**The quality of ICT skills indicators[[1]](#footnote-1)**

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**Abstract**

Basic ICT skills are a prerequisite for social inclusion in the information age. Level of population ICT skills as well as computer and Internet usage are of interest to the European Commission and the national governments. This is reflected in numerous strategic documents (e.g. Digital agenda for Europe, A new skills agenda for Europe, Long-term National Development Strategy for Poland). The EU survey on ICT usage provides a proxy on the level of ICT skills among individuals in Europe. However, it is based on individual’s self-assessment which may be prone to misjudgements (e.g. Dunning et al. 2004) and which is shown to differ from the results of ICT skills direct assessment from PIAAC survey.

Using data from the Polish follow-up study to the Programme for the International Assessment of Adult Competencies (postPIAAC) we compare self-assessment of basic ICT skills to the direct assessment. The postPIAAC was conducted between Oct. 2014 and Feb. 2015 on over 5000 respondents aged 18-69. The questionnaire included Eurostat questions on computer and Internet usage. Respondents performed also several tasks directly comparable to the Eurostat questions: coping files to a folder, using copy/cut/paste tools for text editing and using basic spreadsheet formulas. Among those who have not completed these tasks in the direct assessment, the majority declared they have carried out these task before (54%, 50% and 59% respectively). The preliminary multivariate analysis suggests that young and higher educated people are more likely to overrate their skills in the self-assessment. The discrepancy between the actual and the declared level of ICT skills poses a question of reliability of ICT indicators based on self-assessment.

**Keywords:** ICT skills, quality of indicators, self-assessment, direct measurement of skills

1. Introduction

Skills are an important aspect of human capital, which in turn constitutes one of the main factors for economic and social development. Besides economic growth, human capital and skills measures are often embedded in the discussion on economics of education, ageing, employability, crime, well-being or health (e.g. Stroombergen et al., 2002).

Skills may be analysed from different perspectives: supply and demand perspective, skills mismatch and skills development (Eurostat, 2016, p. 5). Economists investigate the returns to skills – both cognitive and non-cognitive ones with respect to labour market outcomes and social behaviour (e.g. Heckman et al., 2006). Level of population ICT skills as well as computer and Internet usage are of interest to the European Commission and the national governments. This is reflected in numerous strategic documents (e.g. Digital agenda for Europe, A new skills agenda for Europe, Long-term National Development Strategy for Poland).

The estimates of individual or population skills levels are obtained using direct or indirect measures. The indirect measures of skills supply comprise the level, orientation and field of the educational attainment, i.e. the information that can be obtained from administrative registers or from social surveys including the Labour Force Survey. The direct measures cover the self-assessment of skills (e.g. Adult Education Survey), the self-reported ability to perform specific tasks (e.g. ICT Usage in Households and by Individuals, background questionnaire part of PIAAC, Skills and Jobs Survey) and the more objective direct skills assessment framework (e.g. PISA or PIAAC) (Eurostat, 2016).

This paper concentrates on skills related to information and communication technologies (ICT), which ever gain on importance in both daily and professional lives since the computer and computers network revolution in the 1970’s and 1980’s. ICT or computer skills and their early development are more and more often perceived as critical as reading and writing literacy and as a ‘new literacy’ (e.g. Grant et al., 2009). The scientific analyses attempt to quantify the gains on ICT skills. The results on individual returns to ICT skills in the labor market are mixed with some results showing substantial gains (e.g. Falck et al., 2016; Krueger 1993), and some other questioning the causal link between ICT skills and observed higher earnings (e.g. Borghans and ter Weel 2004; DiNardo and Pischke, 1997). Some of these differences may be due to different methodologies of how the skills as measured. As Falck et al. (2016) discuss, most of the research relies on self-reported measures of computer use and computer skills, which are rather imperfect proxies for the true skills level due to reporting bias, or unawareness of the population skill distribution and own placement on it.

The OECD’s Programme for the International Assessment of Adult Competencies provides estimates for directly measured ICT skills (originally named Problem solving in technology rich environment – PSTRE) in over 40 countries by now.[[2]](#footnote-2) In each country, several thousand respondents were asked to go through a computer-based test on literacy, numeracy and PSTRE. In Poland, however, nearly 50%[[3]](#footnote-3) of respondents did not take the computer based assessment (CBA), although many of them had admitted to have computer experience in the background questionnaire. Since this situation was not predicted, the interviewers were not trained to collect the information on the specific reasons for refusing to take the CBA, neither to note any observations on the observed attitude towards computers. Generally, the PIAAC experiences in Poland constitute a serious doubt on the quality of self-reported measures of ICT skills.

The PIAAC in Poland had its follow-up study to PIAAC and one of its parts was dedicated to a deeper investigation on ICT skills of the target population. The Eurostat questions on basic computer skills coming from the ‘ICT Usage in Households and by Individuals’ were included in the postPIAAC questionnaire. After the self-assessment, the respondents were asked to solve three tasks on the computer that directly correspond to the tasks included in the self-evaluation. The results presented in this paper show that the problem of misreporting is prevalent across the surveyed group and different subgroups have different probabilities of misreporting their skills. Reporting heterogeneity may undermine the accuracy of measures for the disparities in ICT skills across groups that also differ in their propensities to accurately judge their skills.

To the best of authors knowledge, there are no studies that deal with the quality of ICT skills indicators and the problem of misreporting for a population. The discrepancy between the computer skills self-assessment and actual skills was investigated by Grant et al. (2009). Their research is, however, limited to over 200 business students in one of the universities in the US enrolled in an introductory business computer applications course. The results of the self-assessed students skills in a questionnaire were compared to the results of a computer-based assessment whose aim was to test their actual skills. The subjective and objective assessment indicated a significant differences in the student’s perception and performance in spreadsheet skills, some differences in perception of their word processing skills and actual performance, and no difference in perception and performance for presentation skills (MS PowerPoint). Generally, the presented results speak in favor of own skills misperception phenomenon among young generation. Mccourt Larres et al. (2003) report similar results for accounting students of two UK universities where majority of students overestimated their computer literacy. These results cannot be, however, generalized to a population of adults.

This article is organized as follows. In the following section, we introduce the methodology of measuring ICT skills and compare the results of the Eurostat survey and PIAAC for 2012. In section 3, we introduce the postPIAAC study, its framework for measuring ICT skills and show some basic descriptive statistics, followed by the results of a multivariate analysis of the misreporting phenomenon. The article finishes with a discussion on reasons of misreporting and conclusions.

2. Objective and subjective ICT skills levels across Europe

The Eurostat publishes the Digital Economy and Society Index (DESI) that *summarises relevant indicators on Europe’s digital performance and tracks the evolution of EU member states in digital competitiveness[[4]](#footnote-4).* DESI covers five dimensions: connectivity, human capital / digital skills, use of Internet by citizens, integration of digital technology by businesses and digital public services. The second dimension and specifically its subdimension “Basic skills and usage” are of interest to this analysis. The data used to compile the specific indicators in this domain comes from the survey ‘ICT Usage in Households and by Individuals’ which provides information on whether the respondents have conducted selected tasks with the computer (self-reports). The survey ‘ICT Usage in Households and by Individuals’ has been conducted since 2002 each year. The table presented in Attachment 1 lists items included in the question on basic computer skills that were included in the survey since its beginning. The questions were not stable over time, but this is partly understandable as the phenomenon measured has been evolving.

The Eurostat Community Survey on ‘ICT Usage (…)’ in 2012 covered items on having carried out the following activities:

* copying or moving a file or folder,
* using copy and paste tools to duplicate or move information within a document,
* using basic arithmetic formulas in a spreadsheet,
* compressing (or zipping) files,
* connecting and installing new devices, e.g. a modem
* writing a computer program using a specialized programming language

Individuals who declared to have performed 1 or 2 of these tasks were classified into low skilled, 2 or 4 – into medium skilled, and 5 or 6 tasks allowed for being assigned to high skilled (Digital Agenda Scoreboard, 2012). The Eurostat results for the year 2012 reporting percentages of population aged 25-64 years characterized by low, middle and high levels of skills are presented in Figure 1.

**Figure 1. The level of digital skills in European countries in 2012 (Eurostat data, pop. 25-64)**



Source: Own elaboration based on Eurostat data, tin00070 (Accessed 05.2018)

Countries with the highest proportions of medium and high skilled individuals comprise the Nordic countries, Luxembourg and the Netherlands (more than 65% of adults 25-64 years old). The other end covers countries with the respective proportion less than 45%: Romania, Bulgaria, Poland, Greece, Cyprus, Croatia, Malta and Italy.

The Eurostat results for 2012 can be compared to the results of the Programme for the International Assessment of Adult Competencies (PIAAC) whose fieldwork (1st round) was carried out in the years 2011-2012. The PIAAC data, apart from respondents declarations on ICT activities, provides also objective measures on ICT skills in the population as the respondents were asked to solve specific tasks on the laptops that were handed them in by the interviewers.

The PIAAC results on ICT skills for the European countries that participated in the 1st round of the Programme are presented in Figure 2.

**Figure 2. The level of digital skills in European countries in 2012 (PIAAC data, pop. 25-65)**

Source: Own elaboration based on PIAAC data

The results between PIAAC and Eurostat estimates on ICT skills in the population of adult people clearly differ. However, it should be stressed that the comparability of the two measures is a complex question. This is why the postPIAAC survey that the Polish follow-up study to PIAAC implemented both the Eurostat self-assessment items and some tasks measuring the actual ICT skills.

# **3. Data and method**

We use data from the Polish Follow-up Study to the Programme for International Assessment of Adult Competencies (postPIAAC). The study collected additional background information on PIAAC respondents not available in the international study and gathered some longitudinal information. The background questionnaire (BQ) was modified version of the PIAAC international questionnaire and was administered as a computer-assisted personal interview (CAPI). The study included parts with direct assessment, both on computer (a working memory test and a basic ICT skills test) and on paper (a coding speed test, a Big Five personality test and a self-assessment of skills). The analysis uses postPIAAC data combined with the proficiency estimates from PIAAC.

The postPIAAC study was conducted between October 2014 and February 2015 on the PIAAC respondents who lived in Poland during the fieldwork. The target population was aged 18–69 at that time. Of the initial 9366 respondents in PIAAC, 5224 completed postPIAAC interviews in 2014/2015. After selecting individuals who have ever used computer but did not complete a task, we kept a working sample of 710, 725 or 2717 individuals, depending on the task.

## Measures

### Self-assessment of ICT skills

The postPIAAC included two self-reported questions on computer and internet usage from ‘Eurostat Community survey on ICT usage in Households and by Individuals’: “Which of the following computer related activities have you ever carried out?” and “Which of the following internet related activities have you ever carried out?”. Respondents could answers „yes” or „no” for each activity. The detailed tasks included in the questions are listed in the Appendix.

### Direct assessment of basic ICT skills

A test of basic ICT skills was a part of postPIAAC interview. It was based on PIAAC ICT-Core test which determined if respondent can proceed with the computer-based assessment of literacy, numeracy and problem-solving (OECD, 2013). Moreover, the postPIAAC ICT test included three additional items measuring performance in tasks self-assessed in Eurostat ICT questions: coping or moving a file or folder, using copy and paste tools to duplicate or move information within a document, using basic arithmetic formulas in a spreadsheet. The screenshots of the additional items are in the Appendix.

### Overstatement

An indicator of people who overestimate their ICT skills. A binary variable, takes value 1 if somebody declared he/she has carried out a task before but failed the direct assessment and 0 if somebody declared he/she has not carried out a task before and failed the direct assessment.

### Understatement

An indicator of people who underestimate their ICT skills. A binary variable, takes value 1 if somebody declared he/she has not carried out a task before but succeeded in the direct assessment and 0 if somebody declared he/she has carried out a task before and succeeded in the direct assessment.

### Control variables

The control variables include measures of human capital: years of education, level of cognitive skills, non-formal and informal educational activities in the last 12 months. We control for the sociodemographic characteristics: age, gender, size of the city and employment status. Additionally, we are interested how personality is related to the propensity to overestimate one skills. We use two available short scales: the Big Five Inventory-Short (BFI-S) (Gerlitz & Schupp, 2005; John, Donahue, & Kentle, 1991) and the short eight-item Grit scale (Grit-S) (Duckworth & Quinn, 2009). Big Five model identifies five dimensions of personality: Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (John & Srivastava, 1999). Grit has two dimensions: perseverance of effort defined as the “tendency work hard even in the face of setbacks” and consistency of interest: “the tendency to not frequently change goals and interests” (Credé, Tynan, & Harms, 2017).

### Method

We used OLS regression to analyse the indicators of overstatement as comparability over models is important for the purposes of this study. This approach allows us to compare the effect estimates between different indicators (Mood, 2010). We performed sensitivity analyses using logit models and the results are qualitatively similar to the linear models in terms of the sign and the significance of the relationship.

# **4. Results**

Table 1 presents the distribution of skills and self-assessment in task 3 in the total population of people who ever used computer and in its subgroups. The results for tasks 1 & 2 follow similar pattern and are presented in the Appendix. In addition the last column (5) reports the distribution of our dependent variable (share of people who claimed that they did the task but could not perform it in the direct assessment). Only 23% of respondents were able to perform simple calculations in a spreadsheet. Among those who could not almost 60% earlier declared that they are able to do it. According to column 5, the overstatement decreases with age and increases with educational level and the size of the city. Also people who participated in non-formal or informal educational activities and employed have higher probability to overestimate their skills. Gender is not related to overstatement. In general, overstatement is higher in groups which have higher probability to complete the task.

**Table 1. The incidence of overstatement in task 3 (spreadsheets)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Understat. | Well-assessed (can) | Well-assessed (can't) | Overstat. | % overstat among those who can't |
|  | (1) | (2) | (3) | (4) |  | (5) |
| Total | 0.016 | 0.218 | 0.312 | 0.453 |  | 0.588 |
| 19-24 | 0.011 | 0.336 | 0.097 | 0.556 |  | 0.846 |
| 25-34 | 0.026 | 0.325 | 0.175 | 0.475 |  | 0.727 |
| 35-44 | 0.014 | 0.212 | 0.314 | 0.461 |  | 0.588 |
| 45-54 | 0.019 | 0.085 | 0.499 | 0.397 |  | 0.441 |
| 55-65 | 0.006 | 0.026 | 0.619 | 0.349 |  | 0.360 |
| 66-68 | 0 | 0.046 | 0.613 | 0.342 |  | 0.358 |
|  |  |  |  |  |  |  |
| Male | 0.019 | 0.257 | 0.293 | 0.431 |  | 0.594 |
| Female | 0.014 | 0.183 | 0.33 | 0.473 |  | 0.584 |
|  |  |  |  |  |  |  |
| ISCED2 | 0.009 | 0.061 | 0.55 | 0.38 |  | 0.408 |
| ISCED3B | 0.022 | 0.025 | 0.657 | 0.296 |  | 0.309 |
| ISCED3A with voc or ISCED4 | 0.02 | 0.132 | 0.391 | 0.456 |  | 0.531 |
| ISCED3A | 0.015 | 0.221 | 0.253 | 0.511 |  | 0.669 |
| ISCED5 (bechelor) | 0.009 | 0.341 | 0.095 | 0.556 |  | 0.853 |
| ISCED5 (master) or ISCED6 | 0.014 | 0.383 | 0.109 | 0.494 |  | 0.815 |
|  |  |  |  |  |  |  |
| Village | 0.015 | 0.166 | 0.378 | 0.441 |  | 0.534 |
| City<20000 | 0.02 | 0.211 | 0.327 | 0.442 |  | 0.575 |
| City>=20000 & <100000 | 0.026 | 0.264 | 0.287 | 0.423 |  | 0.586 |
| City>=100000 & <1000000 | 0.013 | 0.254 | 0.263 | 0.471 |  | 0.641 |
| Warsaw | 0.002 | 0.244 | 0.177 | 0.577 |  | 0.765 |
|  |  |  |  |  |  |  |
| No nonform. activities | 0.012 | 0.148 | 0.413 | 0.427 |  | 0.504 |
| Nonformal activities | 0.022 | 0.318 | 0.170 | 0.490 |  | 0.740 |
|  |  |  |  |  |  |  |
| No inform. activities | 0.018 | 0.151 | 0.426 | 0.406 |  | 0.484 |
| Informal activities | 0.015 | 0.311 | 0.157 | 0.517 |  | 0.763 |
|  |  |  |  |  |  |  |
| Employed | 0.019 | 0.234 | 0.278 | 0.47 |  | 0.626 |
| Unemployed | 0.014 | 0.164 | 0.335 | 0.487 |  | 0.584 |
| Inactive | 0.008 | 0.176 | 0.431 | 0.385 |  | 0.466 |

The results of the multivariate analysis of the probability of overstatement are included in Table 2. We analyse the overstatement only as the incidence of understatement is low. The analysis confirms most of the findings from the descriptive analysis. The propensity to overestimate one’s skills decreases with age and increases with the years of education and the size of city where one lives. Employment status is not related to the propensity to overestimate skills. Women overestimate their skills less often but the result is significant for the task 3 only. The relationships between cognitive skills, personality and the propensity to overstate are heterogeneous between tasks. The most robust results are for cognitive skills and perseverance of effort which are both positively related with overstatement.

**Table 2. Determinants of overstatement**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Moving files | Word processor | Srpeadsheet |
|  | (1) | (2) | (3) |
| Age | -0.013\*\*\* | -0.015\*\*\* | -0.013\*\*\* |
| Female | -0.047 | -0.068 | -0.058\* |
| **Place of living (ref.: village)** |  |  |  |
| City<20000 | 0.155\* | 0.066 | 0.057 |
| City>=20000 & <100000 | 0.023 | 0.112\* | 0.064 |
| City>=100000 & <1000000 | 0.100 | 0.169\*\* | 0.106\*\*\* |
| Warsaw | 0.361\*\* | 0.410\*\* | 0.205\*\*\* |
| Years of education | 0.054\*\*\* | 0.053\*\*\* | 0.054\*\*\* |
| Nonformal education | 0.016 | -0.019 | 0.054\* |
| Informal education | 0.066 | 0.129\* | 0.125\*\*\* |
| **Employment status (ref.: employed)** |  |  |  |
| Unemployed | 0.010 | 0.115 | 0.002 |
| Inactive | -0.094 | -0.068 | 0.003 |
| Numeracy (std) | 0.029 | 0.016 | 0.034\* |
| **Personality traits** |  |  |  |
| Conscientiousness (std) | -0.099 | -0.033 | -0.027 |
| Extraversion (std) | -0.001 | -0.025 | 0.032 |
| Agreeableness (std) | -0.005 | -0.062 | 0.008 |
| Openness (std) | 0.069 | 0.088\* | -0.010 |
| Neuroticism (std) | -0.026 | -0.014 | -0.026\* |
| Perseverance of effort (std) | 0.051\* | 0.030 | 0.044\*\* |
| Consistency of Interest (std) | 0.002 | -0.008 | -0.025 |
| Constant | 0.449\*\*\* | 0.482\*\*\* | 0.302\*\*\* |
| Observations | 710 | 725 | 2717 |
| r2 | 0.260 | 0.323 | 0.296 |

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

5. Why do the respondents misreport?

Statistical surveys are subject to many sources of sampling and non-sampling errors, with the second covering also the response and measurement errors. The respondents may provide untrue or incorrect information, which results in biased estimates. The process of answering questions is regarded to be a several-stage process. The Handbook of Recommended Practices for Questionnaire Development and Testing in the European Statistical System (p. 28)[[5]](#footnote-5) recalls a 4-stage process with the zero stage of ‘encoding’, then ‘comprehension’, ‘retrieval’, ‘judgement’, and the last stage of ‘reporting’. Each stage is usually subject to some cognitive biases or distortions that cause the answer to deviate from the true one. Some of them can be reduced by following appropriate statistical guidelines related to the interviewer behavior, question formulation, dealing with sensitive topics and fear of disclosure. There are three especially appealing cognitive biases that may play a role in reporting computer skills: information deficits, social desirability and social approval.

Dunning et al. (2004) provide a vast overview of psychological mechanism of why people tend to hold opinions of themselves that diverge from objective reality. They claim that people typically do not possess full information allowing for creating perfectly accurate self-assessment, and what is more, individuals often neglect or give too little weight to valuable information that could help in shaping more realistic view of oneself and in avoiding some errors. This is illustrated by an academic experiment in which students were asked to estimate their results just after the exam (Dunning et al., 2003). Those in the lowest quartile of the exam results greatly overestimated their performance, while the 25% top students were much closer to the reality. The authors generalize the results to many other significant social and intellectual domains in which “the skills needed to produce correct responses are virtually identical to those needed to evaluate the accuracy of one’s responses” (p. 85), which drives the so called double curse of incompetence. Kruger and Dunning (1999) refer also to the lack of metacognition, metamemory, metacomprehension or self-monitoring skills – different terms that are used in psychology. This is also explored further in Ehrlinger et al. (2008) who discuss how our impressions on our skills, talents, knowledge or personality shape our careers and life course and how costly the misjudgments may be.

Information deficits certainly play a role in the self-reporting of the level of skills. For the analyzed example, however, this may not be the most appropriate explanation as the respondents were asked whether they had performed listed activities and not to evaluate their skills levels. In this situation, social desirability and social approval may play a significant role. The first one relates to avoiding criticism and portraying oneself in a favorable social image, whereas the second is defined as the need to obtain a positive response in a testing situation. Social desirability is related to the concept of ‘injunctive social norms’ (Cialdini, 2007), which is explained as one’s perception or expectation of what most others approve or disapprove of.

These mechanisms have been investigated e.g. for the comparison of self-assessed and objective measures of physical activity, as the estimates of the proportion of Americans adhering to the U.S. Department of Health and Human Services guidelines on the time spent on moderate to vigorous physical activity vary significantly across different studies that differ in the way the information is collected. Adams et al. (2005) by using both objective and subjective information on physical activity show a positive association between social desirability (measured on a specific scale) and overreporting of activity, both in terms of energy expenditure and durations. The presented unexpected finding was the correlation between social approval and underestimation of physical activity, but its magnitude was small. Several other studies stress the role of social desirability in overreporting of physical activity and report also different propensities to overreport for different subgroups by, among others, sex, age, education and weight (Nusser et al. 2012; Troiano et al. 2008; Ferrari et al. 2007; Sallis and Saelens 2000; Hill et al. 1997; Beyler and Beyler 2017).

Energy intake or diet survey data is observed to be subject to measurement errors too. The self-reported data on food intake is usually biased downwards which is shown to be related to social desirability scores and to differ by sex, eating habits (amount of fat consumed) and potentially by education (Hebert et al., 1995; Hebert et al.,1997; Hebert et al. 2001; Hebert et al. 2002). A vast number of research papers is dedicated to the quality of self-reported measured on health. Johnston et al. (2007) investigate the reporting heterogeneity on hypertension in England and finds that the probability of false negative reporting is significantly income graded which implies underestimation of the true income-related inequalities in health. The listed reasons for the health status misreporting cover a different concept what ‘health’ means, individuals’ expectations of their own health, use of healthcare, and comprehension of the actual survey questions asked. The latter may be corrected by the use of anchoring vignettes methodology and was applied by Bago d’Uva et al. (2008) in correcting the disparities in health by education and increase those by income in India, Indonesia and in case of education – also China.

There are other studies looking at the response process from different perspectives. Bockenholt and Heiden (2007) analyze the randomized response methodology for measuring sensitive behavior and find for two large-scale Dutch surveys that the willingness of respondents to answer truthfully is related to educational level, the perceived clarity of instructions, the size of expected benefits of noncompliance and strength of social control. Kirchner (2015) studies the randomized response technique and its potential to improve the response quality of data collected regarding welfare receipt in labor market surveys. But his results do not support the expectation of an increase in the reporting accuracy about this specific topic.

Some survey methodology discussions point to the problems of intrusiveness and risk of disclosure. But they do not seem to matter for the ICT assessment. One could consider the level of computer anxiety as a predictor of the accuracy in responses. But this measure was not included in the dataset. It was applied by MacIntyre et al. (1997) who investigated the relation between perceived competence in a second foreign language and the actual competence as well as language anxiety. High level of anxiety occurred to be correlated with the tendency to underestimate own skills and the opposite for the low level of anxiety.

6. Conclusions

The problem of ICT skills overstatement is shown to be common in the social surveys. We show that Poles’ propensity to overestimate own skills decreases with age and increases with the years of education and the size of city where one lives. These results might suggest that social desirability plays a big role in the process of forming the answers to ICT-skills related questions: individuals from groups characterized by higher skills are also expected to have higher skills and may be therefore more likely to overstate their skills.

The results speak in favor of developing methodologies where skills are measured directly. The examples of such projects are the OECD’s PIAAC survey. The direct measurement of skills may be more comparable across countries and for some type of skills (like basic digital literacy) it may be the only way to compare selected populations as qualifications or diplomas may not exist in the area. The disadvantage of the direct measurement are the high costs and limitation in the number of skills that can be captured. In PIAAC only the basic skills related to literacy, numeracy and problem solving in technology rich environment were subject to testing. However, different job-specific skills may be of interest to analysts and policy makers, so the expectation is that the direct assessment of skills will become more and more common.

7. References

Adams, S.A., Matthews, C.E., Ebbeling, C.B., Moore, C.G., Cunningham, J.E., Fulton, J., Hebert, J.R., 2005. The effect of social desirability and social approval on self-reports of physical activity. Am. J. Epidemiol. 161, 389–398. <https://doi.org/10.1093/aje/kwi054>

Bago d’Uva, T., Van Doorslaer, E., Lindeboom, M., O’Donnell, O., 2008. Does reporting heterogeneity bias the measurement of health disparities? Health Econ 17, 351–375. <https://doi.org/10.1002/hec.1269>

Beyler, N., Beyler, A., 2017. Adjusting for Measurement Error and Nonresponse in Physical Activity Surveys: A Simulation Study. Journal of Official Statistics 33, 533–550. <https://doi.org/10.1515/jos-2017-0025>

Borghans, L., ter Weel, B., 2004. Are computer skills the new basic skills? The returns to computer, writing and math skills in Britain. Labour Economics, Labour market consequences of new information technologies 11, 85–98. [https://doi.org/10.1016/S0927-5371(03)00054-X](https://doi.org/10.1016/S0927-5371%2803%2900054-X)

Cialdini, R.B., 2007. Descriptive Social Norms as Underappreciated Sources of Social Control. Psychometrika 72, 263. <https://doi.org/10.1007/s11336-006-1560-6>

Credé, M., Tynan, M.C., Harms, P.D., 2017. Much ado about grit: A meta-analytic synthesis of the grit literature. Journal of Personality and Social Psychology 113, No Pagination Specified-No Pagination Specified. <https://doi.org/10.1037/pspp0000102>

DiNardo, J.E., Pischke, J.-S., 1997. The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure Too? The Quarterly Journal of Economics 112, 291–303.

Duckworth, A.L., Quinn, P.D., 2009. Development and validation of the short grit scale (grit-s). J Pers Assess 91, 166–174. <https://doi.org/10.1080/00223890802634290>

Dunning, D., Heath, C., Suls, J.M., 2004. Flawed Self-Assessment: Implications for Health, Education, and the Workplace. Psychol Sci Public Interest 5, 69–106. <https://doi.org/10.1111/j.1529-1006.2004.00018.x>

Dunning, D., Johnson, K., Ehrlinger, J., Kruger, J., 2003. Why People Fail to Recognize Their Own Incompetence. Curr Dir Psychol Sci 12, 83–87. <https://doi.org/10.1111/1467-8721.01235>

European Commission, Statistical Office of the European Union, 2016. Statistical approaches to the measurement of skills 2016 edition. Publications Office, Luxembourg.

Falck, O., Heimisch, A., Wiederhold, S., 2016. Returns to ICT Skills. <https://doi.org/10.1787/5jlzfl2p5rzq-en>

Ferrari, P., Friedenreich, C., Matthews, C.E., 2007. The role of measurement error in estimating levels of physical activity. Am. J. Epidemiol. 166, 832–840. <https://doi.org/10.1093/aje/kwm148>

Gerlitz, J.-Y., & Schupp, J., 2005. Zur Erhebung der Big-Five-basierten persoenlichkeitsmerkmale im SOEP. DIW Research Notes, 4, 2005.

Grant D.M., Malloy A.D., Murphy M.C., ,2009.A Comparison of Student Perceptions of their Computer Skills to their Actual Abilities. Journal of Information Technology Education:Research. <https://www.learntechlib.org/p/111395/>

Hebert, J.R., Clemow, L., Pbert, L., Ockene, I.S., Ockene, J.K., 1995. Social desirability bias in dietary self-report may compromise the validity of dietary intake measures. Int J Epidemiol 24, 389–398.

Hebert, J.R., Ebbeling, C.B., Matthews, C.E., Hurley, T.G., Ma, Y., Druker, S., Clemow, L., 2002. Systematic Errors in Middle-Aged Women’s Estimates of Energy Intake: Comparing Three Self-Report Measures to Total Energy Expenditure from Doubly Labeled Water. Annals of Epidemiology 12, 577–586. [https://doi.org/10.1016/S1047-2797(01)00297-6](https://doi.org/10.1016/S1047-2797%2801%2900297-6)

Hébert, J.R., Peterson, K.E., Hurley, T.G., Stoddard, A.M., Cohen, N., Field, A.E., Sorensen, G., 2001. The Effect of Social Desirability Trait on Self-reported Dietary Measures among Multi-Ethnic Female Health Center Employees. Annals of Epidemiology 11, 417–427. [https://doi.org/10.1016/S1047-2797(01)00212-5](https://doi.org/10.1016/S1047-2797%2801%2900212-5)

[Hebert J.R](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hebert%20JR%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Ma Y](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ma%20Y%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Clemow L](https://www.ncbi.nlm.nih.gov/pubmed/?term=Clemow%20L%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Ockene I.S](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ockene%20IS%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Saperia G](https://www.ncbi.nlm.nih.gov/pubmed/?term=Saperia%20G%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Stanek E.J.](https://www.ncbi.nlm.nih.gov/pubmed/?term=Stanek%20EJ%203rd%5BAuthor%5D&cauthor=true&cauthor_uid=9420529) , [Merriam P.A](https://www.ncbi.nlm.nih.gov/pubmed/?term=Merriam%20PA%5BAuthor%5D&cauthor=true&cauthor_uid=9420529)., [Ockene J.K](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ockene%20JK%5BAuthor%5D&cauthor=true&cauthor_uid=9420529).. 1997. Gender Differences in Social Desirability and Social Approval Bias in Dietary Self-report. American Journal of Epidemiology. 146(12) <https://academic.oup.com/aje/article/146/12/1046/111408>.

Heckman, J.J., Stixrud, J., Urzua, S., 2006. The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. Journal of Labor Economics 24, 411–482. <https://doi.org/10.1086/504455>

Hill, A., Roberts, J., Ewings, P., Gunnell, D., 1997. Non-response bias in a lifestyle survey. J Public Health (Oxf) 19, 203–207. <https://doi.org/10.1093/oxfordjournals.pubmed.a024610>

Item Randomized-Response Models for Measuring Noncompliance: Risk-Return Perceptions, Social Influences, and Self-Protective Responses <https://link.springer.com/article/10.1007/s11336-005-1495-y>

John, O. P., Donahue, E. M., & Kentle, R. L., 1991. The big five inventory—versions 4a and 54. Berkeley, CA: University of California, Berkeley, Institute of Personality and Social Research.

John, O.P., Srivastava, S., 1999. The Big Five Trait taxonomy: History, measurement, and theoretical perspectives, in: Handbook of Personality: Theory and Research, 2nd Ed. Guilford Press, New York, NY, US, pp. 102–138.

Johnston, D.W., Propper, C., Shields, M.A., 2009. Comparing subjective and objective measures of health: Evidence from hypertension for the income/health gradient. J Health Econ 28, 540–552. <https://doi.org/10.1016/j.jhealeco.2009.02.010>

Kirchner, A., 2015. Validating Sensitive Questions: A Comparison of Survey and Register Data. Journal of Official Statistics 31, 31–59. <https://doi.org/10.1515/jos-2015-0002>

Krueger, A.B., 1993. How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989. The Quarterly Journal of Economics 108, 33–60. <https://doi.org/10.2307/2118494>

Kruger, J., Dunning, D., 1999. Unskilled and unaware of it: How difficulties in recognizing one’s own incompetence lead to inflated self-assessments. Journal of Personality and Social Psychology 77, 1121–1134. <https://doi.org/10.1037/0022-3514.77.6.1121>

Larres, P.M., Ballantine, J., Whittington, M., 2003. Evaluating the validity of self-assessment: measuring computer literacy among entry-level undergraduates within accounting degree programmes at two UK universities. Accounting Education 12, 97–112. <https://doi.org/10.1080/0963928032000091729>

Mood, C. (2010). Logistic regression: Why we cannot do what we think we can do, and what we can do about it. European Sociological Review, 26(1), 67–82.

MacIntyre, P.D., Noels, K.A., Clément, R., 2002. Biases in Self‐Ratings of Second Language Proficiency: The Role of Language Anxiety. Language Learning 47, 265–287. <https://doi.org/10.1111/0023-8333.81997008>

Nusser, S.M., Beyler, N.K., Welk, G.J., Carriquiry, A.L., Fuller, W.A., King, B.M.N., 2012. Modeling Errors in Physical Activity Recall Data. Journal of Physical Activity and Health 9, S56–S67. <https://doi.org/10.1123/jpah.9.s1.s56>

OECD, 2013. Technical Report of the Survey of Adult Skills (PIAAC). OECD.

Sallis, J.F., Saelens, B.E., 2000. Assessment of physical activity by self-report: status, limitations, and future directions. Res Q Exerc Sport 71, S1-14.

Stroombergen, A., Rose, D., Nana, G., Pink, B., 2002. Statistics New Zealand. Review of the Statistical Measurement of Human Capital.

Attachment 1

**Table 1. Computer skills measured in the “ICT Usage in Households and by Individuals” survey**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| Item number | B3 | B4 | E2 | F2 | E3 | - | B5 | - | F3 | B3 | - | G1 | F1, F2 | E1, E2 | F1, F2 |
| Which of the following computer related activities have you already carried out? |
|  | x |  | x | x | x |  | x |  | x | x |  | x |  |  |  |
| Which of the following computer related activities have you carried out within last 12 months? |
|  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Which of the following computer or mobile device related activities have you carried out in the last 12 months? |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Which of the following software related activities have you carried out in the last 12 months? |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Using icons and windowing interface to launch applications (e.g. Internet browser, word processor etc.) |
|  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Using a mouse to launch programs such as an Internet browser or word processor |
|  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Using a mouse (or other pointing device) to open programs (e.g. Internet browser, word processor, etc.) |
|  |  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |
| Copying a file |
|  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Coping or moving a file or folder |
|  |  | x | x | x | x |  | x |  | x | x |  | x | x | x | x |
| Using copy and paste tools to duplicate information within a document |
|  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Using copy or cut and paste tools to duplicate or move information on screen |
|  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Using copy and paste tools to duplicate or move information within a document |
|  |  |  | x | x | x |  | x |  | x | x |  | x |  |  |  |
| Using word processing software |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Using basic arithmetic formulas to add, subtract, multiply or divide figures in a spreadsheet  |
|  | x | x |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Using basic arithmetic formulas in a spreadsheet |
|  |  |  | x | x | x |  | x |  | x | x |  | x |  |  |  |
| Using spread sheet software |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Using its advanced functions to organise and analyse data, such as sorting, filtering, using formulas, creating charts [conditional question if basic spreadsheet skills] |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Writing a computer program |
|  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Writing a computer program using a specialized programming language |
|  |  | x | x | x | x |  | x |  | x | x |  | x |  |  |  |
| Writing code in a programming language |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Compressing files |
|  |  |  | x | x |  |  |  |  |  |  |  |  |  |  |  |
| Compressing (or zipping) files |
|  |  |  |  |  | x |  | x |  | x | x |  | x |  |  |  |
| Connecting and installing new devices, e.g. a printer or a modem |
|  |  |  |  | x | x |  | x |  |  |  |  |  |  |  |  |
| Connecting and installing new devices, e.g. a modem |
|  |  |  |  |  |  |  |  |  | x | x |  | x |  |  |  |
| Connecting computers to a local area network  |
|  |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |
| Transferring files between computer and other devices (from digital camera or from/to mobile phone, mp3/mp4 player) |
|  |  |  |  |  |  |  |  |  | x | x |  | x |  |  |  |
| Transferring files between computers or other devices |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Creating a web page |
|  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Creating a web page or an electronic presentation |
|  |  | x |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Creating electronic presentations with presentation software (e.g. slides), including e.g. images, sound, video or charts |
|  |  |  |  |  |  |  |  |  | x | x |  | x |  |  |  |
| Creating presentations or documents integrating text, pictures, tables or charts |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Using software to edit photos, video or audio files |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Installing a new or replacing an old operating system |
|  |  |  |  |  |  |  |  |  | x | x |  | x |  |  |  |
| Installing software or applications (apps) |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Changing the settings of any software, including operational system or security programs |
|  |  |  |  |  |  |  |  |  |  |  |  |  | x | x | x |
| Modifying or verifying the configuration parameters of software applications (except internet browsers) [optional] |
|  |  |  |  |  |  |  |  |  | x | x |  | x |  |  |  |
| Detect and solve computer problems (e.g. computer runs slowly) |
|  |  |  |  |  | x |  |  |  |  |  |  |  |  |  |  |
| **Year** | **03** | **04** | **05** | **06** | **07** | **08** | **09** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |

Source: Own elaboration based on the questionnaire forms available at <https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp> (Accessed 05.2018)

**Table 2. Determinants of overstatement**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Moving files | Word processor | Srpeadsheet |
|  | (1) | (2) | (3) |
| Age | -0.013\*\*\* | -0.015\*\*\* | -0.013\*\*\* |
| Female | -0.047 | -0.068 | -0.058\* |
| **Place of living (ref.: village)** |  |  |  |
| City<20000 | 0.155\* | 0.066 | 0.057 |
| City>=20000 & <100000 | 0.023 | 0.112\* | 0.064 |
| City>=100000 & <1000000 | 0.100 | 0.169\*\* | 0.106\*\*\* |
| Warsaw | 0.361\*\* | 0.410\*\* | 0.205\*\*\* |
| Years of education | 0.054\*\*\* | 0.053\*\*\* | 0.054\*\*\* |
| Nonformal education | 0.016 | -0.019 | 0.054\* |
| Informal education | 0.066 | 0.129\* | 0.125\*\*\* |
| **Employment status (ref.: employed)** |  |  |  |
| Unemployed | 0.010 | 0.115 | 0.002 |
| Inactive | -0.094 | -0.068 | 0.003 |
| Numeracy (std) | 0.029 | 0.016 | 0.034\* |
| **Personality traits** |  |  |  |
| Conscientiousness (std) | -0.099 | -0.033 | -0.027 |
| Extraversion (std) | -0.001 | -0.025 | 0.032 |
| Agreeableness (std) | -0.005 | -0.062 | 0.008 |
| Openness (std) | 0.069 | 0.088\* | -0.010 |
| Neuroticism (std) | -0.026 | -0.014 | -0.026\* |
| Perseverance of effort (std) | 0.051\* | 0.030 | 0.044\*\* |
| Consistency of Interest (std) | 0.002 | -0.008 | -0.025 |
| Constant | 0.449\*\*\* | 0.482\*\*\* | 0.302\*\*\* |
| Observations | 710 | 725 | 2717 |
| r2 | 0.260 | 0.323 | 0.296 |

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

1. This is a preliminary draft of the article. Please do not quote or cite without authors’ permission. [↑](#footnote-ref-1)
2. Information on PIAAC and its results may be found on the OECD’s website: <http://www.oecd.org/skills/piaac/> [↑](#footnote-ref-2)
3. 20% did not report any computer skills, 24% refused to solve tasks on the computer although they had claimed computer-experience before, 7% failed the basic computer test [↑](#footnote-ref-3)
4. <https://digital-agenda-data.eu/datasets/desi/indicators> (Accessed: 10 May 2018). [↑](#footnote-ref-4)
5. After *Tourangeau, 1984; Eisenhower et al., 1991; Biemer and Lyberg, 2003; Groves et al., 2004* [↑](#footnote-ref-5)