Rammstedt, Beatrice; Gauly, Britta; Zabal, Anouk

Adult literacy and weak readers in PIAAC cycle 1

Grotlüschen, Anke [Hrsg.]: Alphabetisierung und Grundbildung von Erwachsenen. 1. Auflage. Weinheim; Basel : Beltz Juventa 2021, S. 88-108. - (Zeitschrift für Pädagogik, Beiheft; 67)

67. Beiheft April 2021

ZEITSCHRIFT FÜR PÄDAGOGIK

Alphabetisierung und Grundbildung von Erwachsenen

BELTZ JUVENTA

Zeitschrift für Pädagogik · 67. Beiheft

Alphabetisierung und Grundbildung von Erwachsenen

Herausgegeben von
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BELTZ JUVENTA

ISSN: 0514-2717
ISBN 978-3-7799-5876-5 Print
ISBN 978-3-7799-5877-2 E-Book (PDF)
Bestellnummer: 443534

1. Auflage 2021

in der Verlagsgruppe Beltz · Weinheim Basel
Werderstraße 10, 69469 Weinheim

Herstellung: Annette Hopp
Satz: text plus form, Dresden
Druck und Bindung: Beltz Grafische Betriebe, Bad Langensalza
Printed in Germany

Weitere Informationen zu unseren Autoren und Titeln finden Sie unter: www.beltz.de

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Beatrice Rammstedt/Britta Gauly/Anouk Zabal

Adult Literacy and Weak Readers in PIAAC Cycle 1

Abstract: The Programme for the International Assessment of Adult Competencies (PIAAC), which was initiated by the Organisation for Economic Co-operation and Development (OECD), assesses key skills of the adult population in an internationally comparable way. Over 35 countries with quite different degrees of economic development participated in the three rounds of the first cycle of PIAAC. This paper gives an overview of the average adult literacy skills by country and across countries and discusses the results from a German perspective. Furthermore, it explores how certain macro-economic indicators relate to the participating countries' average adult literacy skills. PIAAC also provides information on adults with very low levels of literacy, thus enabling us to examine this group – the *weak readers* – more closely. Here too, we compare the proportion of weak readers across countries and examine how it relates to key country characteristics. In addition, we investigate which individual characteristics are associated with low reading skills. The paper concludes with a preview of the upcoming second cycle of PIAAC, which promises to yield additional and enhanced high-quality international data for further analyses.

Keywords: PIAAC, Skills, International Comparison, Literacy, Reading Components

1. Introduction

In 2008, the Organisation for Economic Co-operation and Development (OECD) initiated the Programme for the International Assessment of Adult Competencies (PIAAC). PIAAC aims to assess key skills – literacy, numeracy, and problem solving – of the working-age population across a large number of countries. These skills are considered to be essential for successful labor market and social participation (OECD, 2019a). PIAAC thus provides crucial information about the level and distribution of skills in the participating countries. Moreover, it examines and cross-nationally compares factors associated with the acquisition, retention, and maintenance of these skills, and sheds light on their effects on social and, in particular, economic participation. Thus, PIAAC provides political decision makers and society with a rich empirical basis to evaluate

and develop political interventions and measures, specifically for educational and labor market programs.

Like the OECD's Programme for International Student Assessment (PISA), PIAAC was designed as a multi-cycle program. Three rounds of data collection were conducted in the first cycle of PIAAC, which was launched in 2008. Data collection for the first round of PIAAC Cycle 1 was carried out in 24 countries (including Germany) between 2011 and 2012. These countries were mostly OECD member or associate countries, and they were thus highly industrialized countries that together represented over 70% of the world's GDP (gross domestic product). The second round of PIAAC comprised nine countries, most of which had comparably lower levels of economic development than the Round 1 countries. Data collection for PIAAC Round 2 took place between 2014 and 2015. The data and results for Round 1 were published in 2013 (OECD, 2013a); the aggregated data and results for Rounds 1 and 2 were published in 2016 (OECD, 2016). PIAAC Round 3 was conducted in 2017 in five additional countries (Ecuador, Hungary, Kazakhstan, Mexico, Peru) and in the United States (which also participated in PIAAC Round 1); the data and results were released in autumn 2019 (OECD, 2019a). As the majority of the Round 3 countries had a lower GDP than the countries in the previous rounds, the comparative dimension of PIAAC was enhanced. A visualization of the geographic distribution of the participating countries in the three rounds can be found at https://www.gesis.org/en/piaac/structure-of-the-project/international/participating-countries.

As we review some of the PIAAC results from Cycle 1, we will look more specifically at how the relative position of Germany compares with the other participating countries, how Germany's position has shifted with each round of PIAAC, and we will reflect on the resulting adjusted picture of key skills of the adult population in Germany. We focus on literacy because it is a prerequisite to develop higher-order cognitive skills and to acquire other types of (job-specific) human capital (OECD, 2013a; Zabal et al., 2014). We examine average reading literacy across countries and relate it to key country characteristics, such as GDP or educational spending.

Given that the economic and social heterogeneity of the countries participating in PIAAC increased, especially considering the countries that participated in PIAAC Round 3, this cumulated dataset includes information about a very wide range of proficiencies and also lends itself to the investigation of adults with low reading skills. Again, we compare the proportion of this group across countries and relate it to key country characteristics. In addition, in order to identify possible risk and protection factors for low reading skills, we investigate which individual characteristics are associated with low reading skills.

Before presenting the results, we will briefly describe the design of the PIAAC assessment, outline how *literacy* and *low literacy* are defined in PIAAC, and briefly introduce the key country-level indicators used in our analyses. We then provide an overview of the average literacy skills across countries and explore determinants of low literacy skills.

1.1 The PIAAC Study

In order to produce high-quality data that allow policymakers and scientists to draw reliable conclusions, PIAAC prescribes and follows very high-quality assessment standards. The implementation of these standards is closely controlled by an international consortium, and data are released only if their quality has been confirmed in a data adjudication process.[1]

In all participating countries, PIAAC is based on a comprehensive random sample of approximately 5000 respondents that represents the adult population (aged 16 to 65 years) residing in the corresponding country (see OECD, 2019b). The PIAAC interview consists of two parts: the background questionnaire, conducted as a personal interview, and the subsequent skills assessment, which is self-administered in the presence of an interviewer. The skills assessment in Cycle 1 was computer-based by default, but an optional paper-based assessment was also available. In total, the background questionnaire and the assessment of skills took between one and a half and two hours to administer. Participation was voluntary in nearly all countries. Most countries incentivized participation (in Germany, a conditional monetary incentive of 50 euros was used). For a detailed description of the PIAAC design, see OECD (2019b) and Zabal et al. (2014).

1.2 The Basic Skills Assessed in PIAAC

PIAAC focuses on the assessment of three key skills – namely, literacy, numeracy, and problem solving.[2] The theoretical frameworks for each domain define the content, lay out the measurement area and dimensions, and guide the development and final selection of the assessment items. More detailed information on literacy as assessed in PIAAC and on the other skill domains can be found in OECD (2013b). As the present paper focuses on literacy skills, we will give a brief description of this domain only.

In PIAAC, literacy is defined as "understanding, evaluating, using, and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential" (Jones et al., 2009, p. 8). When developing the instrument, care was taken to include different types of texts and text formats, including both continuous and non-continuous texts. Items tapped key cognitive processes and were embedded in contexts appropriate to adults with a wide range of personal, linguistic, and cultural backgrounds. Assessment tasks included both print-based and digital texts, and referred to everyday literacy activities, such as reading and understanding medication labels, short newspaper articles, or reviewing online job postings. Skills in lit-

1 However, data quality differs across the countries participating in PIAAC. Details on the evaluation results of the data adjudication of the different countries can be found in OECD (2019b, Appendix 7).

2 In Cycle 1, the problem-solving domain focused on problem solving in technology-rich environments.

eracy – and in the other two domains – are regarded as a continuum, and results are represented on proficiency scales that range from 0–500 points (OECD, 2013b). To facilitate the interpretation of the proficiency scores, each scale was divided into five proficiency levels with descriptions of typical tasks and task characteristics that can be successfully completed at this level. Persons at Literacy Level 1 or below are typically regarded as low performers (OECD, 2013b; Rammstedt, 2013; Rammstedt, Zabal & Gauly, 2019).

Compared with previous adult literacy surveys, the assessment of literacy in PIAAC was enhanced by extending the measurement at lower levels of literacy by including the assessment of the reading components. This approach was originally based on theories of child literacy acquisition that differentiate the lowest level of competence into basic component skills that are relevant to reading (Strucker, Yamamoto & Kirsch, 2007). These component skills include spelling ability, automated decoding of known words, constructive decoding of unknown words, technical and content-related sentence comprehension, and reading fluency. The components approach was tailored to the PIAAC study by Sabatini and Bruce (2009). With the objective of describing what adults with the lowest level of literacy proficiency can do, and of understanding the basic reading skills that underlie proficient literacy performance levels, three basic types of tasks were operationalized in PIAAC: *word meaning* (print vocabulary), *sentence processing,* and *basic passage comprehension* (Sabatini & Bruce, 2009).

In PIAAC Cycle 1, the reading components were implemented only in the paper-based mode which was presumed to be more appropriate for respondents with a low level of literacy proficiency. Respondents who failed a very basic core test consisting of (easy) literary and numeracy items skipped the rest of the assessment and were only administered the reading components. In addition, all respondents who worked on the assessment on paper, and thus respondents without any computer experience, insufficient computer skills, or respondents who refused to work on the computer-based assessment, also completed the reading components. For the analyses that focus on weak readers, we exclusively include respondents who failed the core test consisting of very basic (easy) literary and numeracy items. Respondents who were routed to the paper-based branch for non-literacy-related reasons, such as insufficient computer skills, were excluded.

In comparison to earlier PIAAC-based research on low-literacy which focused on literacy levels I and below (Grotlüschen, Mallows, Reder & Sabatini, 2016), we will thus follow a much more conservative definition of weak readers. This group can be regarded as being at risk, as their literacy proficiency level is not sufficient for a number of everyday tasks across a range of relevant life contexts, such as understanding simple texts, instructions, or basic public information. Although only a very small subset of respondents falls under our definition of weak readers, it is of evident importance to identify factors that increase the likelihood of belonging to this group, in order to inform appropriate outreach and training measures.

1.3 Key Country Characteristics

The heterogeneity of the participating countries increased with each additional round, and it is possible to explore how country-level indicators potentially explain differences in literacy skills across countries. We will examine seven different macro-indicators that have been found in the literature to be related to different levels of literacy skills (e.g., Hanushek & Woessmann, 2015): GDP, the Gini coefficient, the poverty rate, educational spending, the proportion of non-native speakers, the proportion of older citizens, and access to computers.

Countries that participated in PIAAC Cycle 1 differed with respect to their GDP, with per capita levels of GDP decreasing with each additional round. As the literacy proficiency average also decreased with each additional round, it seems plausible to hypothesize that countries with a higher GDP have higher average literacy skills.

The Gini coefficient (Gini, 1921) represents the degree of (income) inequality within countries. Following the concept of inclusive growth, less unequal societies should be better able to mobilize skills and should thus have a higher average skill level (van Damme, 2014).

Unsurprisingly, an individual's level of educational attainment is highly correlated with his or her level of literacy skills. It seemed plausible to assume that not only the quantity of the education received but also its quality would impact the individual's literacy skills. We used national educational spending (as a share of GDP) in 2005 as an indicator for the quality of the education system and expected a higher level of literacy in countries that invested more in education. The data for educational spending were deliberately chosen from almost a decade prior to the first round of PIAAC data collection, as educational spending takes some time to take effect, and, in addition, the PIAAC samples of adults included many individuals who had left the educational system well before they participated in the PIAAC assessment.

The poverty rate was included to explore whether it was related to literacy skills beyond income inequality and educational spending.

Existing studies show that whether a language was learned and spoken in childhood is crucial for literacy in that language (Buddeberg & Riekmann, 2012; Heilmann & Grotlüschen, 2020). As the skill assessment in PIAAC was administered only in the official country language(s), we also expected literacy results to be impacted by the proportion of individuals whose mother tongue was not the same as the assessment language (i.e., the proportion of non-native speakers).

Another possible determinant of average literacy skills is the general access to computers within a country. Among other things, using computers and other digital devices increases exposure to written texts (see for example Hunter, 2014; Storrer, 2010).

Aging is known to be associated with a loss of cognitive skills (age effect; Desjardins & Warnke, 2012; Reder, 2009). In addition, older respondents developed their skills in different education systems and usually had fewer years of schooling (i.e., cohort effect). Thus, a further factor to be considered was the proportion of comparatively older individuals (aged 54–65 years).

2. Results

2.1 Average Literacy Skills Across Countries

The first question we addressed was how literacy skills were distributed across countries – specifically, how the average level of literacy skills of the German adult population compared to that of the other countries that participated in the first cycle of PIAAC.[3] Table 1 shows the mean literacy proficiency score across all countries. The table includes the OECD average and the overall PIAAC average score for the total set of countries that participated in PIAAC Cycle 1, as well as PIAAC average scores for each round separately. As can be seen from the averages reported, literacy skills in Rounds 2 and 3 were on average lower than those of the countries that participated in the preceding round(s).

Results of PIAAC Round 1 have been the focus of numerous international and national publications. From the German perspective, the results revealed that the average level of adults' literacy skills in Germany was slightly – but statistically significantly – lower than the OECD average (Rammstedt, 2013) and also lower than the PIAAC average over all countries that participated in Round 1, i.e. including the non-OECD countries. A re-analysis based on the aggregated Round 1 and Round 2 data showed that, based on this extended database, the average literacy skills of the German adult population was slightly and statistically significantly higher than the average across the extended set of participating OECD countries and also than the PIAAC average across the two rounds (Rammstedt, Zabal & Gauly, 2019). Using the full PIAAC database that includes all three rounds, we can see that the average literacy skills of the German adult population were also significantly higher than the PIAAC average over all three rounds.

The second question we explored was how country-level indicators explain the observed differences in literacy skills across countries. We examined the effects of the seven different macro-indicators outlined above.[4] Unfortunately, not all macro-indicators were available for all countries. In our analyses we only included countries for which all indicators were available (24 out of 33 countries), thus excluding Austria, Cyprus, Ecuador, Kazakhstan, Peru, New Zealand, Singapore, the United Kingdom, and the United States.

To investigate how these macro-level indicators were related to countries' average level of literacy skills, we conducted analyses of variance (ANOVA). ANOVA does *not* provide evidence of the causal nature of the relationship between literacy and the re-

3 Data from the Russian Federation were excluded as they do not include the population of Moscow and cannot be considered to be representative. Data from Indonesia were excluded as they were collected in the Jakarta municipal area only.

4 The data for the macro-indicators were taken from the OECD database (https://data.oecd.org/).

Country	Average Literacy Skills	Country	Average Literacy Skills
Japan (JPN)‡	296.2	Cyprus (CYP)	268.8
Finland (FIN)‡	287.5	Poland (POL)	266.9
Netherlands (NLD)	284.0	Lithuania (LTU)*	266.8
New Zealand (NZL)*	280.7	Ireland (IRL)	266.5
Australia (AUS)	280.4	Hungary (HUN)†	264.0
Sweden (SWE)	279.2	France (FRA)‡	262.1
Norway (NOR)	278.4	Singapore (SGP)*	257.6
Estonia (EST)	275.9	Slovenia (SVN)*	256.4
Belgium (BEL)	275.5	Israel (ISR)*	255.2
Czech Republic (CZE)	274.0	Greece (GRC)*	253.9
Slovak Republic (SVK)	273.8	Spain (ESP)	251.8
Canada (CAN)	273.3	Italy (ITA)	250.5
Korea (KOR)	272.6	Kazakhstan (KAZ)†	249.1
United Kingdom (GBR)	272.5	Turkey (TUR)*	226.5
Denmark (DNK)	270.8	Mexico (MEX)†	221.6
Germany (DEU)	**269.8**	Chile (CHL)*	220.1
United States (USA)	269.8	Ecuador (ECU)†	196.4
Austria (AUT)	269.5	Peru (PER)†	195.6
OECD Average	**266.0**		
Overall PIAAC Average	**261.5**		
PIAAC Round 1 Average	**272.6**		
PIAAC Round 2 Average	**252.2**		
PIAAC Round 3 Average	**225.3**		

Notes: Countries are displayed in descending order according to their average literacy. Countries without a superscript are Round 1 countries; * refers to Round 2 countries; † refers to Round 3 countries. ‡ refers to the three Round 1 countries that did not include the assessment of reading components and were therefore excluded from our subsequent analyses. Data from the Russian Federation were excluded as they do not include the population of Moscow and cannot be considered to be representative. Data from Indonesia were excluded as they were collected in the Jakarta municipal area only. Data for the United States (which participated in PIAAC Round 1 and Round 3) refer to PIAAC Round 1.

"OECD Average" excludes Cyprus, Ecuador, Kazakhstan, Peru, and Singapore.

Tab. 1: Average Literacy Skills Across Countries

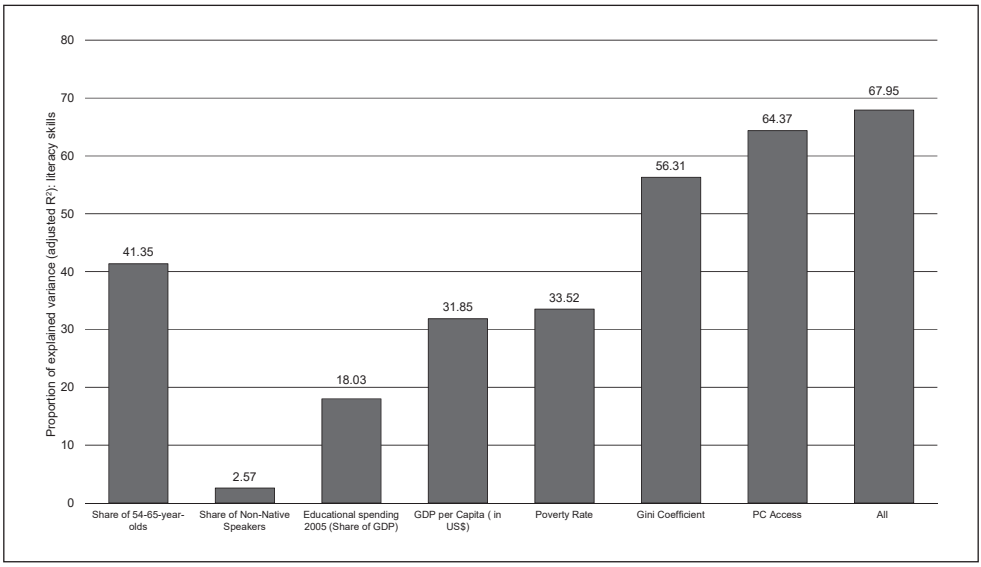


Fig. 1a: Explained Variance in Average Literacy Skills Across Countries

spective macro-indicators. Rather, it identifies only the proportion of the variance in average literacy skills across countries that is explained by a particular variable.

The results of the analyses are displayed in Figure 1a. As can be seen from that figure, the degree of computer access explains a large proportion (over 60%) of the variance in literacy proficiency across countries. Countries with higher levels of computer access performed better in literacy. The Gini coefficient is the second most important factor; it explains more than 50% of the variance across countries. As the Gini coefficient is related to other economic indicators such as a country's poverty rate (r = .87 in the data we used), it is not surprising that the poverty rate also explains part of the variance in literacy across countries, although, compared with the Gini coefficient, the proportion was lower (33.5%). The proportion of older individuals (56–65 years) in the national sample explains over 40% of the variance in literacy skills across countries, while GDP per capita explains roughly 32%. Nearly one fifth (18%) of the variance in literacy across countries can be explained by differences in their investments in the educational system. Contrary to our initial assumption, the proportion of non-native speakers in a country explained only a negligible portion of the differences in literacy proficiency across countries.

As all these indicators – investigated separately – overlap substantially, we additionally conducted a multivariate analysis of variance (MANOVA) taking all indicators into account in parallel. As can be seen from the last bar in Figure 1a, all investigated macro-level indicators together explained more than two thirds of the country variance in literacy (68%). The degree of computer access in a country and the level of income inequality (Gini coefficient) were the most powerful predictors.

To sum up, we found that the overall average literacy proficiency decreased with each additional round of PIAAC. Compared to the Round 1 results, in which it was found that literacy proficiency in Germany was below average, in Round 3 – given the different average – it can be concluded that literacy proficiency in Germany is actually above average. Based on the data including all PIAAC countries (Rounds 1–3), we identified macro-level factors associated with country differences in literacy proficiency: The degree of computer access and the country's level of income inequality (Gini coefficient) had the strongest relationship with the variance in literacy skills across countries. Contrary to our initial assumption, the proportion of non-native speakers in a country was not associated with its performance in literacy.

2.2 Individuals With Weak Reading Skills

As outlined above, respondents routed to the reading components due to their low basic literacy and numeracy skills are classified in this paper as weak readers. The first column of Table 2 shows the proportion of individuals with this very weak literacy proficiency by country. Peru had the largest proportion of weak readers (20.1%); the Netherlands had the lowest proportion (0.5%). For Germany and many other Western industrialized countries, the proportion of weak readers was around 2%. Across all countries, 3.4% of the population were weak readers. Although this is only a small percentage, it does represent a considerable number of individuals.

It is also apparent that all Round 1 countries – with the exception of the United States and Spain – had quite low proportions of weak readers (< 3.4%; average 2%). In contrast, the proportion of weak readers among the Round 2 countries varied considerably: Whereas Greece and New Zealand had quite low proportions (1% and 1.9%, respectively), Turkey and Chile were among the countries with the highest proportions (7.2% and 11.5%, respectively). At 4.4%, the average proportion of weak readers in the Round 2 countries was over twice as high as the average across the Round 1 countries. In all Round 3 countries, the average proportion of weak readers (8.2%) was almost twice as high as the average for the Round 2 countries.

2.3 Country-Level Indicators for Weak Readers

As we assumed that the same explanatory models and macro-level indicators that were related to countries' average reading skills were also related to their proportion of weak readers, we tested the same set of macro-level indicators for the degree of country-level variance in the proportion of weak readers that they explained. Again, these analyses were based on the same subset of 24 countries. Figure 1b shows the proportion of country-level variance in the proportion of weak readers explained by our set of macro-level indicators.

Country	Weak readers as a share of the total population (%)	Total number of weak readers	Men (%)		Age (%)						Education (%) ISCED 3–6		Native Speaker (%)		Employed (%)	
					16–34 yrs.		35–43 yrs.		55–65 yrs.							
			Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All
Netherlands	0.5	18	*54.5*	50.3	*12.6*	35.1	*59.3*	43.5	*28.1*	21.4	*29.4*	67.5	*48.0*	87.4	*60.7*	74.5
Greece*	1.0	38	31	49.3	*40.5*	34.2	*31.1*	45.5	*28.3*	20.3	*37.4*	67.1	91.0	93.7	*36.3*	48.6
Cyprus	1.2	145	*48.6*	48.5	*24.8*	42.9	38.0	39.8	37.2	17.3	35.8	64.5	77.9	77.4	42.8	51.5
Denmark	1.3	110	45.7	50.4	*25.5*	35	39.1	43.3	35.4	21.7	38.6	73.4	63.9	88.7	44.5	73.1
Sweden	1.3	35	*43.7*	50.7	*33.6*	37.2	*49.8*	40.9	*16.6*	21.8	*38.3*	76.2	*24.5*	82.1	*44.0*	73.7
Estonia	1.6	128	62.3	47.9	*16.7*	39.2	39.1	40.4	44.2	20.4	56.2	81.6	96.2	95.7	40.5	71.7
Norway	1.7	69	59	51.1	*40.5*	38.1	*30.9*	42.4	*28.7*	19.5	46.8	70.9	50.3	84.5	51.1	77.1
Germany	1.8	82	36.3	50.4	*19.2*	33.6	54.4	46.6	*26.4*	19.8	49.8	81.4	57.3	86.4	55.6	74.3
Austria	1.9	75	51.3	49.9	*35.7*	35.1	*33.6*	46	*30.7*	18.9	35.5	75.7	50.4	84.3	47.1	72.1
Lithuania*	1.9	99	49.7	48.2	*16.4*	37.1	57.1	42.4	26.5	20.5	78.0	84.1	91.0	86.8	47.3	62.3
New Z.*	1.9	114	62.1	48.4	28.8	37.9	35.7	42.6	35.5	19.4	36.2	75.6	54.0	80.6	56.2	75.8
Canada	2.0	773	50.7	50	18.6	37.3	47.2	42.1	34.2	20.6	47.3	84.6	52.7	77.1	51.1	75.7
Belgium	2.4	128	50.2	50.5	22.6	33.3	37.9	43.7	39.5	23.0	36.3	75.8	60.9	87.0	50.2	66.5
Ireland	2.4	137	61	49.1	28.1	41.8	41.8	41.9	30.1	16.4	32.4	71.2	74.6	89.4	44.7	60.9
Slovak Rep.	2.4	158	55.8	50	33.6	40.6	39.0	39.6	27.3	19.9	29.8	79.2	81.7	93.2	37.9	60.6
U.K.	2.4	192	44.8	49.9	40.4	38.5	34.1	42.3	25.5	19.2	38.3	74.6	64.3	88.1	26.5	69.7
Czech Rep.	2.6	71	*40.8*	50.4	*18.8*	38.1	*35.0*	40.1	46.2	21.8	60.7	83.9	99.5	96.6	43.4	65.2
Poland	3.1	201	67.6	49.5	20.2	41.1	42.0	38.2	37.8	20.7	61.9	84.6	97.7	98.8	44.5	61.4

Country	Weak readers as a share of the total population (%)	Total number of weak readers	Men (%)		Age (%)						Education (%) ISCED 3–6		Native Speaker (%)		Employed (%)	
					16–34 yrs.		35–43 yrs.		55–65 yrs.							
			Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All
Italy	3.2	136	46.1	50	*16.5*	33.3	40.6	46.2	42.8	20.5	*9.8*	45.9	84.9	90.0	41.2	55.8
Korea	3.3	238	38.7	49.8	*6.1*	36.5	45.2	47	48.8	16.5	18.7	78.1	98.6	98.5	34.5	67.2
Israel*	3.4	214	51.2	49.1	31.7	45.6	37.9	38.2	30.4	16.2	47.8	80.2	73.7	75.1	61.5	68.9
Kazakhstan†	3.4	188	48.4	48.4	39.0	45.2	39.0	39.3	22.0	15.5	80.6	85.4	52.5	54.6	55.5	59.7
Slovenia*	3.6	173	54.5	51.4	*12.6*	34.3	44.2	43.5	43.2	22.2	33.2	75.9	75.3	87.6	46.9	57.5
U.S.	4.0	170	52.6	49.1	32.6	38.9	43.6	41.9	23.8	19.3	40.8	81.6	47.9	81.6	37.6	70.2
Hungary†	4.3	364	56.6	49.5	23.4	33.5	37.1	44.4	39.4	22.1	26.1	75.9	97.5	98.3	61.0	73.3
Singapore*	5.1	231	50.6	49.4	*10.2*	36.4	46.6	44.2	43.2	19.4	25.2	80.2	19.2	27.4	49.4	72.8
Spain	5.1	322	45.2	50.2	13.3	33	38.3	47	48.4	20.0	11.7	52.1	85.7	91.3	68.7	57.9
Australia	1.5	101	43.8	49.8	*27.7*	40.1	42.8	41.2	29.5	18.8	30.0	71.2	51.2	81.1	34.5	72.1
Turkey*	7.2	349	34.6	50.5	25.0	46.4	45.1	40.1	29.9	13.5	8.8	34.8	92.6	93.7	24.5	43.1
Mexico†	7.6	537	48.7	48	32.9	48.7	42.4	38.7	24.7	12.6	9.2	38.4	97.2	97.1	56.1	64.1
Chile*	11.5	654	42.2	49.9	24.0	44	41.1	39.4	34.9	16.6	25.4	67.6	98.3	98.8	60.5	72.3
Ecuador†	16.9	163	51.4	48.6	68.9	50.1	28.0	37.2	*3.1*	12.7	59.7	52.8	98.7	96.1	56.2	62.4
Peru†	20.1	1340	47.5	50.1	34.8	52.1	45.5	35.5	19.7	12.4	29.2	63.6	89.0	91.5	75.2	76.5
OECD Average	**3.1**	**5686**	**49.3**	**49.8**	**24.9**	**38.1**	**41.6**	**42.5**	**33.5**	**19.4**	**36.2**	**71.7**	**73.6**	**89.0**	**46.4**	**66.6**
Overall PIAAC Average	**3.4**	**7753**	**49.3**	**49.7**	**26.5**	**38.9**	**41.3**	**41.9**	**32.2**	**19.2**	**37.8**	**72.0**	**72.7**	**86.7**	**48.1**	**66.5**

Country	Weak readers as a share of the total population (%)	Total number of weak readers	Men (%)		Age (%)						Education (%) ISCED 3–6		Native Speaker (%)		Employed (%)	
					16–34 yrs.		35–43 yrs.		55–65 yrs.							
			Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All	Weak readers	All
PIAAC Round 1 Average	**2.0**	**3289**	**49.9**	**49.9**	**24.3**	**37.1**	**41.6**	**42.5**	**34.1**	**20.4**	**37.4**	**74.4**	**68.4**	**88.8**	**45.7**	**67.6**
PIAAC Round 2 Average	**4.4**	**1872**	**47.0**	**49.5**	**23.7**	**39.5**	**42.4**	**42.0**	**34.0**	**18.5**	**36.5**	**70.7**	**74.4**	**80.5**	**48.8**	**62.7**
PIAAC Round 3 Average	**8.2**	**2592**	**50.05**	**48.9**	**39.8**	**45.9**	**38.4**	**39.0**	**21.8**	**15.1**	**40.9**	**63.3**	**87.0**	**87.5**	**56.8**	**67.2**

Notes: Countries are displayed in descending order according to their proportion of weak readers. Countries without a superscript are Round 1 countries; * refers to Round 2 countries; † refers to Round 3 countries. Values within variables may not add up to exactly 100% percent due to missing values. The italic numbers indicate that the calculations are based on a sample size of N < 30. "Employed" is defined following the International Labour Organization (ILO) as having done paid work for at least one hour during the last seven days.

Tab. 2: Share and Composition of Weak Readers Compared With the Total Population in the Various Countries

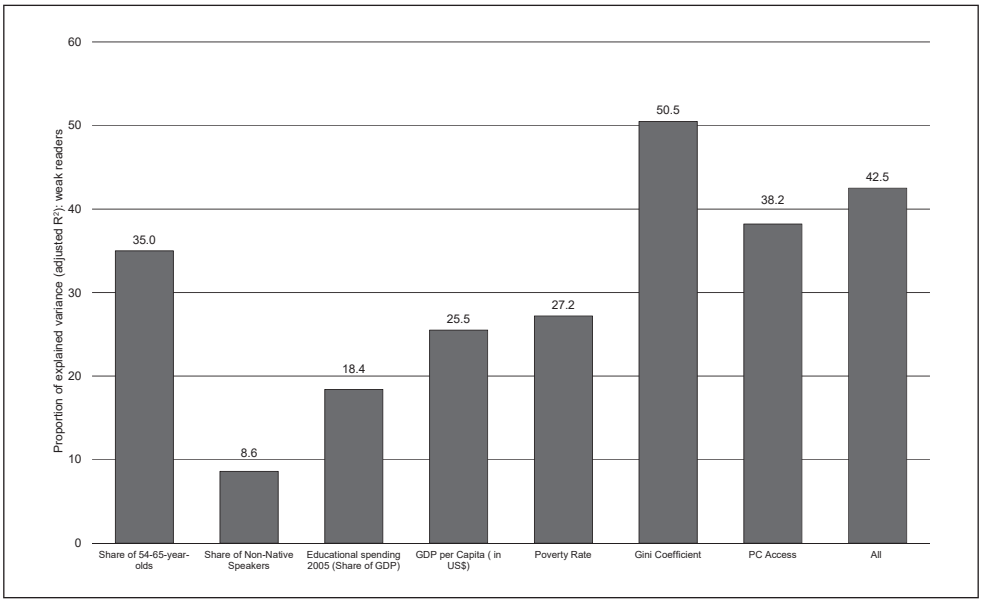


Fig. 1b: Explained Variance in the Proportion of Weak Readers Across Countries

The most important predictor – explaining over half (50.5%) of the variance in the proportion of weak readers across countries – was the level of income inequality in a country (Gini coefficient). Similar to results in Figure 1a, another strong predictor of the proportion of weak readers in a country was the general level of computer access in the country. However, at 38.2%, the magnitude of the variance explained was substantially lower than that for literacy proficiency. Considering that the reading components were administered exclusively in the paper-based mode, the extent to which a country's performance in reading components still depended on the overall level of computer access in a country is somewhat surprising. However, computer access can be regarded as generally reflecting the degree of industrialization and welfare. The same holds for the poverty rate (27%) and the GDP per capita (25%).

As in the case of literacy proficiency in general, the average age distribution – specifically, the share of older individuals in a country – was also of relevance for country differences in the proportion of weak readers. It explained 35% of the variance across countries. Countries with a higher proportion of older persons had a higher proportion of weak readers.

The level of educational spending in a country explained a moderate proportion (18.4%) of the variance in weak readers across countries. This is comparable in size to the portion of the variance explained for general literacy proficiency.

In contrast to the findings for general literacy proficiency, a country's proportion of non-native speakers was of relevance for explaining the proportion of weak readers by country, although the amount of explained variance was comparatively low (8.6%).

We also took all the different – and at least partly highly overlapping – country-level indicators into account in parallel. Altogether, these indicators explained 42.5% of the variance in the proportion of weak readers across countries. In this combined analysis, we found that the level of income inequality and the poverty rate showed the strongest relationship with the proportion of weak readers.

To sum up, based on the heterogeneous set of countries that participated in PIAAC Cycle 1, we observed substantial variation in the proportion of weak readers by country. Whereas this proportion was comparatively low for all the highly developed countries[5] participating in Round 1, it increased with each additional round, which included, on average, less developed countries. Our analyses empirically supported this impression: Across the investigated countries, the degree of income inequality in a country explained about half of the variance in their proportion of weak readers.

2.4 Individual Characteristics Related to Weak Literacy Skills

In the first part of this paper, we focused on country differences in literacy skills and the proportion of weak readers – that is, low-literacy performers with very low reading skills. We identified macro-level indicators explaining differences across countries in the average level of literacy proficiency and in the proportion of weak readers.

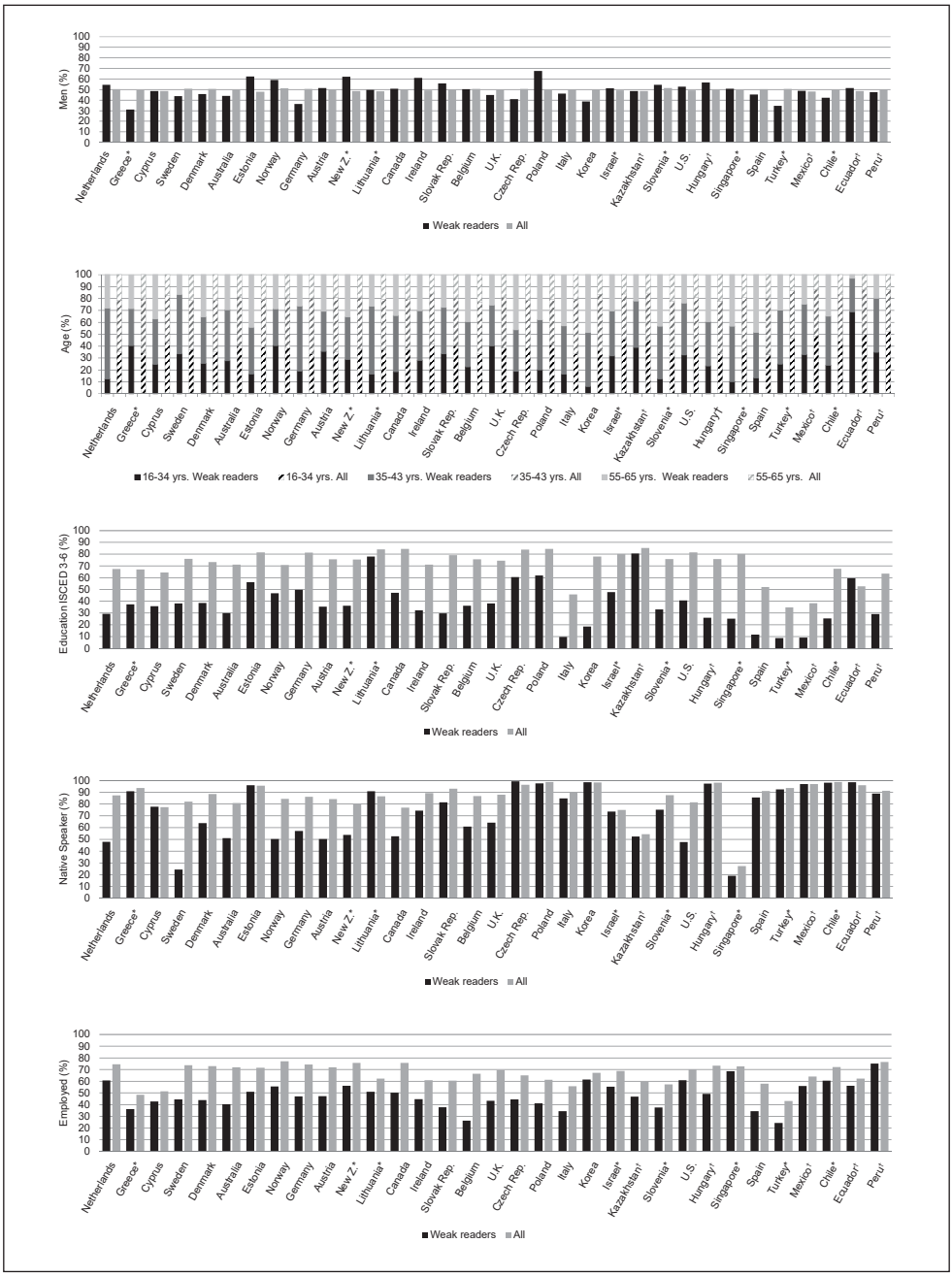
To obtain a clearer picture of these individuals with weak reading skills, the next section focuses on the individual level. First, we compared the sociodemographic characteristics of weak readers with those of the entire population of the country in question. Second, we performed multivariate regression analyses to analyze how individual characteristics were related to the likelihood of having weak reading skills.

To illustrate these individual characteristics, Table 2 and Figure 2 show the composition of the group of weak readers in the different countries and compare it with that of the country's general population.

In most countries, there was a more or less equal distribution of gender within the weak readers group. In some countries, such as Estonia, New Zealand, and Poland, men were more likely than women to be weak readers. In a few other countries – including Germany and Greece – women were over-represented among the weak readers.

In most countries, weak readers tended to be older. Comparable to the macro-level effect of age/cohort, this hints at two different interpretations: first, older generations may have disporpotionally weak reading skills (e.g., due to the schooling system at the time or less exposure to the education system) and thus the overall level of weak reading skill should decrease in the coming decades; second, the age differences in skills may be due to a loss of reading skills after leaving school (see, e.g., Wicht et al. in this issue). In line with practice engagement theory (Reder, 2009), it can thus be argued and empir-

5 According to the United Nations, there is no convention for the designation of "developed countries." Within this article, we consider high-income countries as developed countries.



Note: Countries are ranked in increasing order according to their share of weak readers. Values within variables may not add up to exactly 100% due to missing values. "Employed" is defined following the International Labour Organization (ILO) as having done paid work for at least one hour during the last seven days.

Fig. 2: Distribution of different sociodemographic and economic Indicators in the share of weak readers compared with the total population in the various countries.

ically shown that the more time has passed since leaving school, the higher is the risk of having weak reading skills if they are not practiced ("use it or lose it"; Desjardins, 2019; Reder, Gauly & Lechner, 2020).

Not surprisingly, we find larger proportions of higher education levels (ISCED 3–6) in the general population compared to the group of weak readers across all countries except for Ecuador. However, differences varied considerably across countries.The largest difference of around 50 percentage points is found in Korea, Singapore, Hungary, and the Slovak Republik. In Lithuania and Kazakhstan, however, it was less than 10 percentage points.

In some countries, non-native language was related to the risk of being a weak reader. Especially in countries with low levels of weak readers – and also in Germany – the proportion of non-native speakers among these weak readers was higher compared with the general population.

To gain a more holistic view of the relationship between these individual-level indicators and low reading skills, we conducted a logistic regression analysis in which we predicted the likelihood of being a weak reader by taking individual characteristics into account. For the regression analysis, we pooled data across countries, which resulted in a sample size of N = 213,038. The dependent variable in the regression analysis was a binary indicator of reading skills *(1 = weak reading skills, 0 = non-weak reading skills)*. As covariates, we analyzed gender, age, education, employment status, and mother tongue. The results are reported as average marginal effects. In addition, the model included country fixed effects, so that all estimates only rely on within-country variation.

What factors increase the risk of being a weak reader? As can be seen from the results displayed in Table 3, education – not surprisingly – is clearly and most strongly related to low reading skills: Lower educated respondents had a higher risk of being weak readers. The second strongest relationship was found for mother tongue: Being a non-native speaker clearly increased the risk of being a weak reader in the official country language. In addition, a higher age, or an earlier year of birth, increased the risk of being a weak reader. Being non-employed was only weakly associated with a greater likelihood of being a weak reader. We found no association between reading skills and gender. Overall, the amount of variance in the likelihood of being a weak reader explained by the factors investigated was comparatively small (7.8%). However, these results must be considered within the limitations imposed by the very small variation in our dependent variable with an average prevalence of 3.4% across all PIAAC countries.

	r	*SE*	*p* > z
Female	.001	.002	.707
Age (Ref: 35–54 yrs.)			
15–34 yrs.	−.023	.002	.000
55–65 yrs.	.020	.003	.000
Education (Ref: ISCED 3/4)			
ISCED 0/2	.081	.004	.000
ISCED 5/6	−.018	.002	.000
Non-Employed	.011	.003	.000
Non-Native Speakers	.065	.006	.000
Constant	−.011	.003	.000
R^2		.078	
N		213,038	

Notes: The dependent variable is a binary indicator for weak reading skills *(1 = weak reading skills; 0 = non-weak reading skills).* "Non-Employed" is defined following the International Labour Organization (ILO) as not having done paid work for at least one hour during the last seven days. Country fixed effects are included.

Tab. 3: Association between Weak Reading Skills and Individual Characteristics Across all Countries

3. Summary and Conclusion

In the present paper, we presented for the first time, results based on all countries participating in the three rounds of PIAAC Cycle 1 from a German perspective. As each of the two additional PIAAC rounds included, on average, less developed countries compared to the previous round(s), it is not surprising that the overall literacy proficiency across all PIAAC countries (and also the average across all OECD countries) decreased with the inclusion of each additional round. From a German perspective, this implies that the average literacy proficiency of the German adult population, which, based on the results of Round 1, was below the OECD average, was significantly above the – decreased – average based on the results of all three rounds.

When we took a closer look at the macro-level factors that explained the country-level differences in overall literacy proficiency, it became clear that the development of the country as reflected by its computer access, income inequality, and the age structure of the population were central to its overall performance in literacy.

In the second part of the paper, we investigated the group of weak readers in each country. With an average of 2%, the proportion of adults with an extremely low literacy level in the highly industrialized countries that participated in PIAAC Round I was very low. However, it increased markedly with each additional round, as they comprised, on

average, less developed countries. Our macro-level analyses supported this finding: As in the case of general literacy proficiency, the development of the country in terms of income inequality, computer access, and the age structure of the population explained to a high degree the country differences in the proportion of weak readers.

In the last empirical analysis, we investigated which individual characteristics were related to being a weak reader – across and within countries. Not surprisingly, weak readers were usually less educated compared with the country's general population. In most countries, they were also on average older and less often employed. Native language was of relevance, especially in the case of the highly industrialized countries: Respondents who had not been raised in the official country language had a higher risk of being weak readers.

Although the cross-sectional data do not allow for causal analyses from which recommendations for intervention programs to foster reading skills can be directly derived, these results nonetheless yield some important suggestions. In view of increasingly aging populations throughout the world, recognizing that adults with weak reading skills tend to be older points to the importance of actively maintaining and developing reading and other literacy skills in older age groups. Literature on cognitive aging indicates that there are possibilities of maintaining functional literacy through practice ("use it or lose it"; e.g., Reder, 2009), and potentially even for cognitive growth in older age groups, too. Along the same lines, being employed can also contribute to literacy skills through reading demands associated with work tasks (Adam Bay, Bonsang, Germain & Perelman, 2006; Celidoni, Dal Bianco & Weber, 2017). Thus, alternative opportunities for comparably cognitively stimulating activities could be provided for people outside the labor market.

4. Outlook

The first cycle of PIAAC produced a rich database on key skills of the adult population in a wide range of countries, which offers an excellent basis to empirically address a myriad of research questions and inform policymakers, institutions, and the general public. PIAAC has now proceeded to its second cycle, with over 30 countries, most of which also participated in the first cycle. The second cycle of PIAAC will again measure the key skills literacy, numeracy, and problem solving.[6] Scales for literacy and numeracy will be linked back to Cycle 1, thus allowing analyses of trends over the last decade. The main data collection will take place in 2022/2023 and it is expected that data and results will be published in the autumn of 2024.[7]

From a methodological point of view, some interesting innovations will be introduced in the second cycle of PIAAC. First, interview administration – and more spe-

6 In Cycle 2, the problem-solving domain will focus on adaptive problem solving.

7 Due to the worldwide Corona pandemic, the OECD and the participating countries decided to postpone the PIAAC data collection schedule by one year.

cifically, the assessment of skills – will be tablet-based with the aim of eliminating, or at least greatly reducing, the need for an additional paper-based instrument. The tablet-based assessment will primarily use touch functionalities that should be easily usable by respondents with very different backgrounds and familiarity with digital devices. The theoretical frameworks for literacy and numeracy have been enhanced and extended, especially with a view to taking into account changes in modern societies and ever-increasing digitalization, which is reflected in different forms of textual and numerical information, representations, and tools. PIAAC will continue to explore ways of obtaining more differentiated information on respondents with lower levels of literacy.

A somewhat modified reading components instrument will be used in Cycle 2, and a similar instrument has been developed to measure the basic building blocks of numeracy – the numeracy components. The administration of both the reading components and the numeracy components will be tablet-based, thus allowing for precise information on reaction times. This is essential for the central measures of fluency. For the reading components, this will be a significant improvement on the manual time capture that was attempted while administering the paper-based reading component instrument in Cycle 1. Thus, the second cycle of PIAAC promises to offer further interesting and internationally comparable data of high quality, with enhanced measurements of adult literacy, including the reading components that can be used for a wide range of analytical purposes and to provide policymakers with valuable indicators for monitoring and benchmarking purposes.

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Zusammenfassung: Das *Programme for the International Assessment of Adult Competencies* (PIAAC) wurde von der Organisation für Entwicklung und wirtschaftliche Zusammenarbeit (OECD) entwickelt, um die grundlegenden Kompetenzen der erwachsenen Bevölkerung in verschiedenen Ländern international vergleichend abzubilden. Am ersten Zyklus von PIAAC nahmen über 35 Länder teil, die deutlich in ihrer wirtschaftlichen Entwicklung variieren. In diesem Artikel vergleichen wir die durchschnittliche Lesekompetenz der teilnehmenden Länder und reflektieren sie vor dem Hintergrund der unterschiedlichen wirtschaftlichen Entwicklung der Länder. Im Fokus der Analysen stehen Personen mit äußerst geringen Lesekompetenzen (schwache Lesende). Wir kontrastieren den Umfang der schwachen Lesenden über die Länder und untersuchen welche Makro-Indikatoren als Erklärungen für die Länderdifferenzen herangezogen werden können. Zusätzlich analysieren wir welche individuellen Merkmale mit geringen Lesekompetenzen zusammenhängen. Wir schließen mit einem Ausblick auf den kommenden zweiten Zyklus von PIAAC und dessen Innovationen.

Schlagworte: PIAAC, Kompetenzen, Internationaler Vergleich, Lesekompetenz, grundlegende Komponenten der Lesekompetenz

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