier research has demonstrated that the differences between men and women as well as between e.g. ethnic groups with regard to these characteristics may be correlated with the wage gap. The same applies to differences in reservation wages, which may in turn be due to e.g. poorer negotiating skills and higher risk aversion in women. This analysis does not enable confirmation of these hypotheses, but previous knowledge suggests that it could be important to introduce aspects such as development of negotiating skills to career counselling. In essence, this would first mean conducting an analysis of negotiation strategies by gender and, on this basis, compiling materials (instructional videos etc.) to increase knowledge and awareness of how to be a successful negotiator at the wage negotiations. Also not to be underestimated when it comes to the issue of fair wages is the existence of transparent salary information for various professions and areas of activity.
- As the results indicated that Russian-speakers had poorer English proficiency, additional English training should be aimed specifically at these people. At the same time, English proficiency correlates with wages in the case of Estonian-speakers too, indicating that it is important to improve English proficiency among Estonian-speakers with low English language proficiency as well. It should be borne in mind in this connection, however, that low English skills does not mean lower wages in all regions of Estonia. Specifically, superior English ability appears to be more important in Tallinn, Tartu (and northern and southern Estonia in general) and for people living in central Estonia with an average or lower level of English proficiency. It cannot be ruled out that a higher level of English proficiency among e.g. residents of north-eastern Estonia could open up new career opportunities for inhabitants with Russian as their home language.
- By age group, the focus in English language learning should be placed on quite a broad group – those aged 16-54. In this analysis, only in the case of those aged 55-65 were no wage differences apparent depending on English proficiency.
- Acquiring good Estonian proficiency is also key to improving the labour market outcomes (as measured in this research by wages) of the Russophone population. Although the wages of Russian-speakers with various levels of Estonian proficiency were not statistically different from those of Estonian-speakers among the youngest and the oldest age group, poor or average Estonian proficiency is associated with noticeably lower wages among those aged 24-54.

The most important methodological implications of the analysis are as follows:

- Questions pertaining to reservation wages should be added to the background questionnaire of the second round of the PIAAC study (or other relevant study conducted regularly). In addition, the conditions under which people in various socio-demographic groups would be prepared to earn somewhat lower wages should be examined – for example, could greater flexibility in organising working time be one incentive for women asking for significantly lower wages than men?
- To make the analysis of wage gaps more comprehensive, it will be important to deal, among other factors, with information about people's non-cognitive skills. This analysis revealed that information about people's numeracy, literacy and problem-solving skills in a technology-rich environment – information that was not previously

known from comparison of Estonian men and women and people with Estonian and Russian as their respective home language – did not reduce the unexplained components of the wage gap all that extensively. This does not mean, however, that variations in other skills that for various reasons were not built into the analyses could not explain the unexplained components. One such characteristic is information about people's non-cognitive skills (personality traits, self-management skills etc.).

- Subsequent analyses will certainly benefit from a larger sample size, which would yield more accurate assessments according to a large set of background characteristics. This analysis addressed (horizontal) educational mismatch cursorily (only in the descriptive overviews). It was not possible to take this into consideration in the more thorough analyses. This would be possible with a larger sample.

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

Pille Pruulmann-Vengerfeldt, Ave Roots, Tarmo Strenze, Mare Ainsaar

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 Valk¹⁵ 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 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.

¹⁵ Halapuu, V., Valk, A. (2013). *Täiskasvanute oskused Eestis ja maailmas. PIAAC uuringu esmased tulemused*. Tartu: Haridus- ja Teadusministeerium.

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

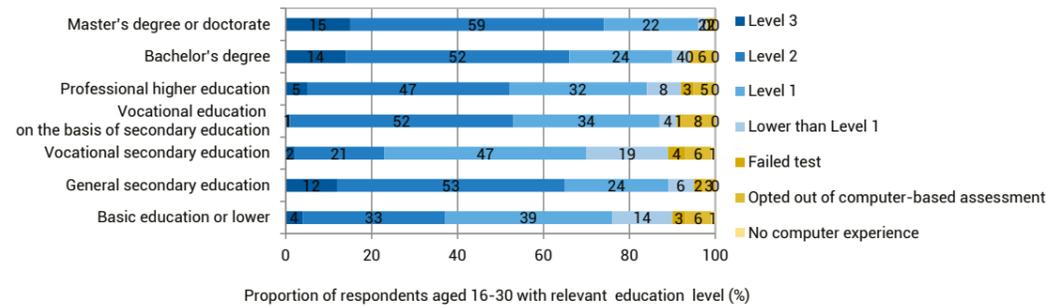
According to the results of the analysis, 10% of Estonian adults use a computer in a versatile way and the total share of active computer users (both non-work and work-related) is 39%. However, 51% of Estonian adults use a computer very little or in a very limited number of ways or not at all.

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.

Figure 5.1. Division of respondents aged 16-30 by education level based on problem-solving skills in technology-rich environments



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.

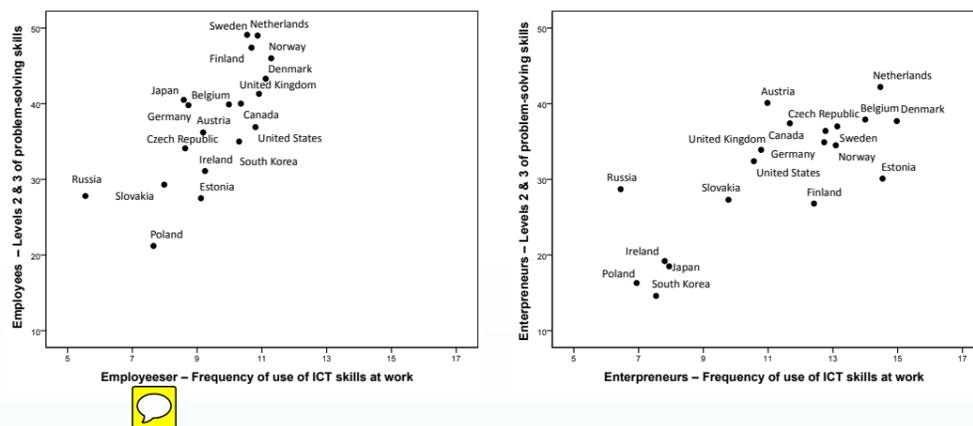
The report disproves the argument that computer use and skills originate from a work-related environment. Earlier analyses of the PIAAC study already showed that approximately one third of workplaces in Estonia do not use a computer at all¹⁶. This

¹⁶ Halapuu, V., Valk, A. (2013). *Täiskasvanute oskused Eestis ja maailmas. PIAAC uuringu esmased tulemused*. Tartu: Haridus- ja Teadusministeerium, pp. 116.

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.

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.**

Figure 5.2. Two-dimensional relationships between proportions of business operators and salaried workers with good or very good problem-solving skills and average frequency of computer use for work purposes by business operators and salaried workers



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.**

EDUCATION AND SKILLS

Aune Valk, Gerli Silm

The Education and Skills report mostly focuses on the analysis of two issues on the basis of data from PIAAC, the Estonian Education Information System (EHIS) and the State Register of Occupational Qualifications. First, who in Estonia study longer and why and what the role of different factors is in the length of education path is analysed, and the importance of results of national examinations administered in the end of upper secondary programmes (hereafter national tests) and differences between education paths taken by various groups are evaluated. Second, the role of formal education and other factors to assess the level of information-processing skills and its changes is analysed. The skills of graduates at different levels and fields of education as well as the skills differences between men and women are reviewed. Attention is separately paid to the skills of teachers and graduates in the field of education. A more precise review of occupational qualifications in the labour market as compared against skills and education has been also carried out.

The results of the analysis have shown that:

- 1. The average education length has grown by one year over the last 30-40 years: today's youth go to school for 13 years, on average. The difference in the education length between men and women and between people with Estonian and other home languages has also become greater. The difference is one year or longer in both cases. The length of an education path depends not only on one's gender and home language, but also on the home background, the education of the parents and, after the completion of secondary education, on the national test results. Taking into account other factors, the latter depends both on the location of the school and the language of instruction.**

People in Estonia place a great value on education: the role of education in future success is considered as important approximately by 80% of the population¹⁷. The education length in Estonia has increased approximately by one year over the last 30 years. People who currently belong to the 55-65 age group went to school, on average, for 12 years, but people who currently belong to the 25-35 age group went to school, on average, for 13 years. Speaking about the education length and results it is difficult to deny the impact of home background; to lessen differences caused by the family social status is one of the goals often stated for education. An education path is also influenced by personal characteristics (intellectual abilities, gender, readiness to make efforts, etc.) and the related personal value put on the investment into education. Education prospects are also influenced by financial means, awareness, etc. Good school systems are able to offer a uniformly good education regardless of a

specific school (location, size, etc.) and the background of a student's parents.

This analysis has shown that the sources of inequality in the length of education path in Estonia have been home background (measured through the parents' education and the number of books at the childhood home), home language and gender. The impact of home background has also been identified in all the earlier works. The analysis of the entire PIAAC sample has shown that a father and a mother with a higher education both add over one extra year of schooling to the child's education length, i.e. children whose both parents have a higher education study almost two and a half years longer than children whose both parents have only lower secondary education. The home learning environment (measured through the number of books at respondents' homes when they were 16-year-olds) is especially important and it might cause a two-year difference in the education length. There is no obvious trend showing the changing significance of home background, but for younger age groups the role of a father with a higher education has decreased and the role of the mother's education has increased. Nevertheless, the role of parents' education in Estonia is rather small compared to other countries.

A link between the education length, home language and gender needs additional attention, because inequality measured through these indicators has grown. People who speak Estonian as their home language study approximately one year (0.9) longer than people with other home languages, and women, on average, study 0.7 years longer than men. Education paths of men and women are different in all the age groups, but in older age groups the difference is 0.5-0.7 years and in the youngest age group (25-34) where education has been usually finished the difference is one year. At the same time, the difference in education length between respondents with Estonian and other home languages has increased. Leaving aside the youngest age group where education has not been completed yet, the difference in the other age groups is from 0.5 years in the oldest age group (55-65) up to 1.2 years in the 25-44 age group. **The rising gender- and language-based inequality definitely requires more attention in the education policy, especially considering the fact that respondents with the Russian home language actually place an even greater value on education than Estonians¹⁸.** It should be further studied whether young people with the Russian home language who achieve the best test results prefer to continue studies abroad more often than Estonians, thus creating an education divide. An indication of the greater inclination to continue education abroad among the Russophone youth is a Praxis report¹⁹ that studied the specific intentions of secondary school graduates after graduation. Only 7% of the Estonian youth intended to study abroad, whereas the respective indicator among the Russophone youth was 31%. The follow-up survey of the same study was conducted in the autumn following the graduation from secondary school and it showed that a little more than half of the respondents realised their intention to go abroad.

The report also attempted to shed some light on the causes of differences in the education path after graduation from secondary school. The analysis of youth has shown that all the aforesaid factors (gender, home language, parents' education level and home background) also influence national test results, and the education length after the graduation from upper secondary school also depends on these factors. The

¹⁷ Täht, K., Helemäe, J., Võõrmann, R. (2014). *Public opinion on the importance of education and its dependence on financial means*, Unt, Marge; Täht, Kadri (Eds.). *Tööturu väljakutsed kõrgharidusele (17 - 78)*. Põltsamaa: Vali Press OÜ

¹⁸ Masso, A., Kirss, L., Kriger, T. (2012). *Haridus ja noored. Kogumikus (AS Emor, SA Poliitikauringute Keskus Praxis, Tartu Ülikool, koostajad) Integratsiooni monitooring 2011, 51-79*. http://www.kul.ee/sites/default/files/integratsiooni_monitooring_2011.pdf

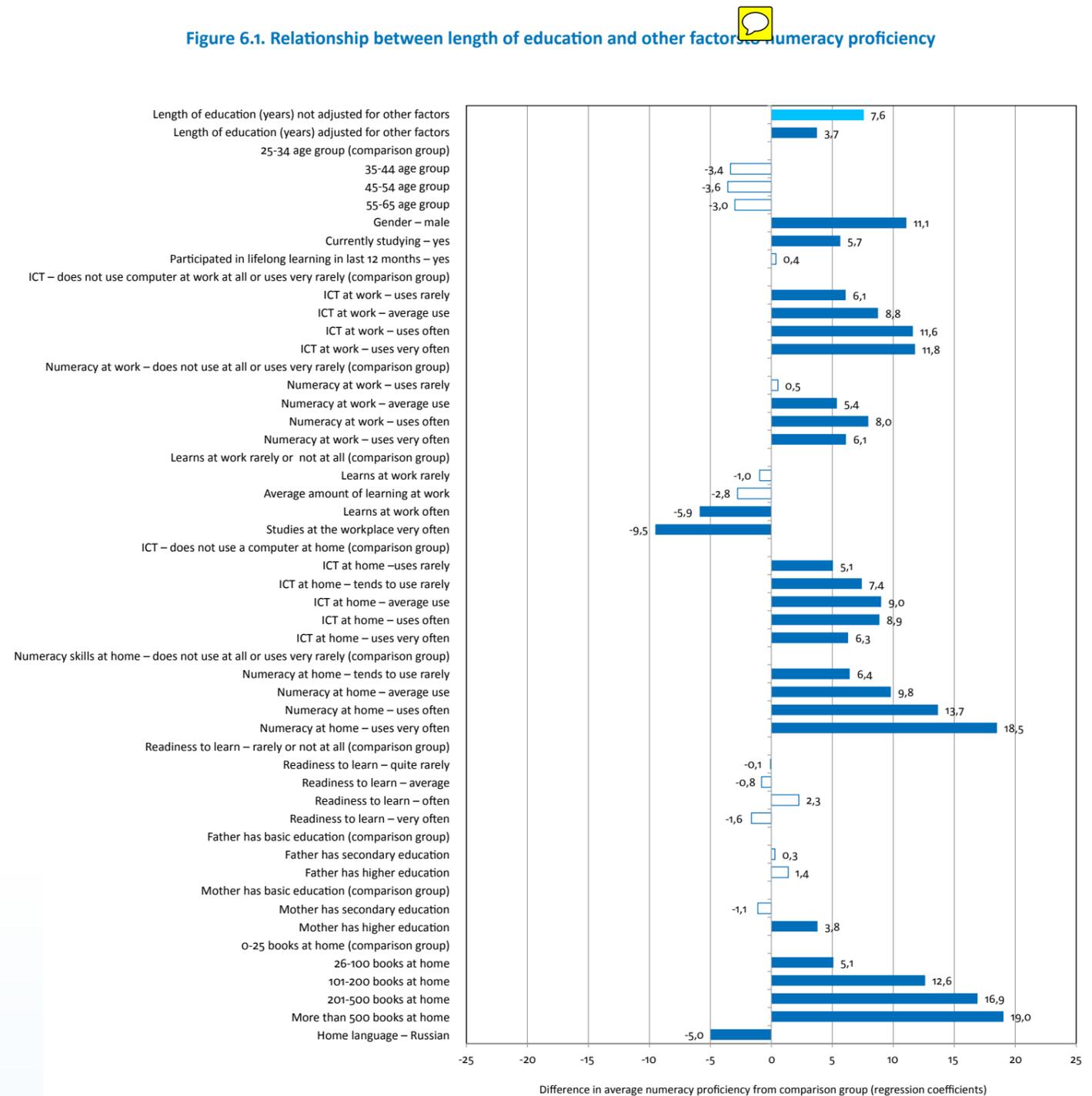
¹⁹ Mägi, E. ja Nestor, M. (2012). *Koolilõpetajad ja nende karjäärivalikud*. SA *Archimedes*

better the national test results, the longer the period of studies after the completion of secondary education. Ten additional points in the test results lead to an education path that is approximately half a year longer. It further confirms the findings of Dubow et al.²⁰ that the education level of parents is also related to the education level acquired in the adult age 40 years later, but this influence is diminished: the parents influence the educational ambitions of their child until he/she becomes 19 years old and his/her education level achieved by this time. When considering national test results, one can first of all see the diminishing role of home background (the number of books at one's childhood home) in influencing the length of education path as well as of mother's education and gender. It confirms earlier findings that educational inequality caused by home environment should be addressed early. A needs-based student allowance or other measures at the level of higher education might not be enough to correct inequality that emerged earlier.

In the context of school-related differences, this analysis offers rather positive messages. **The education path of school graduates from rural areas, small towns and other cities is as long or even longer than the education path of those who go to a basic school, e.g., in Tallinn or Tartu. At the same time, the language of instruction in basic school does not correlate with the education length, if the background factors are taken into account.** Nevertheless, a school's location and language of instruction do correlate with national test results: **Compared to Tallinn, upper secondary school graduates in Tartu receive higher national test results and the graduates in rural areas and small towns lower test results.** Similarly, basic school graduates in rural areas, small towns or other cities receive, on average, lower results compared to the graduates in Tartu and Tallinn, even if home background is taken into account. In this context it is important to remember that over 40% of basic school graduates from rural areas and small towns in this sample continued their education in a bigger centre: Tallinn, Tartu or other larger city. The results of those who continue their education in other location become similar to the results of students who originally studied in this location: it is very clear in the case of Tartu and other larger cities where the results of students who moved from rural areas and small towns do not differ from the results of students who went to a basic school in the same city.

2. Education is very important for the prediction of skills, but in Estonia this factor is sometimes even over-valued. Taking into account various factors, numeracy proficiency of men exceeds that of women at an amount equal to three years of schooling, i.e. the number of years that it takes to obtain a bachelor's degree. At the same time, work sophistication plays a key role in the prediction of skills level (the frequent use of ICT skills). Also, nothing can replace home background – a lot of books at the childhood home leads to higher skills regardless of education. The lower the education, the greater the effect of continued studies – a higher education adds less to skills than the continuation of studies after graduation from basic school. Nevertheless, the comparison of school graduates with similar national test results shows that those who later acquire a higher education have information-processing skills that are higher by approximately 10 points compared to those who limit themselves to secondary education. However, attention should be paid to numeracy and problem-solving skills in a technology-rich environment among people with a bachelor's degree who studied under the 3+2 system. The

Figure 6.1. Relationship between length of education and other factors and numeracy proficiency



skills of graduates in science and the humanities and arts are at a (very) good level in the international comparison, but the skills of graduates in the field of education, engineering, manufacturing and construction are (very) low.

Evaluating the role of formal education in skills development, the earlier findings that the length of an education path predicts the level of skills to an important extent got confirmed. Taken separately, education predicts 4-17% of the variation in the skills level, depending on a specific skill. On the other hand, education is clearly not the

²⁰ Dubow, E. F., Boxer, P., & Huesmann, L. R. (2009). Long-term Effects of Parents' Education on Children's Educational and Occupational Success: Mediation by Family Interactions, Child Aggression, and Teenage Aspirations. *Merrill-Palmer Quarterly: Journal of Developmental Psychology*, 55(3), 224-249. doi:10.1353/mpq.0.0030

only way to improve one's skills. When other factors are taken into account, the role of education in predicting the level of skills drops by approximately 2 times, i.e. two persons with the same education do not necessarily have the same skills. In addition to formal education, skills are related to age, gender, home language, home background and mother's (higher) education and the frequency of use of one's skills, especially the use of ICT skills at work and at home. The best skills are demonstrated by young men with the Estonian home language whose mother has a higher education and who had a lot of books at home during childhood. However, the role of these factors is very different depending on specific skills. Although the age difference (the youngest vs. the oldest group) means a 30-point gap in problem-solving skills that could only be bridged by at least 10 years of schooling for older persons, the link between numeracy and age is insignificant, if other factors are taken into account.

The gender-based difference is the biggest in the case of numeracy – 11 points, which is comparable to 3 school years. Home language correlates most with literacy; taking into account other factors, respondents with the Estonian and Russian home language have the same problem-solving skills. Taking into account other factors, father's education is insignificant for the prediction of the skills level, and the correlation of mother's education with skills is rather weak compared to all the other factors (a 3-4 point difference between lower secondary and higher education). As was already shown above, it means that mother's education correlates with national test results and the length of the education path, and when these factors have been taken into account, mother's education loses its key role.

The home background (the number of books) during childhood and the use of ICT skills at work uniformly and strongly predict the level of information-processing skills independently of all the other factors. If the latter has been factored in, the length of the post-secondary education path loses its significance for the prediction of problem-solving skills. It shows that sophisticated work may compensate education-based differences in the level of problem-solving skills, i.e. an incomplete education is not necessarily critical for these skills provided that the use of ICT skills is required at work. The same cannot be said about numeracy and literacy, because formal education makes an independent contribution into the development of these skills. On the other hand, it must be noted that a higher education level is usually required to get more sophisticated work. At the same time, the education length indicator does not take into account a possibility that a person had started to acquire a higher education level but discontinued the studies at some point.

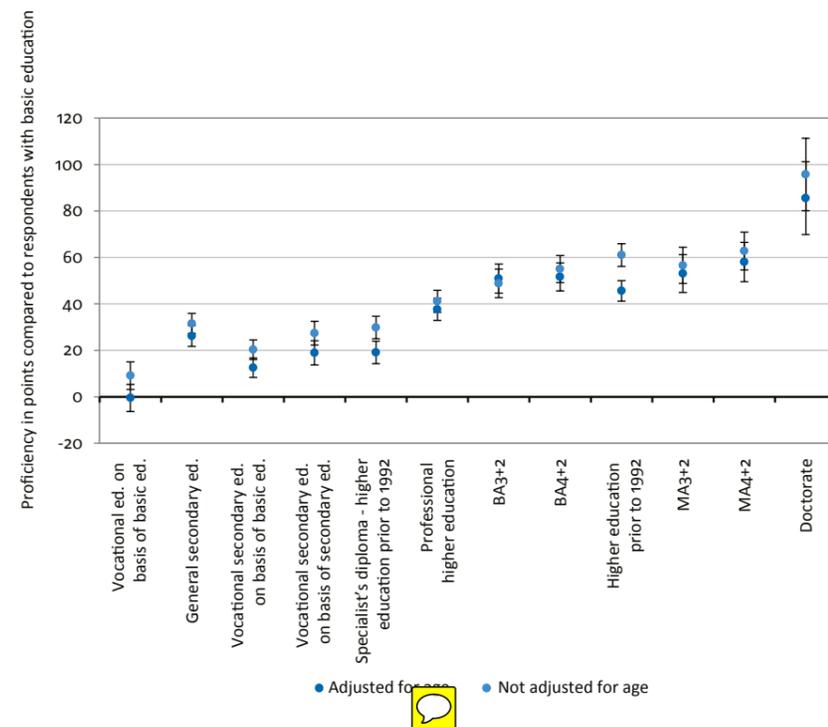
The skills of more advanced students are better at all the education levels regardless of the time when the highest education level has been acquired, e.g. 1 or 10 years ago. However, the lower the education level, the greater the effect of further studies – higher education adds less to skills than the continuation of studies after graduation from basic school. To put it simply, if a person would continue his/her studies without interruptions, he/she would compensate the age-related drop in the skills level by 2-10 times. In a younger age the age-related decrease in the skills level is slower (approximately 0.5 point per year). Therefore, the benefit of education is greater, whereas in the oldest age group skills are decreasing by approximately 2 points per year. Earlier studies have shown that participation in formal education at an older age (over 40 years) brings greater work-related benefits for women.

A closer look at the comparison of different education levels uncovers an earlier confirmed fact that in the youngest age group (under 30) Estonia has average or above-average skills at every education level compared to the countries participating in PIAAC. **Lower secondary, general secondary and academic higher education graduates have above-average skills and the graduates of professional and applied higher educational institutions have average skills. It illustrates current education competitiveness.** Unfortunately, things are not so good in older age groups. In these groups adults with general secondary and applied higher education (including secondary specialised education acquired after secondary education) are considerably below average in the international comparison of the countries participating in PIAAC. It may be related to the fact that for older age groups secondary education was compulsory. It meant that even people with poor skills were "dragged through". However, many people with secondary specialised education currently work at positions that do not require such education, i.e. they perform work that does not match their education.

An interesting opportunity offered by this report was the possibility to compare the contribution of post-secondary education into the development of skills, taking into account national test results retrieved from EHIS. The contribution of one school year after the completion of secondary education is clearly (approximately 2 times) smaller than across the entire educational range. **All the higher education levels have a statistically significant impact on the improvement of the literacy level, with the approximate difference from general secondary education being 10 points.** Thus, higher education is not only chosen by more capable students, but it can be argued that higher education makes an independent contribution into the development of information-processing skills. The contribution of professional and applied higher education to skills development after graduation from upper secondary school is zero for all the skills, and the difference between applied higher education and 3-year bachelor's degree is actually very small. Regardless of very broad confidence intervals and the consequent overlapping of results, it appears that old curricula based upon the 4+2 system (first of all, master's programmes) were more successful in developing numeracy and problem-solving skills than new higher education curricula. **The development of problem-solving skills is clearly a challenge for the organisers of 3-year bachelor's studies.** For example, graduates of bachelor's and master's programmes based on the 4+2 system have a numeracy advantage over respondents with secondary education equal to +11 and +18 points, respectively, whereas the similar advantage of graduates in the 3+2 system is only +5 and +6 points. For problem-solving skills the difference is +11 and +15 and -1 and +8, respectively. The first decade after the introduction of the 3+2 system in 2003 was also characterised by the largest admission numbers that could also influence the results. It should be also taken into account that the period of studies in the case of a 3-year bachelor's programme is a year shorter than in the case of a 4-year programme. The period and scope of studies are further reduced by the fact that opportunities to prolong studies have become more limited during the last decade: additional and prolonged studies are no longer welcomed or tolerated as much as 10-20 years ago.

The review of the contribution of various fields of study in higher education into the development of skills after national tests shows that the science curricula indeed enhance one's numeracy skills. On the other hand, the situation in the field of health and welfare is rather disturbing as it does not add extra points to any skills. It may

Figure 6.2. Average numeracy proficiency with a 95% confidence limit by education level in Estonia



be caused by the intense competition, for example, in the education of physicians and by the fact that advanced studies focus more on occupation-related skills rather than on general skills. A more significant improvement of skills after graduation from upper secondary school was identified among people whose national test results were in the lowest quartile. On the one hand, it is a positive sign that the lack of skills can be compensated for later or it may indicate that people with lower test results included those who just failed at the test and whose skills could have actually allowed a better result. On the other hand, it indicates the need of tertiary education providers to work more efficiently with more capable persons and develop their potential.

The skills of graduates in various broad groups of study in higher education have also been reviewed with the conclusion that Estonia clearly has the biggest problems with the skills of graduates in the field of education, engineering, manufacturing and construction. **The stronger results are shown by graduates in science as well as by graduates in the humanities and arts, and social sciences, business and law.** The skills gap between graduates in science and graduates in the field of education is approximately 50 points, which is as large as the difference between an average person with lower secondary education and an average person with higher education. It should be noted that the skills gap between the graduates is influenced by the selection effect, at least partially: the national test results upon the completion of upper secondary education shown by graduates in science have been, on average, 15 points higher than those of graduates in the field of education. Comparing Estonian graduates in different groups of studies with graduates in the same groups of studies in the other countries, Estonia is behind the strongest countries (the Netherlands, Finland) in practically every area; in the humanities and arts, and science we are competing with Sweden. People who graduated in professional secondary education

after the completion of secondary education have a more uniform distribution of skills in different groups of studies; only graduates in the humanities and arts stand out in all the skills and graduates in science stand out in problem-solving skills. Graduates in the humanities and arts mostly come from music schools.

3. The levels of the occupational qualifications system are adequately related to each other: the information-processing skills of people with a higher qualification level are better than the skills of those with a lower qualification level. In the majority of cases a person's qualification is lower than his/her education level. It is probably connected to the fact that, taking into account other factors, the presence of a qualification is associated with a lower rather than higher salary. People with qualifications are more active in the labour market than adults without a qualification. Among people with qualifications the share of employment as well as unemployment is higher; among the respondents with higher education the share of employed persons is higher.

In general, it can be argued that qualification levels are logically arranged in terms of skills, although the proficiency of information-processing skills of people with the I and II qualification levels does not differ between the groups, and the same is true when comparing the skills of people with the IV and V qualification levels. The literacy proficiency of people with the I-II qualification levels matches the skills of people with general secondary education, the skills of people with the IV-V qualification levels match the skills of an average person with higher education and the III level is between the two. Thus, it can be said that people with the I and III qualification levels have better information-processing skills compared to the corresponding education level. In the majority of cases a person's qualification is lower than his/her education level. Thus, the qualifications system corrects imprecisions of the education system, but it does so more effectively with over-education rather than with under-education. It is proved by the salary analysis of people with different qualification levels: the salaries of people with the III-V qualification levels exceed the salaries of people with the I qualification level by 18.8%. If the qualification level is taken into account, the correlation between the education level and salary becomes statistically insignificant.

People with qualifications have a greater probability of active participation in the labour market compared to people without qualifications; they have a greater share of both employed and unemployed persons. Approximately half of employed people with qualifications work in the area of economic activity corresponding to their highest qualification. The most important question of the analysis was whether a qualification gave an advantage in the labour market alongside skills and education. In the context of unemployment no difference between people with and without qualifications has been identified, but people with qualifications who have higher education have a greater probability of active participation in the labour market. Considering gender, home language and the skills-intensity of the occupation, the expected correlation of the highest education level and numeracy with salaries has been identified. A qualification as such does not correlate with a higher salary; even the contrary is true, which indicates that a lower qualification level is more often acquired compared to one's education level. **If other factors are taken into account, people with professional qualifications do not earn more than people without a qualification. Thus, the system of qualification has yet to prove its importance in the labour market.** One possibility to explain these results is the hypothesis that the acquisition of a qualification at lower education levels provides more active people

an opportunity to avoid or exit unemployment and at higher education levels an opportunity to look for new challenges, even if they require a lower competence compared to the acquired education.

- Correlation of gender with education and skills has been separately analysed. Gender differences in the youngest age group are either advantageous for women (in literacy), absent (in problem-solving skills) or smaller (in numeracy) compared to older age groups. In the 35-44 age group, however, men have better skills in all the categories compared to women and this difference remains in older age groups as well. **The most important finding was that women's skills were more influenced by children than men's skills and this influence was negative, whereas in the case of men the number of children may even point to better skills. As a rule, men have better skills, but if the number of children is factored in, the best skills are demonstrated by young women who do not have children.**
- The analysis of skills of teachers and graduates in the field of education has shown that Estonian teachers have the average or slightly below-average level of information-processing skills compared to their colleagues in the other countries but they clearly do worse in problem-solving in a technology-rich environment,** which is also a general problem in Estonia. The outcomes of teaching that are partially revealed in all the adult skills (PIAAC's average results) and more clearly revealed in student skills (PISA results) are, at the same time, (slightly) above average, except problem-solving skills. In the national level analysis, information-processing skills of teachers and students correlate (one explains the variation in the other by 30-40%), but the causality of this link is difficult to assess. Compared to an average employed person, the skills advantage of teachers in Estonia is smaller than in other countries and the ratio of a teacher's salary against the national average is the lowest in Estonia compared to the other countries. The situation with teacher's skills is somewhat ambiguous, but we clearly have a problem among graduates in the field of education where Estonia's results are among the lowest in all the measured skills both in the international comparison and in the comparison with other broad groups of study in higher education.

Policy recommendations based on this work are as follows

- One issue in education that needs to be monitored and possibly intervened into is inequality in the length of an education path arising, first of all, from gender and home language, but also from parents' education.** The sources of inequality are family and home background in Estonia (parents' education and the number of books at one's childhood home), home language and gender. All these factors, in general, add or subtract one year: a male child in a family where both parents have lower secondary education, with a non-Estonian home language and a limited number of books, studies approximately 5 years less than a female child in a family with the Estonian home language, where both parents have higher education and the home learning environment is favourable (a lot of books). The impact of gender and language upon the length of an education path has grown over the last 30 years. One way to intervene is to treat these groups as kind of risk groups that need a separate attention in career counselling and monitoring of possible discontinuation of studies. Intervention is complicated by the fact that the same factors (home language, gender, parents' education and home background) also correlate with lower national test results that, in its turn, have a negative shortening impact on an education path.

- This analysis supports the policy promoting strong basic schools in the vicinity of home and strong upper secondary schools located in bigger centres.** Although the location and language of instruction of a school do not correlate with the length of an education path, they do correlate with national test results. When considering differences in parents' education and home background, the national test results upon the graduation from upper secondary school are lower for graduates of basic schools in rural areas or small towns compared to the graduates of Tartu or Tallinn schools. However, lower grades receive only those students who also graduate from an upper secondary school in a rural area or small town. The results of those who move to Tartu, Tallinn or other larger city do not differ from the results of those who also graduated from a basic school in a city. Nevertheless, the results in upper secondary schools in rural areas and small towns are somewhat lower.
- In higher education curricula, attention should be paid to the development of numeracy and problem-solving skills in a technology-rich environment.** The analysis compared the contribution of post-secondary education into the development of skills and the results of curricula applied in different time periods. However, the small sample used in this analysis does not provide final answers and, therefore, the results should be taken with care. Although various analyses show that there are no differences in literacy between graduates under the 3+2 and 4+2 systems, graduates of 3-year bachelor's programmes have lower numeracy skills and problem-solving skills in a technology-rich environment compared to those who received higher education earlier. According to one hypothesis, the difference already arises earlier: graduates from upper secondary schools already have lower mathematical skills. Nevertheless, this difference also stands out in the analyses where national test results have been taken into account. The contribution of studies under the 3+2 system (as well as the contribution of applied higher education and professional post-secondary education) into the development of numeracy skills and problem-solving skills in a technology-rich environment is very small. The insignificance of this contribution cannot be blamed exclusively on the poor skills of upper secondary school graduates.
- A policy supporting more equal child care and education opportunities for parents with small children could raise the skills of women with children (in the 25+ age) to a more competitive level.** As a rule, in Estonia as well as in the other countries participating in PIAAC the skills divide between men and women usually arises after the graduation – in the 25-44 age group. Before that women demonstrate the same or higher level of skills than men. A possible cause of this situation that has been partially confirmed is that motherhood more often steers women away from work and the active use of skills, negatively influencing their skills. Women without children have the same or even better skills than men without children. However, men occupy a more advantageous position in the comparison of men and women with children. The gender-based salary divide that was the main topic of the PIAAC's thematic report no. 4²¹ is also related to this issue as well as the perceived strong need of additional education among women with small children that has been identified in the PIAAC's thematic report no. 2²². A possible solution would be a policy of parental benefits supporting a shorter and partial parental leave with a more even distribution of leave between fathers and mothers than in the current system. Another possibility

²¹ Halapuu, V. (2015). *Infotöötlusoskuste roll soolise ja keelelise palgalõhe selgitamisel Eestis: PIAAC uuringu temaatiline aruanne nr 4*. Tartu: Haridus- ja Teadusministeerium.

²² Saar, E., Unt, M., Lindemann, K., Reiska, E., Tamm, A. (2014). *Oskused ja elukestev õpe: kellelt ja mida on Eestil oskuste parandamiseks õppida? PIAAC uuringu temaatiline aruanne nr 2*. Tartu: Haridus- ja Teadusministeerium.

lies with an education policy (financed by the government or employers) providing an employee who takes a parental leave with an opportunity to participate in in-service training and maintain their skills.

5. The biggest problem identified in this report is poor skills of graduates in teacher training and education science that have been already identified in the analysis published earlier. The numeracy and problem-solving skills in a technology-rich environment of the Estonian graduates in the field of education are currently very low compared both to the graduates in the same field of study in the other countries and to the graduates in other fields of studies in Estonia. On the one hand, it is caused by the selection effect, because graduates in the field of education have the weakest national test results. On the other hand, studies cannot close the initial gap. Thus, there is an urgent need for all the policies that influence the attractiveness of the teaching profession, improve the level of teacher education and support the further development of graduates.
6. It should be taken into account in the development of the system of qualifications that people with qualifications currently tend to be over-educated for their qualifications: in the majority of cases a person's qualification is lower than his/her education level. The same is indicated by the salary analysis: taking into account other factors, a qualification tends to be associated with a lower rather than higher salary. Thus, the qualifications system corrects imprecisions of the education system, but it does so more effectively with over-education rather than with under-education. **The system of qualifications should become a ladder where work experience combined with education would help acquire a higher qualification level and, consequently, receive a higher salary.** The system of qualifications matches the labour market when the link between education and salary becomes insignificant after the qualification level has been taken into account: a salary tends to depend on the qualification level rather than on the education level. Unfortunately, the former rule is currently followed less closely than the latter.

EASURING SKILLS AND EDUCATION MISMATCH IN ESTONIA ON THE BASIS OF PIAAC DATA

Vivika Halapuu

Since 1989 notable changes have occurred in the structure of workplaces in Estonia: by 2014, the share of skills-intensive jobs rose from 35% to 42.7% and the share of semi-skilled white-collar workers from 12.4% to 20.2%. On the contrary, the share of semi-skilled blue-collar workers has fallen from 44.6% to 36.8% and the share of low-skilled workers has remained relatively unchanged. In other words, a trend towards the creation of more sophisticated workplaces can be noticed in the employment structure. Statistics Estonia's data show similar changes in the relative shares of people with different education levels. Nevertheless, the actual situation in the labour market indicates a mismatch between skills and workplace requirements. Estonian entrepreneurs and foreign investors consider the scarcity of adequately trained labour as one of the main impediments to economic growth in Estonia.

Based on the aforesaid, the 7th thematic report of the PIAAC study analyses whether the education and skills of Estonian workers match their job requirements. First, we examine whether and how such indicators can be measured on the basis of the OECD's Survey of Adult Skills PIAAC. After that we analyse both education and skills mismatch on the basis of chosen methods. The analysis of education mismatch is based on the subjective method, in other words, on the question "If somebody would like to get this job today, what kind of education would s/he need?", and comparing the result with the highest level of education acquired by such person. The analysis of skills mismatch is based on the method proposed by Allen et al.²³, despite its certain shortcomings.

Since in the case of skills mismatch the emphasis is put on numeracy mismatch, this report obviously cannot fully address the problem often cited by employers (the lack of skilled labour), because employers might actually mean the lack of other skills (e.g., different professional skills). Nevertheless, the author hopes that the report will be able to point out at least some new aspects of the issue of skills and education mismatch. In addition to the identification of education and skills mismatch, education demand in the Estonian labour market and education supply are separately addressed. The same has been done for skills – before approaching the skills mismatch issue, the use intensity of various skills in different areas of economic activity in Estonia is analysed. These results are then placed into an international context to get a better overview.

²³ Allen, J., Levels, M., van der Velden, R. (2013). *Skills mismatch and skill use in developed countries: Evidence from the PIAAC study*. ROA Research Memorandum.

The results of the analysis have shown that:

1. **Over one-third of employed people in Estonia are over-educated, which is the highest percentage among the countries that participated in the PIAAC study. The probability of over-education is greater among older people and people with higher education.**

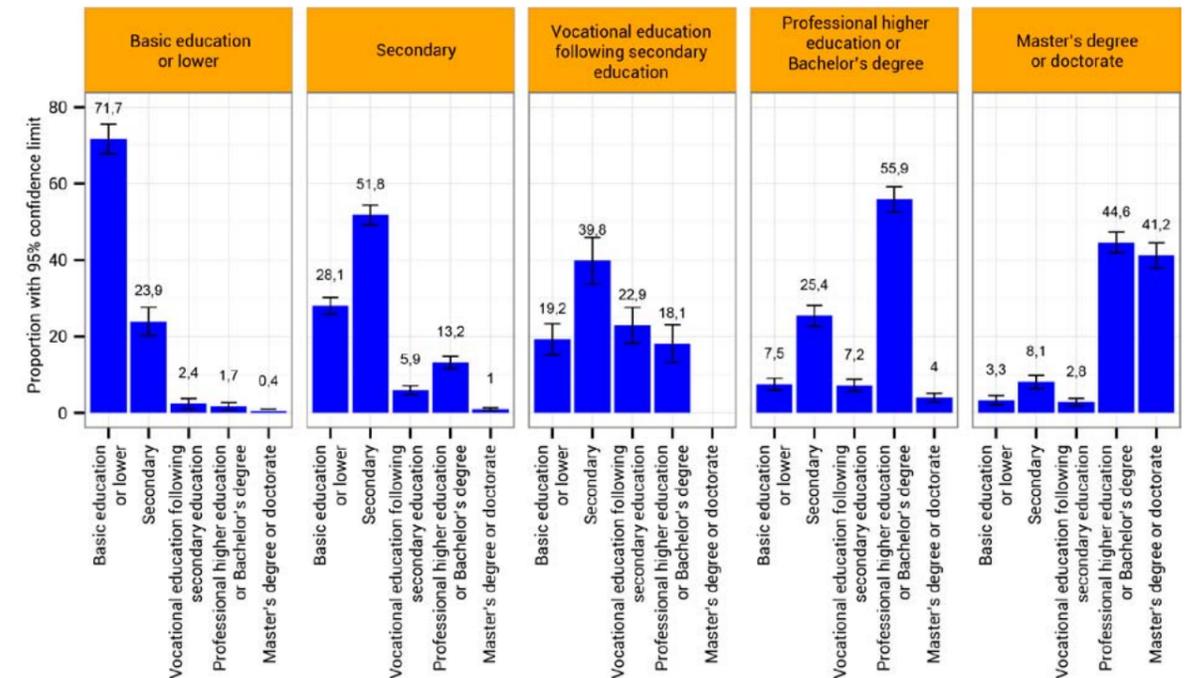
If we categorise all the people whose highest completed level of education exceeds the level of education required to receive their current job as people with education surplus and all the people whose highest completed level of education is below the level required to receive their current job as people with education deficit, then **education surplus in Estonia is characteristic of 36.9% of the employed persons included into the sample.** Their estimated number is 199,200 people. **Education deficit seems to be a smaller problem that concerns only 12.6% of the employed persons included into the sample – i.e., approximately 67,800 people.**

It should be also noted that **education surplus in Estonia is the largest among all the compared countries.** The share of people with education surplus in France, Japan and Ireland is similar to Estonia's, but the average indicator in the compared countries – 24% of all the hired workers in the 16–65 age group who do not define themselves subjectively as pupils, students or trainees and who do not work as entrepreneurs – is clearly lower than the respective indicator in Estonia. The lowest percentage of people with education surplus is in Italy, the Netherlands, Belgium, Finland and Denmark.

Such results would suggest the availability of people with a high education level in Estonia (the country especially stands out by the large share of people with a master's or equivalent degrees) who might be used at workplaces that really require a higher education level. It is another issue what kind of skills these people have received during their formal education. Since older citizens of Estonia received education in a different economic system, their skills do not necessarily match the actual requirements of workplaces and this might be a cause of the large share of over-educated persons. This is suggested by the result of regression analysis that showed a higher probability of over-education among older people and people with higher education. The percentage of over-educated people in the 45–54 age group in Estonia exceeds the average value for the surveyed countries by 21.9 percentage points (pp) and in the 55–65 age group by 21.8 pp. In younger age groups the differences are smaller and in the youngest age group the percentage of over-educated people in Estonia is actually 3.7 pp below the international average. There is a question, however, of how other countries that have undergone changes similar to Estonia (Slovakia, the Czech Republic and Poland) have managed to achieve a clearly smaller percentage of over-educated people even in the oldest age group. It seems that the relatively higher share of highly educated people among the oldest age group in Estonia might explain some of this finding.

The relative number of over-educated persons is also higher among graduates in certain areas of education. In the comparison of people of the same age, with the same home language, the same gender and the same level of education, **in such areas as social sciences, business and law; engineering, manufacturing and construction; and services and agriculture there are more over-educated graduates than among people with general education.** On the other hand, there are clearly fewer over-educated persons among graduates in such areas as health and welfare. **In terms of areas of economic activity, education surplus is the largest in agriculture, forestry and fishing; manufacturing; construction; and accommodation and food service activities (compared to wholesale and retail trade).** On the other hand, over-education is clearly less of a problem in education; professional, scientific and technical activities; public administration and defence; and human health and social work activities.

Figure 7.1. Assessments of people with different levels of education of the education level required to get their job in Estonia



Notes: The 'basic education or lower' category includes vocational education without the basic education requirement and short-term vocational education based on basic education. Secondary education combines both general and vocational secondary education as well as long-term vocational studies based on basic education. Professional higher education and Bachelor's degree also include secondary specialised education following secondary education. The "Master's degree or doctorate" category includes the 4+2 system Bachelor's degree and specialist's diploma studies (higher education prior to 1992) in addition to the 3+2 and 4+2 system Master's degree and doctorate.

Education deficit is clearly a smaller problem among graduates and people with higher education in agriculture; engineering, manufacturing and construction; and services. **In terms of areas of economic activity, the probability of experiencing education deficit compared to wholesale and retail trade is the largest for workers in more skills-intensive areas: information and communication; financial and insurance activities; professional, scientific and technical activities; education; public administration and defence.**

2. **All in all, workplaces in Estonia require lower skills: secondary or lower education is sufficient in more than half of all workplaces. Estonia stands out in international comparison for the fact that areas of economic activity with a supposedly greater number of skills-intensive occupations have education demand similar to other countries. Predominantly blue-collar areas of economic activities tend to demand lower education levels.**

As already mentioned above, submitted background information is worth analysing separately from the education mismatch analysis. Namely, it has been found that workplaces in Estonia require rather low skills in the opinion of employed persons – **secondary or lower education is sufficient to get 55.2% of jobs and people employed at workplaces with lower education requirements have a larger proportion of those who think that an**

even lower level of education would be actually sufficient for such workplaces. The last observation indicates a certain over-dimensioning of the role of education requirements in getting such jobs in people's opinion. Moreover, on the basis of the sample of employed persons under 35 it has been shown that at least one-year professional work experience is required to get approximately half or more jobs that require applied higher education or a bachelor's, master's or Ph.D. degree. It emphasises **the importance of acquiring work experience in parallel with (full-time) studies.**

It has been also found that a majority of people employed at positions with presumably simpler work tasks have a low level of education, but it is believed that, in the whole, a low level of education would be sufficient for an even larger number of jobs. When people are asked to assess how many people with a high level of education would be necessary in their areas of activity, their assessments are clearly below the indicators showing the actual percentage of people with a high level of education in the corresponding areas of activity. These results indicate education surplus among people employed in areas of activity requiring less skills-intensive work.

Differences in education demand between the selected areas of activity show that education demand in the areas of activity with a presumably higher number of skills-intensive jobs is rather similar to the other countries. **Predominantly blue-collar areas of activity tend to demonstrate demand for lower levels of education,** indicating a possibility that work performed in such areas of activity is too simple compared to the same areas of activity in the other countries. **On the other hand, predominantly white-collar areas of activity tend to demonstrate demand for relatively higher levels of education.** It may be due to the fact that these areas of activity are indeed more sophisticated in Estonia compared to the other countries or it is possible that unnecessarily high education requirements for hired workers have been set without good reason, leading to skills and education surplus in these areas of activity.

3. The mismatch of information processing skills is a smaller problem in Estonia than education mismatch. Moreover, education and skills mismatch in Estonia usually do not coincide.

The analysis of skills mismatch is based on the method proposed by Allen et al.²⁴, despite its certain shortcomings. According to this method, the ratio of the average frequency of skill use to the level of skills is used as an indicator of skills mismatch (by statistical method). The frequency of skill use is considered as matching the level of skills if the frequency of skill use does not deviate from the average frequency of skill use for people with such level of skills by more than 1.5 standard deviation.

According to this approach, in Estonia **7.4% of people included in the sample had numeracy surplus** (the international average is 9%), i.e. approximately 40,100 people. **Numeracy deficit was demonstrated by 9.9%** of those employed who were not entrepreneurs and who did not define themselves subjectively as students or trainees (the international average is 10.2%). In other words, we are talking about approximately 54,000 people. **10.9% of people have literacy surplus** (59,100 people) **and 11% have a deficit** (59,400 people); the international average is 10% and 9.4%, respectively. The USA stands out as a country with the lowest numeracy surplus (4.5%) and the highest deficit (25%).

The analysis has shown that **skills and education mismatch mostly do not coincide (in the same direction).** Thus, the percentage of persons in Estonia in this sample with a

surplus of both education and skills is just 3.7% and the percentage of persons with both education and skills deficit is just 1.9%. Since the percentage of persons in Estonia whose education and skills match their work requirements is among the lowest in the international comparison (42.2%), Estonia stands out as a country with a huge number of people who have a mismatch in only one aspect or, e.g., have education surplus and skills deficit at the same time.

The probability of skills mismatch with work requirements tends to relate to work being done rather than people's background. Thus, it has been determined that **the probability of numeracy surplus is the highest among people in the youngest age group (16-24)** and the smallest among graduates in the field of education compared to general education graduates. In addition, an important factor is the area of activity where a person is employed. This could actually be expected, because the frequency of skill use at work depending on the skills-intensity of the workplace has been a component in the creation of the skills mismatch indicator. **The analysis has shown that numeracy surplus (as compared to wholesale and retail trade) is the largest in such areas as information and communication; public administration and defence; administrative and support service activities; and education, human health and social work activities.** There is a smaller probability of numeracy deficit in these areas of activity compared to the comparison group. It is also smaller in such areas of activity as the manufacturing and agriculture.

4. In international comparison, skills are used to a large extent in transportation and storage and to a relatively large extent in accommodation and food services, public administration and defence. Manufacturing, education and agriculture are examples of areas of economic activity where work in Estonia appears to be somewhat simpler.

The analysis of skills required at workplaces has shown that **Estonia positively stands out to the greatest degree in the international comparison by the frequency of different skill use in transportation and storage,** where the use of literacy, numeracy, problem-solving, selling and teaching skills, but also computer use exceeded the average result of the analysed countries. The accommodation and food service activities as well as public administration and defence differ from transportation and storage by the frequency of problem-solving skill use; in these areas of activity this indicator is equal to the average results of all the countries. In wholesale and retail trade, the frequency of selling and persuasion skill use also does not differ from the average result of the other countries. In administrative support service activities; professional, scientific and technical activities; and information and communication, the use frequency of a majority of corresponding skills does not differ from the average result of all the countries. In other words, by the use of skills these areas of activity are very similar to the same areas of activity in the other countries.

Manufacturing, education and agriculture are examples of areas of economic activity in which work performed in Estonia appears to be somewhat simpler. Thus, for example, the average use frequency of literacy, numeracy, problem-solving, selling and persuasion, and teaching and presentation skills as well as computer use in Estonia's manufacturing industry is below the average result of the other countries. This is the only analysed area of activity where workers in Estonia perform more physical work compared to the other countries.

It appears that Estonia is facing a pervasive lack of co-operation skills. The average use frequency of this skill does not exceed the average result of all the countries in any area of activity and remains below the average result for all the countries in such areas of activity as transportation and storage; accommodation and food service activities; wholesale

²⁴ Allen, J., Levels, M., van der Velden, R. (2013). Skills mismatch and skill use in developed countries: Evidence from the PIAAC study. ROA Research Memorandum.

Table 7.2. Difference between average frequency of use of different skills in Estonia from respective skill-use in all countries by area of activity

	Literacy	Numeracy	CTask	Problem-solving skills	Selling and persuasion skills	Teaching and presentation skills	Cooperative skills	Physical skills
Transportation and storage	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Grey	Grey
Accommodation and food service activities	Yellow	Yellow	Yellow	Grey	Yellow	Yellow	Blue	Blue
Public administration and defence; compulsory social security	Yellow	Yellow	Yellow	Grey	Yellow	Yellow	Blue	Blue
Wholesale and retail trade; repair of motor vehicles and motorcycles	Yellow	Yellow	Yellow	Grey	Yellow	Yellow	Blue	Blue
Human health and social work activities	Yellow	Yellow	Yellow	Grey	Yellow	Yellow	Blue	Blue
Financial and insurance activities	Grey	Grey	Yellow	Grey	Grey	Grey	Blue	Blue
Administrative and support service activities	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue
Professional, scientific and technical activities	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue
Information and communication	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue
Manufacturing	Blue	Blue	Blue	Blue	Blue	Blue	Grey	Yellow
Education	Grey	Blue	Grey	Blue	Yellow	Blue	Blue	Blue
Construction	Grey	Grey	Grey	Grey	Grey	Yellow	Blue	Blue
Agriculture, forestry and fishing	Blue	Blue	Grey	Blue	Blue	Grey	Grey	Grey

Note: See report for an explanation of the content of attributes of frequency of use of various skills.

- Estonian indicator statistically significantly (at 95% confidence level) above the average of 19 countries under study
- Estonian indicator does not differ statistically significantly (at 95% confidence level) from the average of 19 countries under study
- Estonian indicator statistically significantly (at 95% confidence level) below the average of 19 countries under study

and retail trade; public administration and defence; professional, scientific and technical activities; information and communication; and education and construction. Improvement of this skill might produce a synergy for new developments.

Policy and action recommendations for national authorities and entrepreneurs based on the report are as follows:

- The results of the analysis indicate that education requirements might sometimes be unnecessarily high, especially for white-collar jobs. In the international comparison it is noticeable, for example, that 14.2% of people employed in Estonia’s wholesale and retail trade sector believe that lower secondary education or even lower education would be sufficient for their jobs, whereas the average corresponding result in the compared countries is more than twice higher (29.9%). According to workers, an Estonian employer would like to hire for such positions people with applied higher education or a bachelor’s degree. The same trend has been noted in the accommodation and food service activities. The readiness of Estonian entrepreneurs

to pay for such an expensive indicator of a person’s abilities as a diploma of higher education, even if they are unable to offer such people a job that would later require such qualifications, was also demonstrated by Anspal et al.²⁵. To avoid unnecessary costs of acquiring the highest possible level of education instead of acquiring professional skills that are actually needed in the labour market it is important that employers bring their education requirements in line with work requirements, thus contributing to the decrease of over-education.

- Nevertheless, in certain areas of activity the contrary is true – Estonian employers are relatively more willing to hire people with a lower level of education compared to the same areas of activity in the other countries. For example, this factor concerns construction and manufacturing where a large part of the employed believe that lower secondary education or an even lower level of education would be sufficient to get their jobs. In the Nordic countries, the requirement of secondary education in these areas of activity is almost two times more frequent than in Estonia. Since the manufacturing industry stands out in the most negative light both in terms of worker skills and the skills-intensity of work, attention should be paid to workplaces in this area of activity and the skills of workers employed in this sector.
- Analyses have shown that education deficit is experienced by 22.4% of people who acquired their highest level of education in the area of general education. This figure is 2-5 times higher than in other education areas. Nevertheless, this perceived education deficit might be caused by a relatively low education level rather than purely by a lack of professional skills, because the majority of people who acquired their highest education level in the area of general education have only basic or secondary education. Thus, the need to bring people without professional training back to the education system is confirmed.
- Entrepreneurs in such areas as the manufacturing and agriculture; forestry and fishing; and, if we narrow down the results of the analysis, in construction should review whether and where there is a need to make workplaces more sophisticated. The results of the analysis indicate that in these areas relatively simple work is being done which, in its turn, points to a development opportunity in these areas.
- In the whole, co-operation between Estonian workers is relatively poor, limiting the opportunity for synergy. On the one hand, a problem may be caused by poor co-operation skills, and on the other hand – by the excessive individualisation of work. Since employers have put an emphasis on the acquisition of this skill and pointed out that a low level of this skill among school graduates represents a problem²⁶, ways of teaching it at school must be considered. Steps in this direction have also been taken in the framework of the Estonian Lifelong Learning Strategy 2020.²⁷ This strategy emphasises the need to make an effort in the next few years in the actual implementation of objectives, including the acquisition of problem-solving skills and their implementation in teamwork, which have been focused upon in national formal education curricula approved during the last decade.

²⁵ Anspal, S., Järve, J., Jürgenson, A., Masso, M., Seppo, I. (2014). Oskuste kasulikkus tööturul: PIAAC uuringu temaatiline aruanne nr 1. Tartu: Haridus- ja Teadusministeerium.

²⁶ See e.g. Järve, J., Lepik, K.-L., Mägi, A. (2014). Kvantitatiivse tööjõuvajaduse prognoosi andmestiku ja kvalitatiivse tööturu seire ühitamise metoodika väljatöötamine ja piloteerimine. Analüütiline kokkuvõte kvalitatiivsest tööjõuvajadusest tegevusalade kaupa. Riigikantsleil.

²⁷ Haridus- ja Teadusministeerium (2014). Elukestva Õppe Strateegia. Tartu/Tallinn: Haridus- ja Teadusministeerium, Eesti Koostöökoogu, Eesti Haridusfoorum.

- Education mismatch is clearly a bigger problem in Estonia than the mismatch of information processing skills. According to the method used in this report and on the basis of the analysed sample, there are 36.9% of over-educated people and 12.6% of under-educated people in Estonia. 7.4% of all the employed persons demonstrate numeracy surplus and 9.9% have numeracy deficit. Nevertheless, both groups should be addressed. But how can we define these groups? Who are these people?
 - o The share of over-educated people whose qualifications would be better applied by a change of work or making existing work more sophisticated is bigger among people of 45-65 years of age, people with higher education, graduates in social sciences, business and law; engineering, manufacturing and construction; agriculture (compared to people with general education) as well as workers employed in agriculture, accommodation and food service activities, manufacturing and construction. On the other hand, it should be taken into account that over-education does not necessarily mean a very large skills surplus – older people might be over-educated because they have been forced to work in a profession that does not correspond to the profession that they had graduated in. It would imply re-training to ensure a good performance in a new area of activity.

The existence of a large percentage of over-educated persons is indeed countered by a message from the PIAAC report on lifelong learning (Saar et al.²⁸) pointing out that a relatively large share of Estonians believe that they need additional training to improve their job performance. It indicates that if we are unable to offer over-educated people such work that corresponds to their level (and area) of education, we should focus our attention on offering sufficient on-the-job training to such people to enable them to adjust to work in another area of activity.
 - o Under-educated people tend to work in certain areas of economic activity. Thus, people employed in information and communication; financial and insurance activities; professional, scientific and technical activities; and public administration and education believe that a higher level of education is needed to get their jobs compared to their current level. It might be a signal to the education system that employers in these areas of activity cannot find suitable workers from educational institutions and are thus ready to hire people with a lower level of education and then train them for the job.
 - o The numeracy surplus is the largest in the 16-24 age group as well as in such areas of activity as information and communication; public administration and defence; education, human health and social work activities; and administrative and support service activities as compared to wholesale and retail trade. It indicates that in these areas of activity there should be room for work requiring the more intensive use of numeracy.
- The numeracy deficit is the largest among the Russophone population and people who acquired their highest level of education in the service sector. These groups need to use numeracy skills in their work more intensively than their skills allow according to the method used in this report. In other words, attention should be paid to raising the level of numeracy skills for these people.

²⁸ Saar, E., Unt, M., Lindemann, K., Reiska, E., Tamm, A. (2014). Oskused ja elukestev õpe: kellelt ja mida on Eestil oskuste parandamiseks õppida? PIAAC uuringu teemaatliline aruanne nr 2.

