

PIAAC Survey of Adult Skills: A review of the research landscape

Maehler, Débora B.; Hernández Torrano, Daniel; Courtney, Matthew G. R.; Fischer, Franzisca P.; Hollricher, Luca F.; Gorges, Julia

Preprint / Preprint

Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:

GESIS - Leibniz-Institut für Sozialwissenschaften

Empfohlene Zitierung / Suggested Citation:

Maehler, D. B., Hernández Torrano, D., Courtney, M. G. R., Fischer, F. P., Hollricher, L. F., & Gorges, J. (2025). PIAAC Survey of Adult Skills: A review of the research landscape. *International Review of Education*. <https://doi.org/10.1007/s11159-024-10123-4>

Nutzungsbedingungen:

Dieser Text wird unter einer CC BY-SA Lizenz (Namensnennung-Weitergabe unter gleichen Bedingungen) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier: <https://creativecommons.org/licenses/by-sa/4.0/deed.de>

Terms of use:

This document is made available under a CC BY-SA Licence (Attribution-ShareAlike). For more information see: <https://creativecommons.org/licenses/by-sa/4.0>

PIAAC Survey of Adult Skills: A review of the research landscape

Débora B. Maehler^{1*}, Daniel Hernández-Torrano^{2*}, Matthew G. R. Courtney², Franzisca P. Fischer³, Luca F. Hollricher³, & Julia Gorges³

¹ GESIS – Leibniz Institute for the Social Sciences; ² Nazarbayev University; ³ University of Marburg; * Equally contributing authors

Abstract

The OECD Programme for the International Assessment of Adult Competencies (PIAAC) has transformed international research and policy debates on the assessment of adult skills. Although research using PIAAC data is accumulating, little is known about how these data are used and what they contribute to developing the various disciplines interested in adult skills. In this study we use a data-driven approach to examine PIAAC-based international research to date. Drawing on a comprehensive analysis of 880 publications, the review finds that the field of PIAAC research is young and geographically diverse, with dominant contributions from the United States and Germany. While PIAAC research relies on a diverse pool of researchers with high collaboration rates, only a quarter of publications involve international collaboration. Our analyses also revealed that the field has developed grounded on four interrelated disciplines (education, sociology, psychology, economics) and three differentiated historical paths: theoretical and methodological approaches to the measurement of adult skills (e.g. response processes in computer-based assessments), cognitive skills and problem-solving in technology-rich environments at the workplace, and the role of adult literacy skills for societal and economic development. Moreover, the PIAAC literature addresses a broad range of topics, including cognitive, non-cognitive and basic skills (e.g. literacy and numeracy), human capital, occupational mismatch, migration, returns to skills, informal learning and large-scale assessment methodologies. Implications for the further development of PIAAC research for users of PIAAC data, data-providing institutions and policymakers are discussed.

Keywords

PIAAC · adult skills · research review · bibliometrics

Introduction

The OECD's main goal in initiating the Programme for the International Assessment of Adult Competencies (PIAAC) was to provide governments with information about the skills of their adult populations, thereby enabling them to “evaluate policies and design more effective interventions” (Schleicher 2008, p. 627). Introducing PIAAC as “a new strategy for assessing adult competencies,” Schleicher (2008) noted that it would “enhance understanding of the effectiveness of education and training systems in developing basic cognitive skills and key generic work skills” (p. 627). Covering a population with a large age range and diverse occupations and biographies, PIAAC assesses skills that adults need for occupational success and societal participation in the 21st century. Although research using PIAAC data is accumulating (Maehler and Konradt 2022), little is known about how these data are used by – and contribute to the development of – the various disciplines interested in adult skills.

The present review of research seeks to fill this gap by mapping out the terrain of international research and scholarship related to PIAAC. We applied bibliographic analyses to examine research using PIAAC data and research addressing PIAAC-related theoretical and methodological considerations. Our aim was to examine the available literature on PIAAC in terms of its growth trajectory, productivity and the social, intellectual and conceptual structure of PIAAC-based research for the period from 2008 through 2021.

Background: the PIAAC study

PIAAC builds on two earlier international survey programmes – the International Adult Literacy Survey (IALS) and the Adult Literacy and Lifeskills Survey (ALL) – which in turn were built on national adult literacy assessments undertaken in the United States and Canada in the 1980s and early 1990s (see Kirsch et al 2002; Murray et al. 1998). The conceptual and methodological insights gained from IALS and ALL have been used in PIAAC to expand and improve the assessment of cognitive competencies of adult populations. The first international

large-scale assessment of adult skills, IALS, was initiated by Statistics Canada (Murray et al. 1998). Covering 22 countries, it was administered between 1994 and 1998. The successor study, ALL, covered 11 countries, and was conducted between 2003 and 2008 by Statistics Canada and the OECD (OECD and Statistics Canada 2011). An overview of IALS, ALL and PIAAC, and of the conceptual changes implemented from study to study, can be found in work by Kirsch et al. (2020). Compared with its predecessor studies, PIAAC (a) extended the definitions of literacy and numeracy; (b) extended the assessment of literacy to include a measure of reading component skills, thereby providing more information about adults with limited literacy skills; and (c) introduced the domain of problem solving in technology-rich environments (PS-TRE; Kirsch et al. 2020). To document trends in adult skills, PIAAC is designed as a cross-sectional survey repeated at 10-year intervals. Thirty-eight countries participated in Cycle 1 of PIAAC (see Table S1 in the Supplementary Online Appendix), which comprised three rounds of data collection (2011–2012, 2014–2015, 2017–2018). Thirty-two countries are participating in Cycle 2 (2022–2023; for more information, see OECD 2021).

The PIAAC target population comprises adults aged 16 to 65 years resident in private households in the respective participating countries. To ensure comparability of results across participating countries, an international PIAAC Consortium developed a set of best practice standards and guidelines to which all countries are required to adhere when implementing the surveys (OECD 2013). Furthermore, the Consortium defines all features of the PIAAC study design and is responsible for the development of the survey instruments (Rammstedt and Maehler 2014). The Survey of Adult Skills is conducted in the official language or languages of the respective participating countries¹ and consists of two parts: a background

¹ Some countries also translate the questionnaires into the languages of selected migrant groups (Maehler et al. 2017).

questionnaire and a cognitive assessment. In the first part, interviewers administer the background questionnaire to respondents (computer-assisted personal interview [CAPI]; duration: approx. 40 min) and collect a wide range of additional information about respondents in areas such as education, training, employment, current/recent work history, reading/writing/numeracy/computer activities at work and in everyday life, and migration and family background, as well as other personal information, for example volunteering, social trust, political efficacy and health (OECD 2009). In the second part – the cognitive assessment – respondents work on the tasks independently and without external help. The default assessment format is computer-based (CBA); respondents complete the items on the interviewer’s laptop (without time limitation), and the interviewers supervise the process. A paper-based assessment (PBA) option is offered only to respondents with no or insufficient computer experience. In Cycle 1, respondents had to work on a set of items from three skill domains: (a) literacy – the ability to understand, use and interpret written texts (PIAAC Literacy Expert Group 2009); (b) numeracy – the ability to retrieve, interpret and use mathematical information (PIAAC Numeracy Expert Group 2009); and (c) problem solving in technology-rich environments – the ability to use technology to access and process information (PIAAC Expert Group on Problem Solving in Technology-Rich Environments 2009).

Given its scope, PIAAC data are relevant to researchers from multiple disciplines. For example, education scientists might examine how formal education and further education relate to skills; sociologists might investigate the effects of social class; economists might be interested in the effect of participants’ skills on their incomes; and psychologists might explore relations between personality characteristics and skills. Kirsch and Lennon (2017) noted that reports on PIAAC covered a wide range of topics and that research using the PIAAC datasets was conducted by scholars from a variety of disciplines. However, existing reviews have focused predominantly on one specific discipline or research topic, such as

information and communications technology (ICT) literacy (Siddiq et al. 2016), adult learning (Desjardins 2020) or skill mismatch (Asai et al. 2020). In the present review, to overcome this limitation, we placed PIAAC centre stage and examined how PIAAC-based research contributes to various disciplines.

The present study

This study provides a review of PIAAC-based research using a bibliometric approach. Bibliometrics are quantitative methods that examine codified bibliographic metadata about a publication (e.g. author name, publication year, keywords) to provide insights into the evolution and structure of a field (Andrés 2009). Bibliometric approaches have become widely accepted and recognised for their rigour in exploring and analysing the literature, thereby offering insights into the dynamics and development of research fields across multiple disciplines (see Lyu et al. 2023).

Following Öztürk et al. (2024), this study employs a methodological framework based on five dimensions to uncover the state and development of PIAAC-based research: (a) growth trajectory, (b) productivity, (c) social structure, (d) intellectual structure and (e) conceptual structure. The growth trajectory of a research field is often measured by the number of annual publications within a given timeframe, which helps describe the expansion or contraction of the field over time. Productivity is a measure of the quantity and impact of research output and can be used as an indicator of the relevance of institutions and countries in the field of PIAAC research. High productivity often signals active participation and leadership in advancing a research field. Social structure encompasses the patterns of collaboration between scholars, institutions, and countries contributing to a research field. Collaboration is a key component of the scientific process, as it fosters the exchange of ideas, enhances research quality and accelerates knowledge production (Barrett et al. 2011; Bozeman and Corley 2004). The intellectual structure of a field refers to the citation networks

and relationships between publication venues (e.g. journals) and papers. Understanding the intellectual structure of PIAAC research can help scholars navigate key concepts, debates and theoretical frameworks while also offering a foundation for organising and contextualising the body of knowledge across historical and interdisciplinary dimensions. Finally, conceptual structure refers to the key themes, topics and ideas that underpin the research within a research field. By analysing publication keywords and thematic clusters, the conceptual structure reveals the dominant and emerging focus areas, allowing the mapping of the knowledge landscape of PIAAC-based research.

Grounded in this framework, our aim was twofold. First, we aimed to provide an overview of PIAAC-based publications, covering both empirical and non-empirical research. More specifically, we asked how many and what types of PIAAC-based publications had been published each year in the period from 2008, when the programme was initiated, through 2013, when the first PIAAC public data release took place, to 2021 (RQ1). Next, we focused on empirical journal articles to investigate the types of PIAAC datasets underlying these published studies (RQ2.1) and the countries that were most frequently covered and have thus benefited scientifically from PIAAC (RQ2.2). Table S1 in the Supplementary Online Appendix provides an overview of available PIAAC datasets by country. Types of data include, for example, highly anonymised public use files (PUFs) with reduced information, and more detailed scientific use files (SUFs), which are accessible upon application for research purposes only (for more details, see Maehler and Konradt 2020).

Our second aim was to analyse the scientific output of PIAAC by focusing on PIAAC-based articles in academic journals. To this end, we first investigated the productivity of institutions and countries in generating PIAAC-based research (RQ3). Next, we identified the social structure of PIAAC research by analysing collaborative links among researchers, institutions, and countries (RQ4). In a third step, we identified two fundamental aspects that

define the intellectual structure of PIAAC research (RQ5): the disciplines underlying the foundations of PIAAC research and the historical developmental paths of that research. Finally, to gain a better understanding of the conceptual structure of the field and identify key issues and concerns being addressed in PIAAC research, we mapped the research topics that had commanded the most attention in PIAAC-based research (RQ6). Collectively, the insights revealed in this study have the potential to guide future studies and advance research on adult skills and related concepts.

Method

Using “PIAAC” as a search term in scientific databases produces thousands of hits, only some of which actually address – or at least relate to – PIAAC concepts or data in a meaningful way. Thus, when preparing a review of the PIAAC literature, the first task is to identify as many relevant publications as possible. To this end, the present review builds on the PIAAC Bibliography (Maehler and Konradt 2022), an interdisciplinary compilation of publications addressing the theoretical and technical framework of PIAAC, empirical analyses of PIAAC data and academic debates on adult skills that refer to PIAAC. With 892 entries and annual updates, the PIAAC Bibliography (provided in csv-format by the Research Data Center [RDC] PIAAC at GESIS) is thus the ideal starting point for a literature review.

Search criteria

As documented in the PIAAC Bibliography, searches were conducted using the search strings “PIAAC” or “Adult skills”: (a) in the literature databases of the Education Resources Information Center (ERIC), Web of Science and PsychINFO; (b) on the OECD website; (c) in Google (Scholar); and (d) in ResearchGate. The search strings were searched in the title, abstract and keywords of the articles. In addition, publications by users of PIAAC data were reported to the RDC PIAAC by the authors of the publications. The search for publications was conducted annually from March 2017 to December 2021.

Selection procedure

All publications ($N = 892$) identified in the searches were screened by RDC PIAAC staff to verify that they were related to and/or thematically focused on PIAAC (Maehler and Konradt 2022). This screening procedure excluded (a) duplicates, (b) publications that were not in German or English and (c) publications that were not based on PIAAC (data).

Furthermore, the present authors conducted a second screening, which identified further duplicates ($n = 4$) as well as publications not based on PIAAC ($n = 8$). Hence, the database underlying RQ1–RQ2 comprised a total of $N = 880$ publications (see Figure 1) as well as a reference list of all publications included in the review (available in open access at the Research Data Center PIAAC).

For the bibliometric analyses (RQ3–RQ6), only journal articles were retained ($n = 438$). The articles were published in German (approx. 5%) or English in the period from 2008 through 2021. As Digital Object Identifiers (DOIs) are considered to be best practice in scientific publishing, and they ensure that publications are permanently traceable, only journal articles with a DOI were included in our bibliographic analyses. This led to the exclusion of 28 of the aforementioned 438 journal articles. Thus, the database for RQ3–RQ6 comprised $N = 410$ journal articles (see Figure 1).

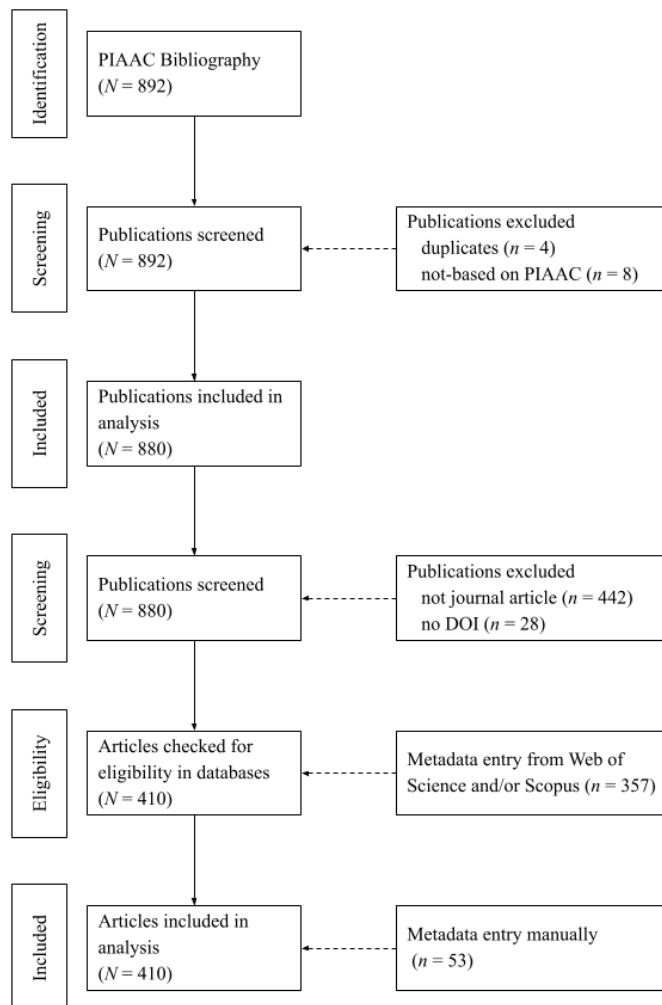


Figure 1 PRISMA flowchart of the process of selection of journal articles for bibliometric analysis.

Coding framework

For the first step (RQ1 and RQ2), information from the PIAAC Bibliography database (Maehler and Konradt 2022) was used. The bibliography provided to us by GESIS included publication year, publication language (English or German), publication type (journal article, chapter in edited book, book, working paper/technical report, doctoral dissertation/master's thesis), countries covered, and the type of data used in the publication.

For the second step (RQ3–RQ6), because bibliographic analyses draw substantially on the metadata of publications (e.g. author affiliations, references, information on the respective journals), the bibliographic data of the journals were complemented with metadata extracted from the Web of Science (WoS) and Scopus. Based on a DOI search for the journal articles ($N = 410$), we identified 357 entries and extracted the following metadata: publication title; abstract; keywords; publication year; journal name; number of citations; references; and authors' names, institutions, and countries of affiliation. The metadata (except references) for the remaining 53 articles were imputed manually (see Figure 1).

Analytic procedure

The analyses were conducted in R (R Core Team 2021). Frequency counts were used to identify the growth trajectory of PIAAC-based research (RQ1) as well as the types of datasets and the countries covered by PIAAC-based publications (RQ2). For RQ3–RQ6, the metadata of the PIAAC-based journal articles were analysed and visually represented using bibliometrix (Version 4.0.0; Aria and Cuccurullo 2017), an R-package for comprehensive bibliometric analyses, and biblioshiny, a shiny app that provides a Web interface for bibliometrix. We assessed the most productive entities based on the number of entries (i.e. distinct journal articles) in the database by the corresponding author's institutional affiliation and the corresponding author's country (RQ3). Country-level analyses in bibliometrix identified the total number of articles associated with the respective country (i.e. regardless of an author's position in the list of authors) and explored the extent to which PIAAC research in the period under study was an international endeavour based on the number of articles jointly published by multiple researchers from the same country (single-country publications, SCPs) versus publications from different countries (multiple-country publications, MCPs).

The social structure of PIAAC-based research was analysed using co-authorships among authors, institutions and countries (RQ4; Newman 2001, 2004), reflecting the degree

of research collaboration. In co-authorship maps, the nodes represent actors (e.g. authors), and the edges represent co-authorships (e.g. publications co-authored by researchers). The node size indicates the number of publications in the dataset for each element, and the colours denote clusters of elements that represent frequently co-authored – in this case—PIAAC-based journal articles. Note that to ensure that we captured a full range of collaborative patterns among key contributors to PIAAC research while facilitating the interpretation of the network, the analyses were limited to the 100 most productive authors/institutions. Leading authors who had not published co-authored journal articles were excluded from the analysis.

The intellectual structure of the field was uncovered using three analyses (RQ5). First, core journals were identified as those in Zone 1 according to Bradford's law of scattering (Bradford 1934). Bradford's law of scattering describes the distribution of articles among scientific journals. It states that the number of journals containing a certain number of articles will follow a logarithmic curve, with a small number of journals containing a large number of articles and a large number of journals containing a small number of articles. Zone 1 refers to the group of journals that are the most productive in a given subject area and that tend to publish the majority of articles on that subject. In addition, we identified the most influential – that is, most highly cited – research articles. Second, we conducted a co-citation analysis (Ding et al. 2000) of the most cited journals in the database to explore the disciplines underlying the structure of PIAAC research. Basically, two sources (e.g. journals) are co-cited if a third source in the database cites a common publication in those two sources. As frequently co-cited sources are assumed to share theoretical and semantic grounds, clusters (i.e. colours) can be interpreted as disciplines from which PIAAC research emerges. Third, to trace the development of PIAAC research over time, we performed historiographic direct citation analysis (Garfield 2004) and created a historiograph displaying the chronological ordering of the most important (i.e. most cited) documents, along with their direct citation relations. In this historiograph, the nodes represent highly cited papers, and the arrows

indicate the chronological change in research trends. Each path reflects the historical evolution of a research theme, based on the chronological relations of the most relevant journal articles. This allowed for the identification of historical developmental paths and the understanding of the genealogical antecedents and descendants of PIAAC research. To maintain a clear visualisation, we decided to display a network of the 25 most cited documents, representing about 5.5% of all journal articles in the database (Garfield et al. 2003).

The conceptual structure of PIAAC research was explored using co-occurrence analysis (van Rijsbergen 1977) of the most frequent author keywords in the database (RQ6). In this analysis, the nodes represent frequently occurring keywords, and their size reflects their occurrence. The edges connect keywords that frequently co-occur in the journal articles. The clusters represent groups of keywords with high co-occurrence relationships. They can be interpreted as research topics or themes addressed in the PIAAC literature. Before the analysis, synonymous keywords (e.g. adults, adulthood) were merged, and the term “PIAAC” and other keywords referring to the programme’s name were excluded, as they dominated the visualisation without enhancing the understanding of research topics.

Results

RQ1 Growth trajectory of PIAAC-related publications

The frequency analysis in Figure 2 illustrates the total number of PIAAC-related publications per year in the period from 2008 (the beginning of the conceptual phase of PIAAC) to 2021. After the first release of PIAAC data from Round 1 of Cycle 1 in 2013, the total number of publications per year began to grow steadily. From $n = 23$ in 2013, it rose to a peak of $n = 210$ in 2018 following the release of the PIAAC Cycle 1, Round 3 data in 2017. In this phase we observed a substantial increase in the annual volume of journal articles, which became the most frequently published publication type between 2018 and 2021. The proportion of

working papers (e.g. pre-publication versions of journal articles) and reports (including, for example, technical reports, the country or OECD reports) also remained high. The total of $N = 880$ publications included 49.8% journal articles, 31.4% working papers or reports, 10.4% chapters in edited books, 4.6% doctoral dissertations or master's theses and 3.7% books.

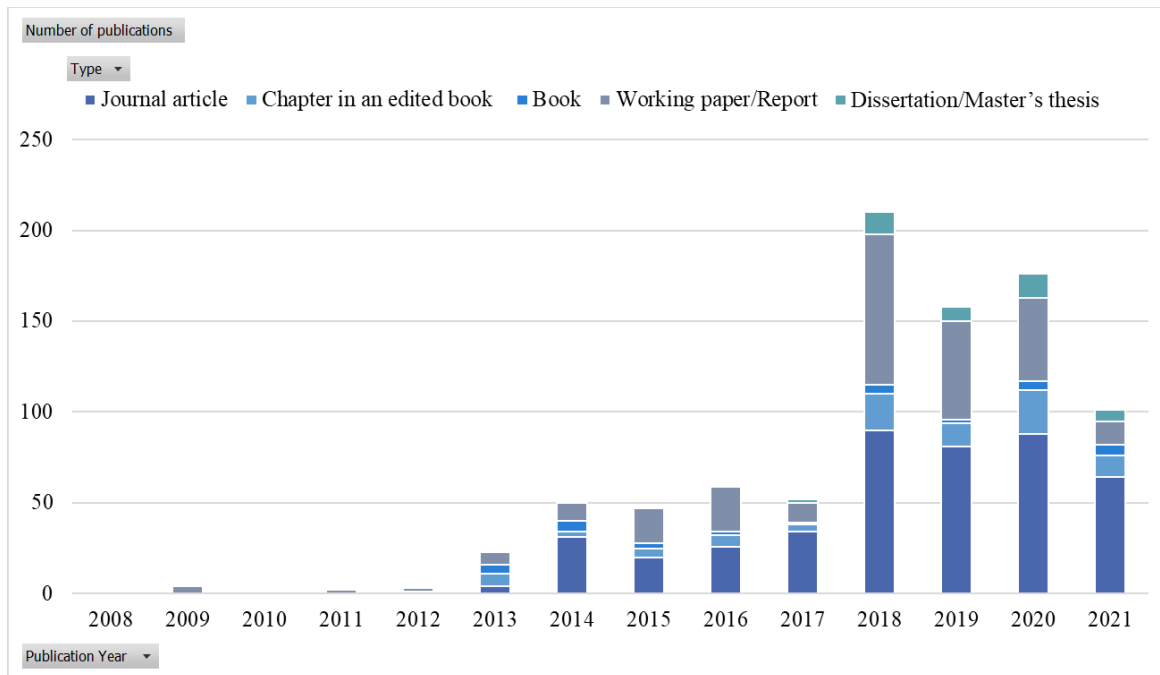


Figure 2 Number of PIAAC-based publications from 2008–2021 by year and type.

RQ2 Types of PIAAC datasets and countries covered by PIAAC-based publications

Table 1 provides a breakdown of the different types of PIAAC datasets used in PIAAC-based publications in the period from 2008 to 2021. PUFs were the most frequently used data source (57.1%) for all types of publications, followed by SUFs (27.2%). As expected, methodological metadata (e.g. nonresponse or interviewer information), unpublished data and process data (e.g. log files) were less frequently used in publications. Methodological and unpublished data were typically used by researchers and members of the statistical or methodological institutions that carried out the surveys in the respective countries (e.g. GESIS

in Germany, or the American Institutes for Research [AIR]/ National Center for Education Statistics [NCES] in the United States).

The 24 countries that participated in Round 1 (2011–2012) of PIAAC Cycle 1, the data for which were released in 2013, were most frequently focussed upon, followed by the nine countries that participated in Round 2 (2014–2015) and the six countries that participated in Round 3 (2017–2018). Furthermore, Table S2 in the Supplementary Online Appendix shows that Germany, the United States, the Nordic countries, such as Finland and Denmark, and the United Kingdom were covered most frequently.

Table 1 Total number of PIAAC-based publications by publication type and PIAAC dataset type

Publication type	Public use file <i>n</i> (%)	Scientific use file <i>n</i> (%)	Process data <i>n</i> (%)	Unpu- blished data <i>n</i> (%)	Methodol ogical data <i>n</i> (%)	Total
Journal article	228 (63.3)	87 (24.2)	13 (3.6)	16 (4.4)	16 (4.4)	360
Working paper/report	136 (59.4)	57 (24.9)	4 (1.7)	16 (7.0)	16 (7.0)	229
Book/chapter in edited volume	28 (28.9)	38 (39.2)	4 (4.1)	9 (9.3)	18 (18.9)	97
Doctoral dissertation/ master's thesis	22 (5.6)	15 (38.5)	1 (2.6)	1 (2.6)	0 (0)	39
Total <i>n</i>	414 (57.1)	197 (27.2)	22 (0.3)	42 (5.6)	50 (6.6)	725

Note. Publications for which the exact data source could not be identified ($n = 6$), or publications that involved non-empirical research ($n = 155$) were not included.

RQ3 Most important impact on the dissemination of PIAAC-based research

The PIAAC Bibliography (Maehler and Konradt 2022) includes 410 journal articles published by 689 unique authors affiliated with 431 institutions in 37 countries around the world. Table S3 in the Supplementary Online Appendix lists the most productive institutions in PIAAC-

based research, ranked by the number of journal articles in the field. GESIS, with 64 journal articles, stands out as the leading institution in PIAAC-based research internationally. Other productive researchers are affiliated with the University of Barcelona (28 articles), the University of Hamburg (27 articles), Maastricht University (27 articles) and the University of Maryland (21 articles).

Table 2 presents the leading countries in PIAAC research, ranked by the number of journal articles in the field. Germany and the United States emerged clearly as the leading countries, both in terms of the authorship of journal articles in the field and the affiliation country of the corresponding author. Other countries with a substantial number of journal articles in the field were Spain and the United Kingdom, with more than 50 publications each. Despite having relatively low numbers of journal articles overall, Estonia and Sweden emerged as the countries with the highest international co-authorship rates according to their MCP ratio (i.e. the rate of publications with at least two co-authors from different countries; 0.60 and 0.57, respectively), whereas Belgium (0.0) and Poland (0.11) had considerably lower levels of international collaboration.

Table 2 Leading countries in PIAAC-based research

Country	Journal articles	CO	SCP	MCP	MCP ratio
Germany	294	101	76	25	0.25
United States	237	72	56	16	0.22
Spain	84	26	19	7	0.27
United Kingdom	65	22	18	4	0.18
Norway	49	18	15	3	0.17
Canada	46	18	10	8	0.44
Netherlands	43	15	10	5	0.33
Italy	31	13	7	6	0.46

France	30	9	7	2	0.22
Poland	28	9	8	1	0.11
Belgium	27	5	5	0	0.00
South Korea	27	10	6	4	0.40
Finland	24	9	5	4	0.44
Australia	21	8	5	3	0.38
Czech Republic	20	9	8	1	0.11
Austria	19	4	3	1	0.25
Israel	16	6	4	2	0.33
Sweden	16	7	3	4	0.57
Estonia	11	5	2	3	0.60

Notes. Only countries with 10+ journal articles in the database are displayed. CO = affiliation country of the corresponding author; SCP = single-country publication; MCP = multiple-country publication; MCP ratio = the rate of publications with at least two co-authors from different countries.

RQ4 Networking among researchers and institutions in PIAAC-based research

In line with standard practice in the social sciences, PIAAC research is a collaborative enterprise, as demonstrated by the large proportion of co-authored journal articles (80%). However, this collaboration was mainly at the national level, with less than a quarter of the co-authored articles representing international co-authorships (23%).

Figure 3 presents the collaboration networks among the 100 most productive researchers in the dataset, excluding isolated nodes. The findings suggest the existence of six clusters representing research groups of different sizes both at the core and on the periphery. The cluster led by Beatrice Rammstedt (GESIS, Germany; pink cluster) maintains links with the most clusters in the network. The pink cluster, for instance, is connected to the green cluster led by Anke Grotlüschen (Hamburg University, Germany) and to the grey cluster led by Frank Goldhammer (Leibniz Institute for Research and Information in Education,

Germany [DIPF]). Two of the clusters situated on the periphery, which have little or no connections with other clusters, are of considerable size and include some leading authors in PIAAC-based research. One of them is the orange cluster headed by Takashi Yamashita (University of Maryland, United States); the other is the purple cluster that includes Kari Nissinen (University of Jyväskylä, Finland). Furthermore, the blue clusters include researchers working closely with the OECD (France; e.g. Francesca Borgonovi) and the Educational Testing Service (ETS, United States; e.g. Matthias von Davier). The light green cluster depicts the research group led by Rolf van der Velden (Maastricht University/Research Centre for Education and the Labour Market [ROA], the Netherlands); the red cluster is led by Jorge Calero (University of Barcelona, Spain).

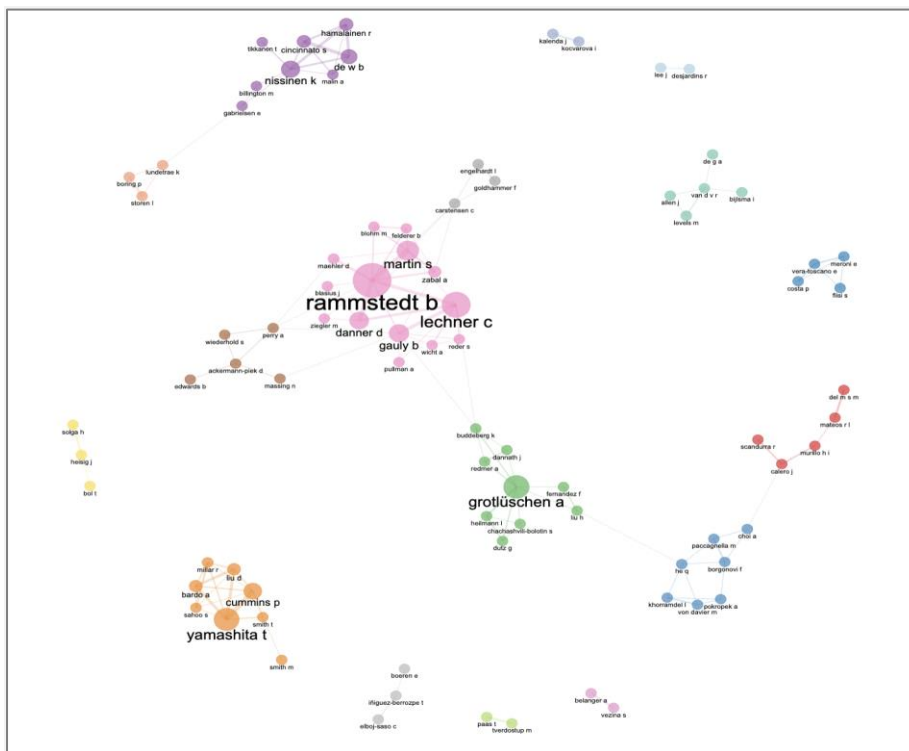


Figure 3 Collaboration networks among authors for PIAAC-based journal articles.

Note. Co-authorship analysis with top 100 authors. Isolated nodes excluded.

Figure 4 displays the networks of scientific collaboration between the 100 most productive institutions in PIAAC research, excluding isolated nodes. The most extensive

the largest number of articles and citations in the database. Other top journals were the *International Journal of Lifelong Education* and *Adult Education Quarterly*, with 14+ publications each. More generally, the results show that most of the core journals belong to the field of education. Only two of the journals in the ranking are not indexed in the “Education and Educational Sciences” category of Clarivate’s Journal Citation Report (JCR) – namely, *Labor Economics* (“Economics”) and *PLOS One* (“Multidisciplinary”). Notably, more than half of the core journals in the field are in the third quartile of the JCR 2021 for their research category or are indexed in Clarivate’s Emerging Sources Citation Index (ESCI). Examining the yearly increase in PIAAC-based articles by journal (see Figure S2 in the Supplementary Online Appendix), we found that, although launched only in 2013, *Large-scale Assessments in Education*, a multidisciplinary journal, had become the core journal in the field of PIAAC-based research in a relatively short time. The *International Journal of Lifelong Education* (IJLE), *Adult Education Quarterly* (AEQ) and the *International Review of Education* (IRE) also showed continuous growth in the publication of PIAAC-based articles. By contrast, *DIE Zeitschrift für Erwachsenenbildung*, the then-journal of the German Institute for Adult Education (DIE), published one special issue on PIAAC in 2014. In 2018, the journal was relaunched under a different name, but the successor journal, *weiter bilden. DIE Zeitschrift für Erwachsenenbildung*, does not appear in the list of most important journals.

Table 3 Core journals publishing PIAAC-based research

Journal title	Articles	TC	Quartile	PY_start
Large-scale Assessments in Education	19	149	Q1	2016
International Journal of Lifelong Education	17	72	Q3	2015
Adult Education Quarterly	14	90	Q3	2016
International Review of Education	13	129	Q3	2008

Compare: A Journal of Comparative and International Education	11	71	Q3	2017
DIE Zeitschrift für Erwachsenenbildung	11	-	ESCI	-
European Journal of Education	8	40	Q2	2016
PLOS ONE	7	83	Q1	2015
Quality Assurance in Education	7	10	Q2	2018
Scandinavian Journal of Educational Research	7	12	Q3	2018
methods, data, analyses	6	2	ESCI	2018
Labour Economics	5	21	Q3	2018
Social Indicators Research	5	109	Q2	2017
ZDM—Mathematics Education	5	19	Q2	2018

Note. TC = total citations; Quartile = quartile in Clarivate's Journal Citation Report 2021; ESCI = Clarivate's Emerging Sources Citation Index; PY_start = publication year of the earliest journal article for a given author in the dataset.

Figure 5 displays the results of the co-citation analysis for journals in the field of PIAAC-based research. The results indicate that PIAAC-based research arises fundamentally from the knowledge generated within four interrelated disciplines. The blue cluster includes educational sources (e.g. OECD publications, *Review of Educational Research*, and *International Review of Education*). The purple cluster comprises mainly journals in psychology (e.g. *Psychological Bulletin*, *Journal of Educational Psychology*). The red cluster includes economics journals, such as the *American Economic Review* and *Labor Economics*. Finally, the green cluster comprises sociological journals (e.g. *American Journal of Sociology*, *European Sociological Review*).

The historiographic analysis of the 25 most cited journal articles in the dataset depicted in Figure 6 reveals three distinctive historical paths in the development of PIAAC research. The earliest developments originated in the inception phase (2008–2013) of the field and correspond to research about the theory, methodology and assessment approach of the PIAAC programme. In this phase, PIAAC was introduced to researchers from various fields via citation of Schleicher’s (2008) paper – “PIAAC: A New Strategy for Assessing Adult Competencies” – which outlined the conceptual and methodological framework of the programme and gave rise to the first historical path in the development of PIAAC research (depicted in red in Figure 6). Two branches of academic research emerged from this paper: first, a critical discourse on the PIAAC framework and its underlying theoretical foundation, the human capital approach, was engendered via the article by Tsatsaroni and Evans (2014); second, psychology researchers investigating response processes in computer-based assessments drew on Schleicher (2008) to generally refer to PIAAC as a data source (Goldhammer et al. 2014; Ulitzsch et al. 2021).

The second historical path in the development of PIAAC research (depicted in green in Figure 6) was forged by Hämäläinen and colleagues. In their own work on problem-solving skills, Hämäläinen et al. (2019) adopted the PIAAC approach to cognitive skills assessment and addressed the role of skills in people’s lives. However, Hämäläinen et al. (2019) also drew on sources other than Schleicher (2008) to start their line of argument. For example, they used the paper by Desjardins and Ederer (2015) as a thematic reference to explain the relationship between educational attainment and proficiency in problem solving in technology-rich environments (PS-TRE) as assessed in PIAAC. Following the Finnish study by Hämäläinen et al. (2015), the discourse on vocational education training (VET) and adults’ problem-solving skills evolved further into research on inequality in PS-TRE skills between adults with a VET background and those with general education qualifications (Hämäläinen et

al. 2017), as well as differences in PS-TRE skills between different countries and systems (Hämäläinen et al. 2019).

The third historical path in the development of PIAAC research (depicted in blue in Figure 6) emerged from 2013 onwards. This network comprised three distinct disciplinary approaches to using PIAAC data – namely, for sociological research (Solga, Levels), psychological research (Rammstedt), and economic research (Hanushek). The highly cited paper by Hanushek et al. (2015) was used in subsequent research in different functional ways. For example, Reder et al. (2020) cited Hanushek et al. (2015) to emphasise the “importance of adult literacy and numeracy for a broad range of economic and social outcomes” (p. 268), whereas Gauly and Lechner (2019) indicated that they had extended the findings of Hanushek et al. (2015) regarding returns to literacy skills.

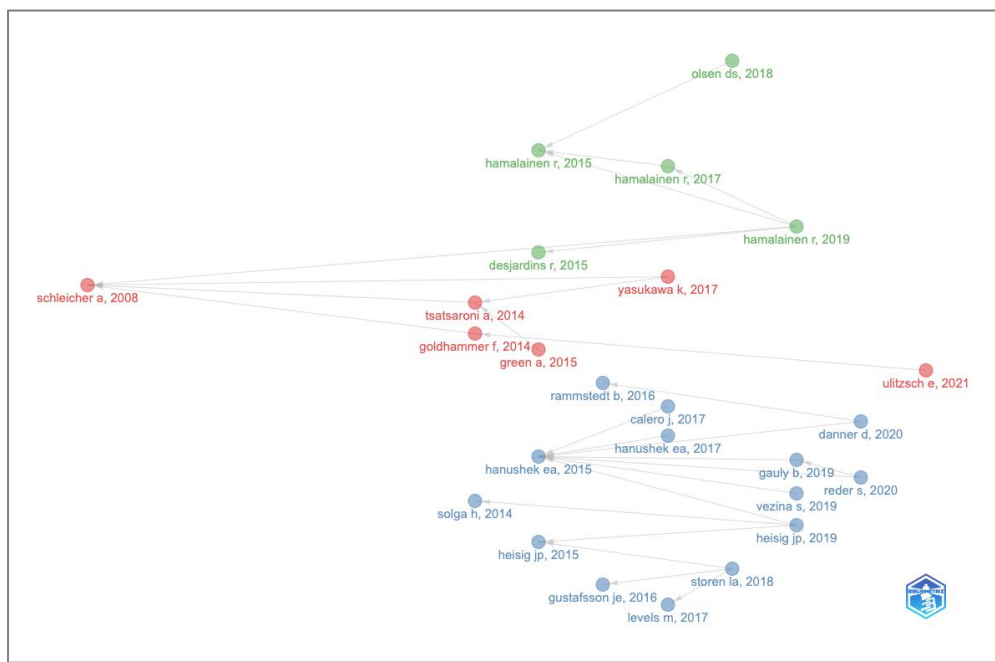


Figure 6 Historical development paths of PIAAC research 2008–2021 as revealed by a historiographic analysis of the 25 most cited journal articles in the database.

RQ6 Topics of research based on PIAAC

The results of the co-occurrence analysis of the 100 most frequently occurring author keywords document a high diversity of topics starting from six key topics depicted at the centre (see Figure 7). Two focal areas clearly dominate the PIAAC literature: first, research on cognitive skills, education, human capital and the labour market in terms of employment, participation, inequality and migration (represented by the yellow cluster); second, research on basic skills (literacy and numeracy) and their relationship with adult education and lifelong learning (the red cluster). Other predominant themes are occupational mismatch (dark-green cluster); non-cognitive skills, such as personality and health (orange); and methodology and data analysis and curation (purple, light green, and dark blue). Topics on the periphery are less salient and more scattered but also recognisable on the map. They include problem-solving skills, automation and technology-rich environments (olive green); informal learning (dark pink); returns to skills (grey); ageing and health literacy (light pink); and trust (brown).

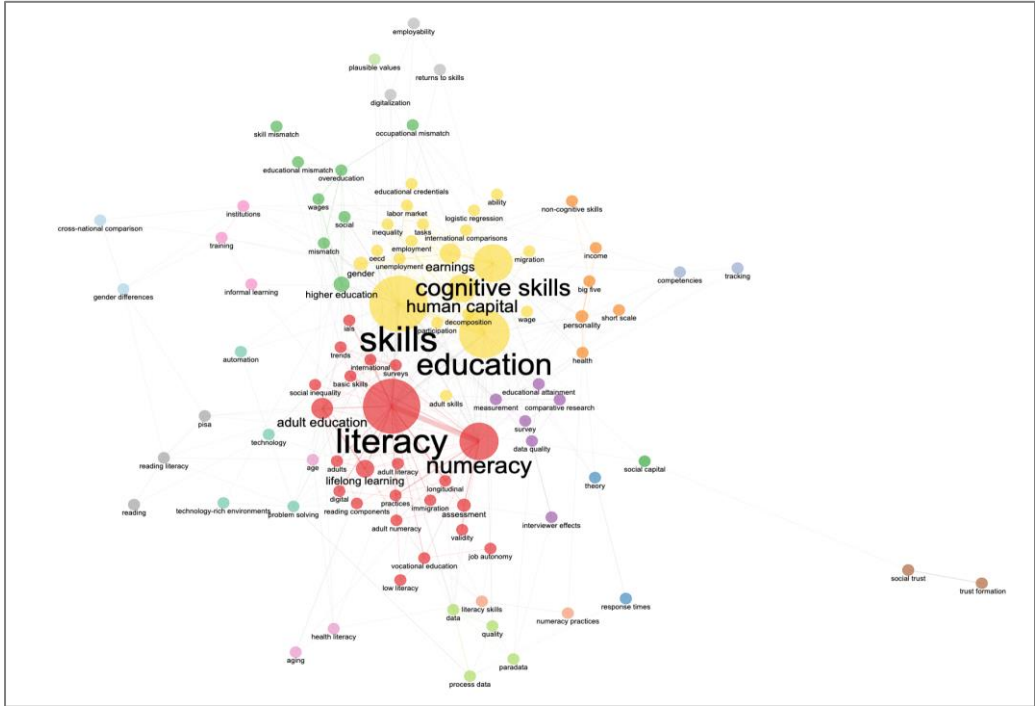


Figure 7 Author keywords network as revealed by a co-occurrence analysis of the 100 most frequently occurring author keywords in the database.

Discussion

The growth trajectory of PIAAC-related publications suggests that PIAAC research has developed steadily since Schleicher's (2008) paper on the conceptualisation of the programme. Following the inception phase (2008–2013), which comprised only a few publications mainly introducing the rationale, design and methodology of PIAAC, the development phase (2014–2018) saw a substantial increase in the annual volume of publications in general and of journal articles in particular. This growth was likely fuelled by (a) the release of data from Round 1 in 2013 (OECD 2013); (b) the launch of specialised journals (e.g. *Large-scale Assessments in Education* in 2013); and (c) the conferences on PIAAC that were held worldwide (see Table S5 in the Supplementary Online Appendix). In the third phase, the maturation phase (2019–2021), publication growth peaked in 2020 and then stabilised. The slight drop in publishing rates in 2021 may be due to the COVID-19 pandemic and related measures, which displaced research in and diverted grants from research areas not closely related to COVID-19 (Riccaboni and Verginer 2022). An alternative explanation could be that researchers turned their attention to other, more recent data, given that the first PIAAC data were collected in 2012/2013. A notable growth in the volume of publications is to be expected from 2024 onwards, when the PIAAC Cycle 2 findings and datasets become publicly available.

Regarding publication types, about the half of all PIAAC-based publications included were journal articles, followed by a large number of scientific reports. Remarkably, despite the large number of scientific publications, most researchers used open access data (PUFs) to underpin their research. As PIAAC PUFs are easily accessible and can be analysed using open source tools, researchers do not require a high level of statistical expertise to use these data. However, as PUFs are prepared mainly for public use purposes, they are highly anonymised, whereas PIAAC SUFs and Restricted Use Files provide access to more detailed variables (e.g. age, income). Hence, the finding that most researchers used PUF data may point to a large number of more detailed analyses that have not yet been conducted by PIAAC researchers but

could further increase our understanding of adult skills and their associated characteristics as well as options for promoting skill development. Furthermore, some SUFs have a thematic topic (i.e. non-cognitive skills), focus on a specific group (e.g. incarcerated people; older age adults) or have a longitudinal design, thereby allowing the investigation of specific questions, which have not yet been possible to address with the existing OECD PUFs. Despite the administrative procedure needed to obtain access to SUF data, almost one-third of the publications included in this review used SUFs. As Table S1 in the Supplementary Online Appendix shows in detail, various PIAAC Cycle 1 SUFs are available for eight participating countries. More refined analyses using PIAAC data may be possible in the future by increasing the use of SUFs and the number of countries for which they are available.

Results regarding the countries covered most frequently in the PIAAC-based publications, and that have therefore presumably benefited most from PIAAC, document the advantage of the timely availability of data. In the ranking of countries by frequency of coverage by PIAAC-based publications (Table S2 in the Supplementary Online Appendix), a sharp drop between Rank 21 (219 publications on Estonia) and Rank 22 (105 publications on Greece) marks the lack of participation in PIAAC until Round 2 or 3 of Cycle 1. Notably, Round 1 countries of Australia and Cyprus are an exception in this regard because their data are not available as PUFs on the OECD website (although they are included in the analysis tools).

Most available PIAAC-based research and knowledge on adult skills is embedded in or stems from a German, U.S., or Northern European context. This finding might be due first to the language of the publications included in the present study (German and English) and second to the fact that Germany is the only country with a PIAAC RDC. The PIAAC RDC provides a large number of datasets, including a longitudinal extension of PIAAC (see Table S1 in the Supplementary Online Appendix), and offers advice and regular activities such as

conferences and training in data use. In the United States, AIR offers researchers training as well as SUF files, including additional datasets (e.g. the U.S. PIAAC Survey of Incarcerated Adults in 2014; Rampey et al. 2016). Furthermore, the American Institutes for Research (AIR) has also organised a series of events and commissioned papers. The Northern European countries (Denmark, Estonia, Finland, Norway, Sweden), for which data can be obtained from the Nordic PIAAC Network, were probably of particular interest to researchers because their adult populations have high skill levels (similar to the performance levels of their student populations in PISA), which make them role models for other countries (see Green 2021). Furthermore, they provide data linkages, for example connecting PIAAC data to national register data – similar to Canada, which additionally offers a particularly large sample and a longitudinal extension (see Table S1 in the Supplementary Online Appendix). The United States and the United Kingdom provide data to analyse non-cognitive skills (see the English Pilot Study on Non-Cognitive Skills; OECD 2018), which have been frequently used in recent years. Furthermore, some countries are often used as prototypes for specific political and/or educational systems (e.g. welfare states; Heisig et al 2019; Massing and Gaulty 2017).

The higher productivity of PIAAC researchers in some countries can be explained by the more substantial support they receive and the specific contribution made by national research institutes to the generation of PIAAC-based knowledge. For instance, the scientific structure in Germany is based on two pillars: universities and research institutes (e.g. Max Planck, Fraunhofer, Helmholtz, Leibniz; Dusdal et al., 2020). In the case of PIAAC-based research in Germany, the main actors have been three Leibniz institutes: GESIS, the WZB Berlin Social Science Center and the Leibniz Institute for Research and Information in Education (DIPF). In the United States, the AIR has produced the bulk of PIAAC-based research and funded the bulk of scientific work on PIAAC (e.g. AIR-commissioned papers). The aforementioned institutions provide key support for work with PIAAC data. Furthermore, they are well resourced with public funding and can gather highly specialised researchers with

outstanding expertise in large-scale methodology who can focus on cutting-edge research because they have no teaching obligations. Moreover, they have less staff turnover compared with universities. These conditions also facilitate the acquisition of third-party funding. Combining data collection and data analysis in one institution (e.g. GESIS) seems to make a remarkable difference compared with institutions that serve only as data collectors and providers (e.g. Statistics Canada) or that focus mainly on educational testing and developing measurement instruments (e.g. ETS). Due to their narrower mission, the latter institutions are less visible when it comes to research output than those with a broader mission, despite their pivotal role in running large-scale assessments in their respective countries, or even worldwide.

PIAAC-based research relies heavily on research teams, with four out of every five journal articles in our database being co-authored. Similar collaboration rates have been found when examining research based on international large-scale assessments of student performance, such as PISA and TIMSS (Hernández-Torrano and Courtney 2021) and reflect a common pattern in social science research (e.g. Leahey and Reikowsky 2008). Likewise, the most productive authors generally have multiple and strong connections with other authors in their research groups but do not necessarily have strong collaboration links with authors in other groups. Given that co-authored publications are an important aspect of scholarly research, which typically leads to a more robust and rigorous approach to research (Freshwater et al. 2006), their prevalence in the database suggests that PIAAC has stimulated the emergence of a vibrant research area with high scientific standards. Additionally, co-authored publications may reflect a sense of community, promote the sharing of ideas and knowledge and provide opportunities for professional networking and mentorship (Barrett et al. 2011).

However, the research groups reflected in the collaboration networks that emerged from the co-authorship analysis demonstrate that these networks (a) are based mainly on

researchers from the same institute; (b) are strongly associated with language; (c) are strongly associated with geographic proximity; (d) received support (e.g. were AIR-commissioned papers or OECD working papers); and (e) are not strongly associated with disciplines.

International collaboration can be beneficial because it allows for the sharing of ideas and knowledge across national borders, leading to a more global and diverse perspective on a subject (Kwiek 2021). In contrast to the high level of co-authorship, PIAAC research demonstrates relatively low levels of international collaboration, which may indicate a lack of international exchange, potentially limiting the reach and impact of the research.

Interdisciplinarity allows for a more holistic and comprehensive approach to studying a topic, as researchers from different disciplines can bring their unique perspectives and expertise (Aboelela et al. 2007). The analyses demonstrate that knowledge in PIAAC-based research is generated mainly by four interrelated disciplines: education, sociology, psychology and economics. The most cited PIAAC-based work in our database is a contribution focusing on returns to skills across countries (Hanushek et al. 2015), which is a key policy issue. Economic topics also stood out in the analyses of the conceptual structure of PIAAC research, which highlights human capital, earnings and other economic keywords, whereas educational topics such as social trust were less pronounced, and current discourses such as sustainable development goals or political education did not form a node in the network. Thus, PIAAC has been widely used for educational research that reflects a specific understanding of education that may tend towards a view of education driven by economic considerations such as labour market needs rather than towards the humanist view of education espoused, for example, by UNESCO (Elfert 2015, p 95).

Nevertheless, PIAAC has significant potential for inter- and multidisciplinary research, which is reflected in multiple links (edges) connecting co-cited journals (nodes) across the four disciplines (clusters) in Figure 5. Indeed, the multidisciplinary journal *Large-*

scale Assessments in Education has become the leading journal in PIAAC research, which is due largely to its special issue on PIAAC in 2017 comprising 10 contributions (see Perry et al. 2017). Specialised journals can help to spread specialised knowledge, promote idea sharing and build a scholarly community of experts in the field (Vanderstraeten et al. 2016). However, such journals are often less prestigious than disciplinary journals and may therefore be less attractive for researchers. Likewise, the most influential articles in our database were rarely published in the core journals in the field of PIAAC research, and the impact of PIAAC-based journal articles is relatively limited at the global level because the core journals are indexed only in Clarivate's Emerging Sources Citation Index (ESCI). Therefore, future efforts should focus on placing PIAAC research – both individual publications and special issues – in high-impact disciplinary journals.

To provide additional focused outlets for PIAAC research, editors of disciplinary journals might consider publishing special issues in the future to help advance our understanding of adult competencies and advocate using PIAAC data in future research. Some researchers may not use PIAAC because of a lack of relevant data on their research topics or a lack of information as to whether their research topic is addressed by PIAAC data. These researchers may be interested in using data from PIAAC Cycle 2, which included, for example, scales on socioemotional skills, which were not included in the first cycle (OECD 2021). Regarding the lack of information about analytical options using PIAAC data, the visibility of PIAAC could be improved by publishing data papers explaining the potential of these data for specific disciplines (e.g. Martin et al. 2022).

Findings from our historiographic analysis show that the first conceptual paper (Schleicher 2008) was a starting point for diverse areas of research that refer to PIAAC in different ways. With the exception of Schleicher (2008) and a review by Olsen and Tikkanen (2018), all papers included in the historiographic analysis represent pioneering empirical research in their fields that could give rise to further research following their lead. Given that

PIAAC data have been available for only 10 years and from just one cycle of data collection, these initial lines of research will probably grow and become more and more established in the future, as can be seen in analyses of similar international large-scale assessment research programmes (e.g. Hernández-Torrano and Courtney 2021).

Limitations and outlook

By focusing on PIAAC-based literature, the scope of this review is limited in two respects. First, the first round of PIAAC data collection took place in 2012. Hence, this review does not speak to trends that may be observed when taking earlier assessments of adult skills into account (e.g. IALS and ALL). For example, major technical developments such as the digitalisation of people's everyday lives, which may have affected the competencies of adult populations, were already well underway by PIAAC Cycle 1. Second, PIAAC has been developed for OECD countries with a well-educated population. Therefore, both the selection of constructs in the background questionnaire and the conceptualisation of skills for the 21st century refer to the needs and developmental goals of such countries and may not be suitable for assessing adult skills in low-income countries (Spring 2008). It should be noted that the UNESCO Literacy Assessment and Monitoring Programme (LAMP or Mini-LAMP) and the instruments and methods developed by and validated in the associated developing countries, are more suitable for this purpose (UNESCO Institute for Statistics, n.d.).

The second limitation of the scope of this review is the fact that it focuses only on PIAAC publications in German and English. As our results show that PIAAC research is conducted globally, future studies could expand the results presented here by including publications in other languages. Languages such as French (e.g. publications from Statistics Canada) may be particularly frequent among PIAAC publications. Another valuable extension of reviewing the literature on the assessment of adult education and skills could be to include publications based on other international large-scale studies addressing adult skills or adult

learning (e.g. the Adult Education Survey [AES] or UNESCO LAMP). Although these studies may be less methodologically sophisticated than PIAAC in terms of measuring adult skills, they may add different perspectives and research topics to gain a more comprehensive overview.

One of the strengths of the present review is that it used an up-to-date and comprehensive bibliography of PIAAC publications (Maehler and Konradt 2022) as the basis for the identification of relevant publications. This contrasts with most other bibliometric studies, which have extract metadata from databases such as Scopus or the Web of Science (e.g. Ivanović and Ho 2019; Meho and Yang 2007). These databases are known to have limited coverage of journals in the social sciences and the humanities (e.g. Mongeon and Paul-Hus 2016), which, as the present review shows, play an important role in generating knowledge based on PIAAC. PIAAC research has paid increasing attention to topics beyond the assessment of adult skills, such as returns to skills, skill mismatch, skill use in the workplace, lifelong learning, educational inequality and – more recently – the impact of the technological revolution on employment. Despite being designed as a primarily economic study, as evidenced by the selection and operationalisation of constructs in the background questionnaire, PIAAC also includes topics that have received little attention to date, such as health, trust and volunteering. We assume that the varied empirical findings from this research have not yet fully made their way into the knowledge sphere of researchers, perhaps because the distribution of PIAAC research is limited in some disciplines – especially for those in which qualitative research is prevalent – and appeals only to researchers with interest and substantial knowledge in quantitative research (Boeren 2018). Considering the high rate of literacy and low rates of civic engagement in most PIAAC-participating countries, practical implications for areas such as health and civil and political participation can potentially be derived from PIAAC research. Moreover, social trust and solidarity, which are genuinely social science questions, can also be investigated using PIAAC data. Future research that

actively connects qualitative research with PIAAC data –and available datasets from other large-scale and monitoring studies such as the Adult Education Survey or the European Social Survey – may help to overcome methodological boundaries for the benefit of a more comprehensive and deeper understanding of current societal challenges.

The present work highlights the growing importance of PIAAC research for understanding adult competencies and its potential to inform policy and practice. However, the findings indicate that researchers in some disciplines, for example, the educational sciences, have yet to fully capitalise on this opportunity. As Elfert (2015) pointed out, “Today’s instrumental approach [to lifelong learning] prevents one from placing education in the context of wider debates about society or offers technocratic solutions to complex social problems” (p. 96). To fully appreciate and understand the educational side of adult skills, for example its relevance for societal and individual growth, more use of PIAAC data for educational research is needed. Future PIAAC cycles should broaden the focus of data collection at least in the background questionnaire to open up research opportunities for educational research and provide interfaces for combining research from the tradition of (adult) education with the wealth of data from large-scale assessments in education such as PIAAC.

References

- Aboelela, S. W., Larson, E., Bakken, S., Carrasquillo, O., Formicola, A., Glied S. A., Haas, J., & Gebbie, K. M. (2007). Defining interdisciplinary research: Conclusions from a critical review of the literature. *Health Services Research, 42*(1), 329–346.
<https://doi.org/10.1111/j.1475-6773.2006.00621.x>
- Andrés, A. (2009). *Measuring academic research: How to undertake a bibliometric study*. Chandos Publishing.
- Aria, N., & Cuccurollo, C. (2017). *bibliometrix: An R-tool for comprehensive science mapping analysis*. *Journal of Infometrics, 11*(4), 959–975.
<https://doi.org/10.1016/j.joi.2017.08.007>
- Asai, K., Breda, T., Rain, A., Romanello, L., & Sangnier, M. (2020). Education, skills and skill mismatch: A review and some new evidence based on the PIAAC survey (IPP Report No. 26). Institut des Politiques Publiques (IPP). <https://www.ipp.eu/wp-content/uploads/2020/01/education-skills-and-skill-mismatch-piaac-survey-ipp-janvier-2020.pdf>
- Barrett, A. M., Crossley, M., & Dachi, H. A. (2011). International collaboration and research capacity building: Learning from the EdQual experience. *Comparative Education, 47*, 25–43. <http://dx.doi.org/10.1080/03050068.2011.541674>
- Boeren, E. (2018). The methodological underdog: A review of quantitative research in the key adult education journals. *Adult Education Quarterly, 68*(1), 63–79.
<https://doi.org/10.1177/0741713617739347>
- Bozeman, B., & Corley, E. (2004). Scientists' collaboration strategies: Implications for scientific and technical human capital. *Research Policy, 33*(4), 599–616.
<https://doi.org/10.1016/j.respol.2004.01.008>

- Bradford, S. C. (1934). Sources of information on specific subjects. *Engineering*, 137(3550), 85–86. (Reprinted in 1985 in *Journal of Information Science*, 10(4), 143–186.
<https://journals.sagepub.com/doi/epdf/10.1177/016555158501000407>)
- Desjardins, R. (2020). *PIAAC thematic review on adult learning* (OECD Education Working Paper No. 223). OECD Publishing. <https://dx.doi.org/10.1787/864d2484-en>
- Desjardins, R., & Ederer, P. (2015). Socio-demographic and practice-oriented factors related to problem solving: A lifelong learning perspective. *International Journal of Lifelong Education*, 4, 468–486. <https://doi.org/10.1080/02601370.2015.1060027>
- Ding Y, Chowdhury G, Foo S. (2000). Journal as markers of intellectual space: Co-citation analysis of information retrieval area, 1987–1997. *Scientometrics*, 47(1), 55–73.
<https://doi.org/10.1023/A.1005665709109>
- Dusdal, J., Powel, J., Baker, D., Fu, Y., Shamekhi, Y., & Stock, M. (2020). University vs. research institute? The dual pillars of German science production, 1950–2010. *Minerva*, 58, 319–342. <https://doi.org/10.1007/s11024-019-09393-2>
- Elfert, M. (2015). UNESCO, the Faure report, the Delors report, and the political utopia of lifelong learning. *European Journal of Education*, 50(1), 88–100.
<https://doi.org/10.1111/ejed.12104>
- Flisi, S., Goglio, V., Meroni, E. C., Rodrigues, M., & Vera-Toscano, E. (2017). Measuring occupational mismatch: Overeducation and overskill in Europe – Evidence from PIAAC. *Social Indicators Research*, 131, 1211–1249. <https://doi.org/10.1007/s11205-016-1292-7>
- Freshwater, D., Sherwood, G., & Drury, V. (2006). International research collaboration. *Journal of Research in Nursing*, 11(4), 295–303.
<https://doi.org/10.1177/1744987106066304>
- Garfield, E. (2004). Historiographic mapping of knowledge domains literature. *Journal of Information Science*, 30(2), 119–145. <https://doi.org/10.1177/0165551504042802>

- Garfield, E., Pudovkin, A. I., & Istomin, V. S. (2003). Mapping the output of topical searches in the Web of Knowledge and the case of Watson-Crick. *Information Technology and Libraries*, 22(4), 183–188.
- Gauly, B., & Lechner, C. (2019). Self-perfection or self-selection? Unraveling the relationship between job-related training and adults' literacy skills. *PLoS ONE*, 14(5), Article e0215971. <https://doi.org/10.1371/journal.pone.0215971>
- German Institute for Adult Education (DIE) (Ed.). (2014). #PIAAC [Special issue]. *DIE Zeitschrift für Erwachsenenbildung*, 21(3). <https://doi.org/10.3278/DIE1403W>
- Goldhammer, F., Naumann, J., Stelter, A., Tóth, K., Rölke, H., & Klieme, K. (2014). The time on task effect in reading and problem solving is moderated by task difficulty and skill: Insights from a computer-based large-scale assessment. *Journal of Educational Psychology*, 106(3), 608–626. <https://doi.org/10.1037/a0034716>
- Green, A. (2021) *Models of lifelong learning and their outcomes. How distinctive is the 'Nordic Model' now?* (LLAKES Research Paper No. 70). Centre for Learning and Life Chances (LLAKES). <https://www.llakes.ac.uk/wp-content/uploads/2021/11/70.-Andy-Green-LLAKES-Research-paper-on-Nordic-model-19.10.2021-v.3.pdf>
- Hämäläinen, R., de Wever, B., & Malin, A. (2015). Education and working life: VET adults' problem-solving skills in technology-rich environments. *Computers & Education*, 88, 38–47. <https://doi.org/10.1016/j.compedu.2015.04.013>
- Hämäläinen, R., de Wever, B., Nissinen, K., & Cincinnato, S. (2017). Understanding adults' strong problem-solving skills based on PIAAC. *Journal of Workplace Learning*, 29(7/8), 537–553. <https://doi.org/10.1108/JWL-05-2016-0032>
- Hämäläinen, R., de Wever, B., Nissinen, K., & Cincinnato, S. (2019). What makes the difference: PIAAC as a resource for understanding the problem-solving skills of Europe's higher-education adults. *Computers & Education*, 129, 27–36. <https://doi.org/10.1016/j.compedu.2018.10.013>

- Hanushek, E. A., Schwerdt, G., Wiederhold, S., & Woessmann, L. (2015). Returns to skills around the world: Evidence from PIAAC. *European Economic Review*, *73*, 103–130. <https://doi.org/10.1016/j.euroecorev.2014.10.006>
- Heisig, J. P., Elbers, B., & Solga, H. (2019). Cross-national differences in social background effects on educational attainment and achievement: Absolute vs. relative inequalities and the role of education systems. *Compare*, *50*(2), 165–184. <https://doi.org/10.1080/03057925.2019.1677455>
- Hernández-Torrano, D., & Courtney, M. G. R. (2021). Modern international large-scale assessment in education: An integrative review and mapping of the literature. *Large-scale Assessments in Education*, *9*, Article 17. <https://doi.org/10.1186/s40536-021-00109-1>
- Ivanović, L., & Ho, Y. S. (2019). Highly cited articles in the education and educational research category in the Social Science Citation Index: A bibliometric analysis. *Educational Review*, *71*(3), 277–286. <https://doi.org/10.1080/00131911.2017.1415297>
- Kirsch, I. S., de Jong, J., LaFontaine, D., McQueen, J., Mendelovits, J., & Monseur, C. (2002). *Reading for change: Performance and engagement across countries: Results from PISA 2000*. OECD Publishing. <https://www.oecd-ilibrary.org/docserver/9789264099289-en.pdf?expires=1727450304&id=id&accname=guest&checksum=3835AC8F6648C337B3A042CCAC5E2AAB>
- Kirsch, I., & Lennon, M. L. (2017). PIAAC: A new design for a new era. *Large-scale Assessments in Education*, *5*, Article 11. <https://doi.org/10.1186/s40536-017-0046-6>
- Kirsch, I., Yamamoto, K., & Khorramdel, L. (2020). Design and key features of the PIAAC Survey of Adult Skills. In B. Maehler & B. Rammstedt (Eds.), *Large-scale cognitive assessment: Analyzing PIAAC data* (pp. 7–26). Springer. https://doi.org/10.1007/978-3-030-47515-4_2

- Kwiek, M. (2021). What large-scale publication and citation data tell us about international research collaboration in Europe: Changing national patterns in global contexts. *Studies in Higher Education, 46*(12), 2629–2649.
<https://doi.org/10.1080/03075079.2020.1749254>
- Leahey, E., & Reikowsky, R. C. (2008). Research specialization and collaboration patterns in sociology. *Social Studies of Science, 38*(3), 425–440.
<https://doi.org/10.1177/0306312707086190>
- Lyu, P., Liu, X., & Yao, T. (2023). A bibliometric analysis of literature on bibliometrics in recent half-century. *Journal of Information Science*, Advance online publication.
<https://doi.org/10.1177/01655515231191233>
- Maehler, D. B., & Konradt, I. (2020). Adult cognitive and non-cognitive skills: An overview of existing PIAAC data. In: Maehler, D., Rammstedt, B. (Eds.) *Large-scale cognitive assessment* (pp. 49–91). Springer. https://doi.org/10.1007/978-3-030-47515-4_4
- Maehler, D. B., & Konradt, I. (2022). *PIAAC bibliography – 2008–2021* (GESIS Papers, 2022/02). GESIS—Leibniz Institute for the Social Sciences.
<https://doi.org/10.21241/ssoar.77833>
- Maehler, D. B., Martin, S. & Rammstedt, B. (2017). Coverage of the migrant population in large-scale assessment surveys. Experiences from PIAAC in Germany. *Large-scale Assessments in Education, 5*(9). <https://doi.org/10.1186/s40536-017-0044-8>
- Martin, S., Zabal, A., Maehler, D. B., & Rammstedt, B. (2022). Data from PIAAC Germany and its longitudinal follow-up, PIAAC-L. *Journal of Open Psychology Data, 10*(1).
<https://doi.org/10.5334/jopd.74>
- Massing, N., & Gauly, B. (2017). Training participation and gender: Analyzing individual barriers across different welfare state regimes. *Adult Education Quarterly, 67*(4), 266–285. <https://doi.org/10.1177/0741713617715706>

- Meho, L. I., & Yang, K. (2007). Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus and Google Scholar. *Journal of the American Society for Information Science and Technology*, *58*(13), 2105–2125.
<https://doi.org/10.1002/asi.20677>
- Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*, 213–228. <https://doi.org/10.1007/s11192-015-1765-5>
- Murray, T. S., Kirsch, I. S., & Jenkins, L. B. (1998). *Adult literacy in OECD countries: Technical report on the first International Adult Literacy Survey* (NCES 98-053). National Center for Education Statistics.
- Newman, M. E. J. (2001). Scientific collaboration networks. I. Network construction and fundamental results. *Physical Review E*, *64*(1), Article 016131.
<https://doi.org/10.1103/PhysRevE.64.016131>
- Newman, M. E. J. (2004). Analysis of weighted networks. *Physical Review E*, *70*(5), Article 056131. <https://doi.org/10.1103/PhysRevE.70.056131>
- Olsen, D. Sutherland, & Tikannen, T. (2018). The developing field of workplace learning and the contribution of PIAAC. *International Journal of Lifelong Education*, *37*(5), 546–559. <https://doi.org/10.1080/02601370.2018.1497720>
- Organisation for Economic Co-operation and Development (OECD). (2009). *PIAAC BQ JRA V5.0 – Conceptual framework*. OECD Publishing.
<https://www.oecd.org/education/48865373.pdf>
- Organisation for Economic Co-operation and Development (OECD). (2013). *OECD skills outlook 2013: First results from the Survey of Adult Skills*. OECD Publishing.
<http://dx.doi.org/10.1787/9789264204256-en>
- Organisation for Economic Co-operation and Development (OECD). (2018). *Programme for the International Assessment of Adult Competencies (PIAAC). English Pilot Study on*

- Non-Cognitive Skills* (Study no. ZA6940, Data file version 1.0.0). GESIS Data Archive. <https://doi.org/10.4232/1.13062>
- Organisation for Economic Co-operation and Development (OECD). (2021). *The assessment frameworks for Cycle 2 of the Programme for the International Assessment of Adult Competencies*. OECD Publishing.
<https://www.oecd.org/skills/piaac/publications/PIAAC-Frameworks-Cycle2-en.pdf>
- Organisation for Economic Co-operation and Development (OECD) & Statistics Canada (2011). *Literacy for life: Further results from the Adult Literacy and Life Skills Survey*. OECD Publishing. <https://doi.org/10.1787/9789264091269-en>.
- Öztürk, O., Kocaman, R. & Kanbach, D. K. (2024). How to design bibliometric research: An overview and a framework proposal. *Review of Managerial Science*.
<https://doi.org/10.1007/s11846-024-00738-0>
- Perry, A., Maehler, D. B., & Rammstedt, B. (2017). Introduction to the special issue on results, methodological aspects, and advancements of the Programme for the International Assessment of Adult Competencies (PIAAC). *Large-scale Assessments in Education*, 6, Article 14. <https://doi.org/10.1186/s40536-018-0066-x>
- PIAAC Expert Group on Problem Solving in Technology-Rich Environments. (2009). *PIAAC problem solving in technology-rich environments: A conceptual framework* (OECD Education Working Paper No. 36). OECD Publishing.
<http://dx.doi.org/10.1787/220262483674>
- PIAAC Literacy Expert Group. (2009). *PIAAC literacy: A conceptual framework* (OECD Education Working Paper No. 34). OECD Publishing.
<http://dx.doi.org/10.1787/220348414075>
- PIAAC Numeracy Expert Group. (2009). *PIAAC numeracy: A conceptual framework* (OECD Education Working Paper No. 35). OECD Publishing.
<https://dx.doi.org/10.1787/220337421165>

- Rammstedt, B., & Maehler, D. B. (2014). PIAAC and its methodological challenges. *methods, data, analysis*, 8(2), 125–136. <https://doi.org/10.12758/mda.2014.005>
- Rampey, B. D., Keiper, S., Mohadjer, L., Krenzke, T., Li, J., Thornton, N., & Hogan, J. (2016). *Highlights from the U.S. PIAAC Survey of Incarcerated Adults: Their skills, work experience, education, and training: Program for the International Assessment of Adult Competencies: 2014* (NCES 2016-40). National Center for Education Statistics. <https://nces.ed.gov/pubs2016/2016040.pdf>
- Reder, S., Gauly, B., & Lechner, S. (2020). Practice makes perfect: Practice engagement theory and the development of adult literacy and numeracy. *International Review of Education*, 66, 267–288. <https://doi.org/10.1007/s11159-020-09830-5>
- R Core Team (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Riccaboni M., & Verginer L. (2022) The impact of the COVID-19 pandemic on scientific research in the life sciences. *PLoS ONE*, 17(2), Article e0263001. <https://doi.org/10.1371/journal.pone.0263001>
- Schleicher, A. (2008). PIAAC: A new strategy for assessing adult competencies. *International Review of Education*, 54, 627–650. <https://doi.org/10.1007/s11159-008-9105-0>
- Siddiq, F., Hatlevik, O. E., Olsen, R. V., Throndsen, I., & Scherer, R. (2016). Taking a future perspective by learning from the past: A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*, 19, 58–84. <https://doi.org/10.1016/j.edurev.2016.05.002>
- Spring, J. (2008). Research on globalization and education. *Review of Educational Research*, 78(2), 330–363. <https://doi.org/10.3102/0034654308317846>
- Tsatsaroni, A., & Evans, J. (2014). Adult numeracy and the totally pedagogised society: PIAAC and other international surveys in the context of global educational policy on

lifelong learning. *Educational Studies in Mathematics*, 87(2), 167–187.

<https://doi.org/10.1007/S10649-013-9470-X>

Ulitzsch, E., He, Q., Ulitzsch, V., Molter, H., Nichterlein, A., Niedermeier, R., & Pohl, S.

(2021). Combining clickstream analyses and graph-modeled data clustering for identifying common response processes. *Psychometrika*, 86(1), 190–214.

<https://doi.org/10.1007/s11336-020-09743-0>

UNESCO Institute for Statistics (UIS). (n.d.). Literacy Assessment and Monitoring

Programme (LAMP). <https://uis.unesco.org/sites/default/files/documents/literacy-assessment-and-monitoring-programme-lamp-information-brochure-en.pdf>

Vanderstraeten, R., Vandermoere, F., & Hermans, M. (2016). Scholarly communication in

AERA journals, 1931 to 2014. *Review of Research in Education*, 40, 38–61.

<https://doi.org/10.3102/0091732X16678836>

van Rijsbergen, C. J. (1977). A theoretical basis for the use of co-occurrence data in

information retrieval. *Journal of Documentation*, 33(2), 106–119.

<https://doi.org/10.1108/eb026637>

Supplementary Online Appendix for Review

Supplemental Tables

Table S1 Available PIAAC Cycle 1 datasets by country

Country	Available datasets (provider)	Year of assessment (Cycle 1)
Australia	Public Use File (Australian Bureau of Statistics/OECD –available only in the analysis tool OECD IDE)	2011–2012
Austria	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Scientific Use Files (Statistics Austria)	2011–2012
Belgium ^a	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Canada	Public Use File (OECD/Statistics Canada)	2011–2012
	Scientific Use File (Statistics Canada)	2011–2012
	Longitudinal and International Study of Adults (LISA) linked to register data (Canadian Research Data Centers)	2011–2012
Chile	Public Use File (OECD)	2014–2015
Cyprus	Public Use File (RDC PIAAC at GESIS)	2011–2012
Czech Republic	Public Use File (OECD)	2011–2012
Denmark	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs ^b)	2011–2012
Ecuador	Public Use File (OECD)	2017
Estonia	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
Finland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
France	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
Germany	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Scientific Use Files (RDC PIAAC at GESIS)	2011–2012
	German PIAAC National Supplement: Prime Age (RDC PIAAC at GESIS)	2011–2012
	German PIAAC National Supplement: Competencies in Later Life/ CiLL (RDC PIAAC at GESIS)	2011–2012
	PIAAC Germany Scientific Use File: Regional Data (RDC PIAAC at GESIS)	2012–2016
	PIAAC-L, Longitudinal Scientific Use File (RDC PIAAC at GESIS)	2017
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	
Greece	Public Use File (OECD)	2014–2015

(continued)

Table S1 (continued)

Country	Available datasets (provider)	Year of assessment (Cycle 1)
---------	-------------------------------	------------------------------

Hungary	Public Use File (OECD)	2017
Indonesia	Not available	2014–2015
Ireland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Israel	Public Use File (OECD)	2014–2015
Italy	Public Use File (OECD)	2011–2012
	Public Use File – Extended (INAPP ^o)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Japan	Public Use File (OECD)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
Kazakhstan	Public Use File (OECD)	2017
Korea	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Lithuania	Public Use File (OECD)	2014–2015
Mexico	Public Use File (OECD)	2017
Netherlands	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
New Zealand	Public Use File (OECD)	2014–2015
	Public Use File - Extended (Ministry of Education New Zealand)	2014–2015
Norway	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Norwegian PIAAC data linked to register data (NSD ^d)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs ^e)	2011–2012
Peru	Public Use File (OECD)	2017
Poland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	
Russian Federation	Public Use File (OECD)	2011–2012
Singapore	Public Use File (OECD)	2014–2015
Slovak Republic	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Slovenia	Public Use File (OECD)	2014–2015
Spain	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
Sweden	Public Use File (OECD)	2011–2012
	Swedish PIAAC data linked to register data (Statistics Sweden)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
Turkey	Public Use File (OECD)	2014–2015
United Kingdom ^f	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC by GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2016

(continued)

Table S1 (continued)

Country	Available datasets (provider)	Year of assessment (Cycle 1)
United States	Public Use File (OECD/NCES ^g)	2011–2012
	PIAAC 2012/2014 US National Supplement Public Use Data File – Household (NCES)	2011–2012; 2014
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012;
	US PIAAC Restricted Use File (NCES)	2011–2012
	PIAAC 2012/2014 US National Supplement Restricted Use Data File – Household (NCES)	2011–2012; 2014
	PIAAC 2014 US National Supplement Public Use Data Files – Prison (NCES)	2014
	PIAAC 2014 US National Supplement Restricted Use Data Files – Prison (NCES)	2014
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2016

^a Only Flanders. ^b Nordic National Statistical Institutions. ^c Istituto Nazionale per l'Analisi

delle Politiche Pubbliche, Italy. ^d Norwegian Centre for Research Data, Norway. ^e Nordic

National Statistical Institutions – Denmark, Estonia, Finland, Norway, Sweden. ^f Only

England and Northern Ireland. ^g National Center for Education Statistics, USA. OECD IDE =

OECD version of the International Data Explorer; RDC = research data centre.

Table S2 Frequency of coverage of countries by PIAAC-based publications

Rank	Country	Count	Rank	Country	Count
1	Germany	355	22	Greece	105
2	United States	314	23	Australia	105
3	Finland	311	24	Slovenia	95
4	Denmark	308	25	Russia	94
5	United Kingdom	306	26	Cyprus	93
6	The Netherlands	302	27	Chile	90
7	Norway	286	28	Israel	87
8	France	276	29	New Zealand	85
9	Italy	275	30	Lithuania	80
10	Sweden	275	31	Turkey	73
11	Belgium	274	32	Singapore	52
12	Spain	273	33	Hungary	18
13	Czech Republic	270	33	Indonesia	19
14	Ireland	269	35	Mexico	15
15	Poland	261	36	Kazakhstan	11
16	Slovakia	235	37	Peru	8
17	Austria	232			
18	Canada	231			
19	Japan	231			
20	South Korea	230			
21	Estonia	219			

Table S3 Leading institutions in PIAAC-based research

Institution	Country	Journal articles
GESIS – Leibniz Institute for Social Sciences	Germany	64
University of Barcelona	Spain	28
University of Hamburg	Germany	27
Maastricht University	The Netherlands	27
University of Maryland, Baltimore	United States	21
University of Jyväskylä	Finland	19
Pennsylvania State University	United States	15
Miami University	United States	13
University of Stavanger	Norway	13
WZB Berlin Social Science Center	Germany	13
Nordic Institute for Studies in Innovation, Research and Education (NIFU)	Norway	12
Freie Universität Berlin	Germany	10
University of Extremadura	Spain	10

Note. Only institutions with 10+ journal articles in the database are displayed.

Table S4 10 most cited journal articles in PIAAC-based research

Article	DOI	Year	Global citations (GCs)	Local citations (LCs)	LC/GC ratio (%)	Normalized LCs	Normalized GCs
Hanushek E. et al. (2015) <i>European Economic Review</i>	https://doi.org/10.1016/j.euroecor.2014.10.006	2015	219	61	27.85	8.13	5.94
Goldhammer F. et al. (2014) <i>Journal of Educational Psychology</i>	https://doi.org/10.1037/a0034716	2014	132	10	7.58	13.00	12.62
Siddiq F. et al. (2016) <i>Educational Research Review</i>	https://doi.org/10.1016/j.edurev.2016.05.002	2016	89	0	0.00	0.00	4.96
Jerrim J. & Macmillan, L. (2015) <i>Social Forces</i>	https://doi.org/10.1093/sf/sov075	2015	77	5	6.49	0.67	2.09
Flisi S. et al. (2017) <i>Social Indicators Research</i>	https://doi.org/10.1007/s11205-016-1292-7	2017	55	9	16.36	7.12	4.70
Schleicher A. (2008) <i>International Review of Education</i>	https://doi.org/10.1007/s11159-008-9105-0	2008	53	16	30.19	1.00	1.00
Forster A. G. et al. (2016) <i>Sociological Science</i>	https://doi.org/10.15195/v3.a21	2016	45	5	11.11	3.47	2.51
Rammstedt B. et al. (2016) <i>Journal of Research in Personality</i>	https://doi.org/10.1016/j.jrp.2016.03.005	2016	45	4	8.89	2.78	2.51
Dohmen T. et al. (2018) <i>Journal of Economic Perspectives</i>	https://doi.org/10.1257/jep.32.2.115	2018	45	0	0.00	0.00	8.09
Green, F., & Henseke, G. (2016) <i>Oxford Review of Economic Policy</i>	https://doi.org/10.1093/oxrep/grw024	2016	42	0	0.00	0.00	2.34

Table S5 Conferences on PIAAC by year, organizer and venue

Year	PIAAC conference
2013	November 2013, OECD, Washington, D.C.
2014	April 2014, GESIS, Mannheim, Germany October 2014, Statistics Austria, Vienna, Austria December 2014, American Institutes for Research (AIR), Arlington, VA
2015	November 2015, OECD, Haarlem, the Netherlands December 2015, AIR, Arlington, VA
2016	November 2016, OECD, Madrid, Spain
2017	April 2017, GESIS, Mannheim, Germany November 2017, OECD, Singapore
2018	November 2018, OECD, Bratislava, Slovak Republic December 2018, AIR, Washington, D.C.
2019	---
2020	January 2020, OECD, Rome, Italy
2021	---
2022	March 2022, GESIS, online

Supplemental Figures

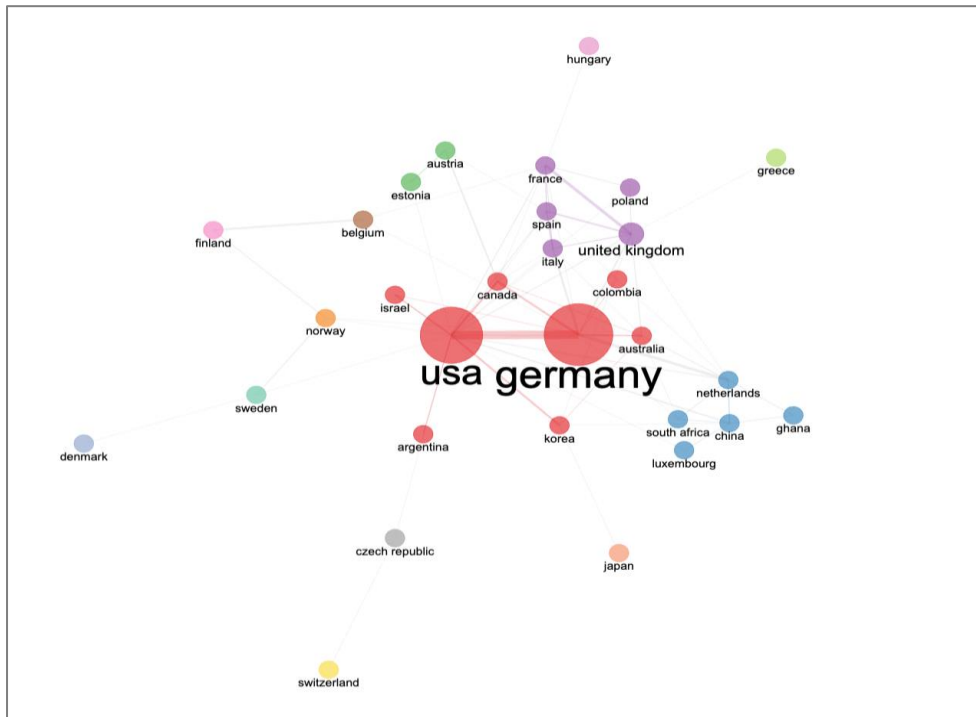


Figure S1 Collaboration networks among countries for PIAAC-based journal articles.
Note. Co-authorship analysis with all countries in the database. Isolated nodes excluded.

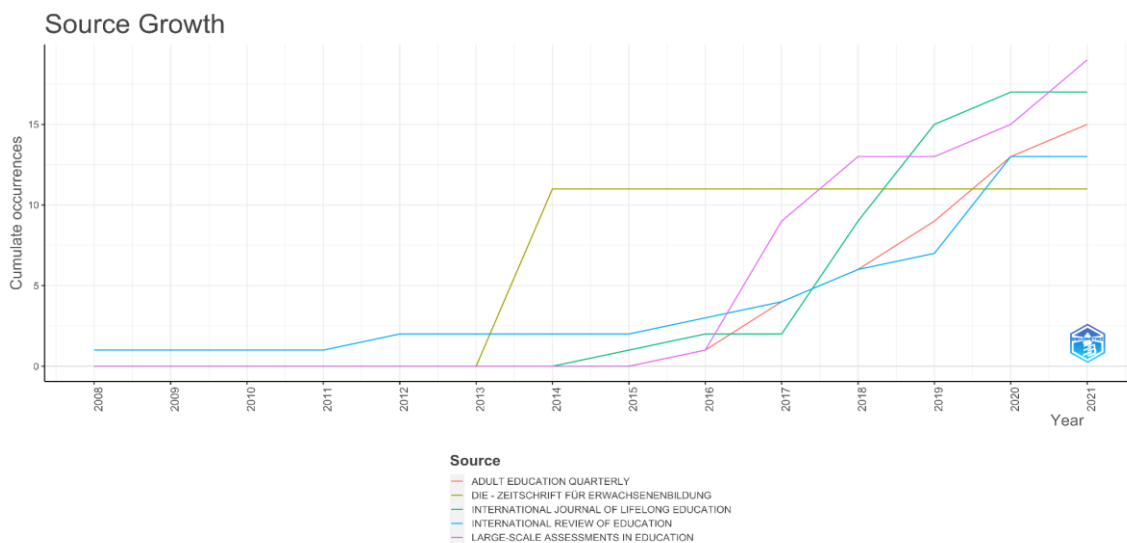


Figure S2 Yearly growth in PIAAC-based articles by journal.

Supplementary Online Appendix for Review

Supplemental Tables

Table S1 Available PIAAC Cycle 1 datasets by country

Country	Available datasets (provider)	Year of assessment (Cycle 1)
Australia	Public Use File (Australian Bureau of Statistics/OECD –available only in the analysis tool OECD IDE)	2011–2012
Austria	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Scientific Use Files (Statistics Austria)	2011–2012
Belgium ^a	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Canada	Public Use File (OECD/Statistics Canada)	2011–2012
	Scientific Use File (Statistics Canada)	2011–2012
	Longitudinal and International Study of Adults (LISA) linked to register data (Canadian Research Data Centers)	2011–2012
Chile	Public Use File (OECD)	2014–2015
Cyprus	Public Use File (RDC PIAAC at GESIS)	2011–2012
Czech Republic	Public Use File (OECD)	2011–2012
Denmark	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs ^b)	2011–2012
Ecuador	Public Use File (OECD)	2017
Estonia	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
Finland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
France	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
Germany	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Scientific Use Files (RDC PIAAC at GESIS)	2011–2012
	German PIAAC National Supplement: Prime Age (RDC PIAAC at GESIS)	2011–2012
	German PIAAC National Supplement: Competencies in Later Life/ CiLL (RDC PIAAC at GESIS)	2011–2012
	PIAAC Germany Scientific Use File: Regional Data (RDC PIAAC at GESIS)	2012–2016
	PIAAC-L, Longitudinal Scientific Use File (RDC PIAAC at GESIS)	2017
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	
Greece	Public Use File (OECD)	2014–2015

(continued)

Table S1 (continued)

Country	Available datasets (provider)	Year of assessment (Cycle 1)
Hungary	Public Use File (OECD)	2017
Indonesia	Not available	2014–2015
Ireland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Israel	Public Use File (OECD)	2014–2015
Italy	Public Use File (OECD)	2011–2012
	Public Use File – Extended (INAPP ^c)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Japan	Public Use File (OECD)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
Kazakhstan	Public Use File (OECD)	2017
Korea	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
Lithuania	Public Use File (OECD)	2014–2015
Mexico	Public Use File (OECD)	2017
Netherlands	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
New Zealand	Public Use File (OECD)	2014–2015
	Public Use File - Extended (Ministry of Education New Zealand)	2014–2015
Norway	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Norwegian PIAAC data linked to register data (NSD ^d)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs ^e)	2011–2012
Peru	Public Use File (OECD)	2017
Poland	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2011–2012
Russian Federation	Public Use File (OECD)	2011–2012
Singapore	Public Use File (OECD)	2014–2015
Slovak Republic	Public Use File (OECD)	2011–2012
Slovenia	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	Public Use File (OECD)	2014–2015
Spain	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2017
	Public Use File (OECD)	2011–2012
Sweden	Swedish PIAAC data linked to register data (Statistics Sweden)	2011–2012
	Nordic PIAAC Database linked to register data (Nordic NSIs)	2011–2012
	Public Use File (OECD)	2014–2015
Turkey	Public Use File (OECD)	2011–2012
United Kingdom ^f	Public Use File (OECD)	2011–2012
	PIAAC Log Files (RDC PIAAC by GESIS)	2011–2012
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2016

(continued)

Table S1 (continued)

Country	Available datasets (provider)	Year of assessment (Cycle 1)
United States	Public Use File (OECD/NCES [§])	2011–2012
	PIAAC 2012/2014 US National Supplement Public Use Data File – Household (NCES)	2011–2012; 2014
	PIAAC Log Files (RDC PIAAC at GESIS)	2011–2012;
	US PIAAC Restricted Use File (NCES)	2011–2012
	PIAAC 2012/2014 US National Supplement Restricted Use Data File – Household (NCES)	2011–2012; 2014
	PIAAC 2014 US National Supplement Public Use Data Files – Prison (NCES)	2014
	PIAAC 2014 US National Supplement Restricted Use Data Files – Prison (NCES)	2014
	PIAAC Data Files on Non-Cognitive Skills (RDC PIAAC at GESIS)	2016

^aOnly Flanders. ^bNordic National Statistical Institutions. ^cIstituto Nazionale per l'Analisi delle

Politiche Pubbliche, Italy. ^dNorwegian Centre for Research Data, Norway. ^eNordic National

Statistical Institutions – Denmark, Estonia, Finland, Norway, Sweden. ^fOnly England and Northern

Ireland. [§]National Center for Education Statistics, USA. OECD IDE = OECD version of the

International Data Explorer; RDC = research data centre.

Table S2 Frequency of coverage of countries by PIAAC-based publications

Rank	Country	Count	Rank	Country	Count
1	Germany	355	22	Greece	105
2	United States	314	23	Australia	105
3	Finland	311	24	Slovenia	95
4	Denmark	308	25	Russia	94
5	United Kingdom	306	26	Cyprus	93
6	The Netherlands	302	27	Chile	90
7	Norway	286	28	Israel	87
8	France	276	29	New Zealand	85
9	Italy	275	30	Lithuania	80
10	Sweden	275	31	Turkey	73
11	Belgium	274	32	Singapore	52
12	Spain	273	33	Hungary	18
13	Czech Republic	270	33	Indonesia	19
14	Ireland	269	35	Mexico	15
15	Poland	261	36	Kazakhstan	11
16	Slovakia	235	37	Peru	8
17	Austria	232			
18	Canada	231			
19	Japan	231			
20	South Korea	230			
21	Estonia	219			

Table S3 Leading institutions in PIAAC-based research

Institution	Country	Journal articles
GESIS – Leibniz Institute for Social Sciences	Germany	64
University of Barcelona	Spain	28
University of Hamburg	Germany	27
Maastricht University	The Netherlands	27
University of Maryland, Baltimore	United States	21
University of Jyväskylä	Finland	19
Pennsylvania State University	United States	15
Miami University	United States	13
University of Stavanger	Norway	13
WZB Berlin Social Science Center	Germany	13
Nordic Institute for Studies in Innovation, Research and Education (NIFU)	Norway	12
Freie Universität Berlin	Germany	10
University of Extremadura	Spain	10

Note. Only institutions with 10+ journal articles in the database are displayed.

Table S4 10 most cited journal articles in PIAAC-based research

Article	DOI	Year	Global citations (GCs)	Local citations (LCs)	LC/GC ratio (%)	Normalized LCs	Normalized GCs
Hanushek E. et al. (2015) <i>European Economic Review</i>	https://doi.org/10.1016/j.euroecorev.2014.10.006	2015	219	61	27.85	8.13	5.94
Goldhammer F. et al. (2014) <i>Journal of Educational Psychology</i>	https://doi.org/10.1037/a0034716	2014	132	10	7.58	13.00	12.62
Siddiq F. et al. (2016) <i>Educational Research Review</i>	https://doi.org/10.1016/j.edurev.2016.05.002	2016	89	0	0.00	0.00	4.96
Jerrim J. & Macmillan, L. (2015) <i>Social Forces</i>	https://doi.org/10.1093/sf/sov075	2015	77	5	6.49	0.67	2.09
Flisi S. et al. (2017) <i>Social Indicators Research</i>	https://doi.org/10.1007/s11205-016-1292-7	2017	55	9	16.36	7.12	4.70
Schleicher A. (2008) <i>International Review of Education</i>	https://doi.org/10.1007/s11159-008-9105-0	2008	53	16	30.19	1.00	1.00
Forster A. G. et al. (2016) <i>Sociological Science</i>	https://doi.org/10.15195/v3.a21	2016	45	5	11.11	3.47	2.51
Rammstedt B. et al. (2016) <i>Journal of Research in Personality</i>	https://doi.org/10.1016/j.jrp.2016.03.005	2016	45	4	8.89	2.78	2.51
Dohmen T. et al. (2018) <i>Journal of Economic Perspectives</i>	https://doi.org/10.1257/jep.32.2.115	2018	45	0	0.00	0.00	8.09
Green, F., & Henseke, G. (2016) <i>Oxford Review of Economic Policy</i>	https://doi.org/10.1093/oxrep/grw024	2016	42	0	0.00	0.00	2.34

Table S5 Conferences on PIAAC by year, organizer and venue

Year	PIAAC conference
2013	November 2013, OECD, Washington, D.C.
2014	April 2014, GESIS, Mannheim, Germany October 2014, Statistics Austria, Vienna, Austria December 2014, American Institutes for Research (AIR), Arlington, VA
2015	November 2015, OECD, Haarlem, the Netherlands December 2015, AIR, Arlington, VA
2016	November 2016, OECD, Madrid, Spain
2017	April 2017, GESIS, Mannheim, Germany November 2017, OECD, Singapore
2018	November 2018, OECD, Bratislava, Slovak Republic December 2018, AIR, Washington, D.C.
2019	---
2020	January 2020, OECD, Rome, Italy
2021	---
2022	March 2022, GESIS, online

Supplemental Figures

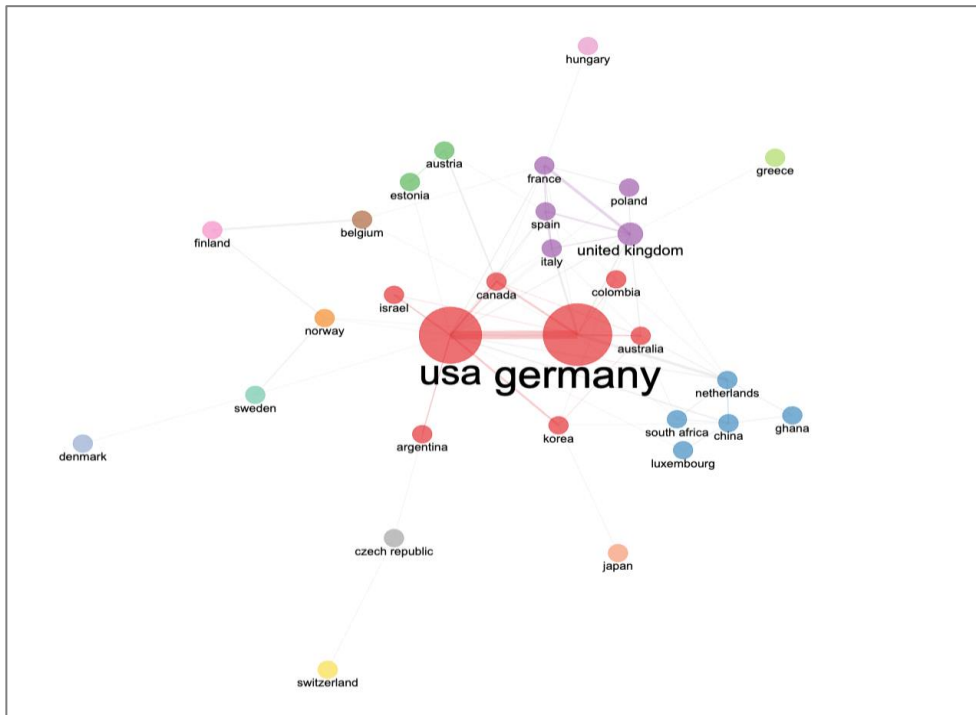


Figure S1 Collaboration networks among countries for PIAAC-based journal articles. *Note.* Co-authorship analysis with all countries in the database. Isolated nodes excluded.

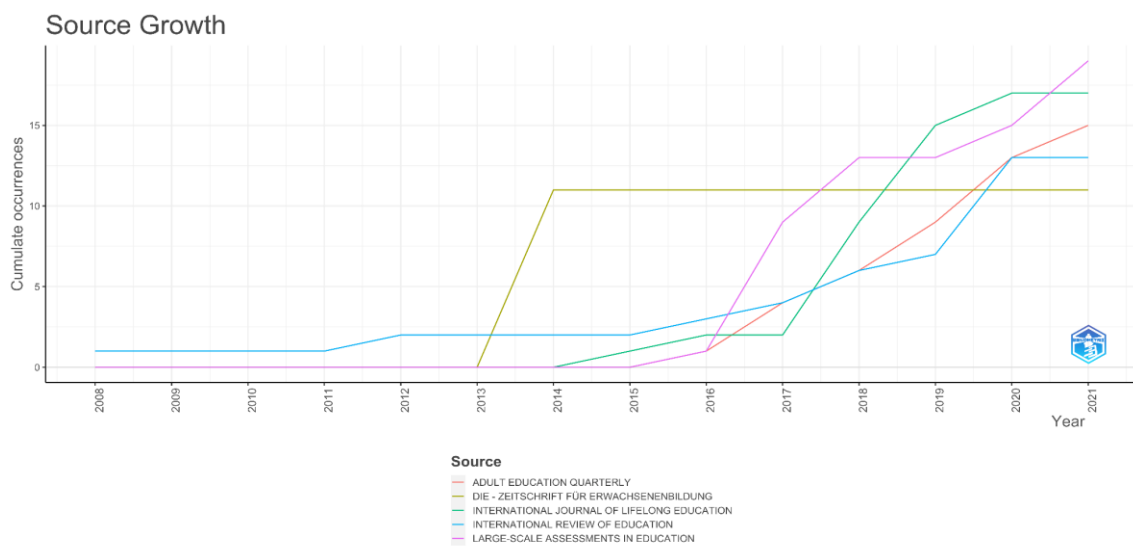


Figure S2 Yearly growth in PIAAC-based articles by journal.