

Bode, Eckhardt; Gold, Robert

## Article

# Adult training in the digital age

Economics: The Open-Access, Open-Assessment E-Journal

## Provided in Cooperation with:

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* Bode, Eckhardt; Gold, Robert (2018) : Adult training in the digital age, Economics: The Open-Access, Open-Assessment E-Journal, ISSN 1864-6042, Kiel Institute for the World Economy (IfW), Kiel, Vol. 12, Iss. 2018-36, pp. 1-14,  
<https://doi.org/10.5018/economics-ejournal.ja.2018-36>

This Version is available at:

<https://hdl.handle.net/10419/179927>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<http://creativecommons.org/licenses/by/4.0/>

## Adult training in the digital age

*Eckhardt Bode and Robert Gold*

### Abstract

Digital technologies will both create new jobs and replace existing ones. To cope with increasing labor market dynamics in the digital age, workers will have to become more mobile across jobs, occupations, and industries. The relative importance of their job-specific skills will decrease while that of their general skills applicable to various occupations will increase. The G20 should establish national adult training programs that focus on improving workers' general skills, specifically their theoretical, non-cognitive, and digital skills. These general skills will enable workers to work with technology instead of competing with it, thereby increasing their job mobility and employability.

(Published as [Global Solutions Paper](#))

**JEL** E24 I38 J24 J62 O33

**Keywords** Digitalization; employability; job mobility; adult training; skills; G20

### Authors

*Eckhardt Bode*, Kiel Institute for the World Economy, Germany, [eckhardt.bode@ifw-kiel.de](mailto:eckhardt.bode@ifw-kiel.de)

*Robert Gold*, Kiel Institute for the World Economy

**Citation** Eckhardt Bode and Robert Gold (2018). Adult training in the digital age. *Economics: The Open-Access, Open-Assessment E-Journal*, 12 (2018-36): 1–14. <http://dx.doi.org/10.5018/economics-ejournal.ja.2018-36>

# 1 Challenge

Technological change will further accelerate in the digital age. This will require even more workers to respond even more flexibly to an ever-changing labor demand. Estimates suggest that almost half of all jobs in developed countries are highly susceptible to being replaced by new, digital technologies within the next one or two decades (Frey and Osborne 2017). Jobs in less developed countries may face even greater challenges (Maloney and Molina 2016). While digitalization put medium-skilled, routine jobs at particularly high risk of being automated in the past (Acemoglu and Autor 2011), future digitalization may put low-skilled jobs at significantly higher risk (Bode et al. 2018). The digital technologies will create many new jobs, too. But most of these new jobs will emerge in different occupations or industries. Moreover, they will require different skills than the current jobs (Brynjolfsson and McAfee 2011; Autor 2015, Acemoglu and Restrepo 2018). The resulting skill mismatches may fuel significant technological unemployment in the short and medium term. To retain their employability and strengthen their resilience to technological change in the digital age, even more workers than in the computerization age need to continuously update and adjust their skills to complement the new technologies. Doing so will improve their mobility across tasks, jobs, occupations, and industries.

The political concepts of adult learning developed for the computerization age need to be re-focused to meet the challenges of the digital age. Policy responded to the continuously changing skill requirements of the computerization age by emphasizing lifelong learning (e.g., OECD 2003, 2005, 2010; UNESCO 2009; ILO 2010). Lifelong learning was also recognized as an important goal in United Nation's Sustainable Development Goals (SDG 4) and has been assigned high priority by the G20 since its 2009 Pittsburgh Summit. These political concepts of lifelong learning correctly recognize the need for public support of lifelong learning from cradle to grave. However, many of the current concepts fail in targeting those workers who need training the most, and teach practical skills needed on the current job instead of general (theoretical, non-cognitive and digital) skills<sup>1</sup> required for job mobility.

The lion's share of adult training in OECD countries is still made up by education and training of persons who are already highly skilled, and by activities focusing on skills that enhance workers' productivity within their current jobs rather than their mobility across tasks, jobs, occupations or industries. Table 1, which reports results of an OECD survey of adult skills (PIAAC) for individuals aged 25–65 in 28 countries, shows that participation rates in formal or non-formal adult training is about four times higher among high-skilled (48.8%) than among low-skilled individuals (11.8%).<sup>2</sup> This is even though low-skilled individuals have been found

---

<sup>1</sup> Following Becker (1962), we distinguish between training of *general skills* that enhance a worker's productivity in a variety of different jobs, and training of *specific skills* that enhance a worker's productivity in only her current job (or occupation). We will specify these types of skills in more detail below. For a theoretical analysis of the greater economic benefits from investments in general relative to specific (vocational) skills in times of rapid technological change see Gervais et al. (2008) and Tanaka (2018).

<sup>2</sup> OECD (2016a: 364) and UNESCO (2016a: 238) report similar educational gaps in participation rates in training measures. Even in the countries with the lowest gaps, New Zealand and the Netherlands, participation rates are more than two times higher for high-skilled than for low-skilled individuals. The gaps are highest in the Russian Federation

to benefit the most from adult training (Schwerdt et al. 2012).<sup>3</sup> The OECD (2015a: 384–391) identifies additional gaps at the expense of those workers who might need training the most: Participation in adult training is significantly lower among older workers, workers with lower proficiency in digital skills, and workers with fixed-term contracts. These gaps suggest that adult training currently fails to focus on those persons who arguably need adult training the most to retain or enhance their labor market resilience in the digital age.

Table 1 also shows that the lion’s share of training activities is employer-sponsored. Among the participants who were actually employed during their training activities—which is the vast majority of participants (92.6%)—four fifths (80%) recieved support by their employers. They received either financial support or were trained during working hours. Employer-sponsored training is even more prevalent among low-skilled workers. Only about one in 20 (5.7%) low-skilled employees participated in training with no notable support by their employers. This share varies across countries, ranging from virtually zero in some Eastern European countries to 15% in Denmark, Chile and Germany. Little is known about the extent to which employer-sponsored training also teaches general skills that enhance the participants’ mobility across jobs. However, some evidence hints at a particular strong focus of training of low-skilled workers in firm-, occupation- or industry-specific skills. Virtually all of the low-skilled training participants surveyed in PIAAC considered their training (at least moderately) useful for their current jobs, compared to only about half of the high-skilled participants. A strong focus of employer-

*Table 1: Participation in adult training in OECD countries*

	All	High-skilled	Low-skilled
Share in total population	33.3	48.8	11.8
Share of employed training participants	92.6	92.5	94.3
Share of employer-sponsored training	80.0	78.3	94.3
Useful for current job	55.0	57.7	94.3

*Notes:* Results of the Survey of Adult Skills (PIAAC) for persons aged 25–65 in Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Israel, Japan, Korea, Lithuania, Netherlands, New Zealand, Norway, Poland, Russian Federation, Singapore, Slovakia, Slovenia, Spain, Sweden, Turkey and United Kingdom. Adult training includes formal and non-formal training, as defined in OECD (2016a: 369). High-skilled: tertiary education (ISCED5 or higher), low-skilled: up to lower secondary education (ISCED2 or lower). Share in total population: Share of individuals aged 25–65 who participated in at least one formal or non-formal training activity during the year prior to the survey. Share of employed training participants: Share of training participants who were employed (full- or part-time) or self-employed during the training activity. Share of employer-sponsored training: Share of training participants whose employer paid at least partly for this training or whose training activity took place at least partly during working hours. Useful for current job: Share of participants who stated that this training was at least moderately useful for their current job or business.

*Source:* OECD (2016b), own calculations.

(18 times higher) and Greece (14 times). Detailed country-specific results are available from the authors upon request.

<sup>3</sup> In line with this, Table 1 reveals that low-skilled individuals are significantly more likely to find the training measures they attend to be useful for their current jobs. However, this would also be in line with low-skilled workers participating in training programs to enhance their job-specific skills, and high-skilled workers participating in training measures to expand their skill set beyond their current job’s requirements.

sponsored training on specific skills appears reasonable, as most employers can be expected to be more interested in improving their workers' productivity within the current jobs rather than their workers' mobility across jobs (Becker 1962: 16). Overall, this suggests that adult training currently focuses too little on enhancing general skills.

More public support is needed to increase participation of employed workers in general training, particularly of those with skill deficiencies. This task should not be left to employers alone because employers pursue different goals. It should also not be left to the workers alone because many workers face obstacles to participating in training measures they cannot easily overcome without additional support. The reasons why participation in training of general skills is rather low, especially for lower-skilled workers, are manifold (see below). Governmental support may help workers to cope with these issues. There is, however, no one-size-fits-all concept for adult training policies in the G20. The relative importance of the various obstacles to training participation differs not only across individuals but also across countries (Roosma and Saar 2017). Increasing participation of employed workers in general training in the G20 thus requires concepts that are, on the one hand, tailored to the needs of the specificities of the national economic, social and educational systems, and, on the other hand, help individual workers overcome their specific obstacles.

Eventually, the goal should be to enable workers to complement technology instead of competing with it. Digitalization provides manifold opportunities to increase labor productivity, also of low- and medium skilled workers. With digitalization, new tasks emerge that require cooperation between man and machine but not necessarily a college degree. As technologies become "smart" and "intelligent", they can make up for workers' insufficiencies and allow them to focus on tasks where they have skill advantages. To tap into this potential, workers need to be trained to productively work with technology. Theoretical, non-cognitive and digital skills are complements to technology in a variety of work tasks. Training these general skills will therefore help workers to flexibly adjust to technological change. It will increase their mobility across tasks, jobs, occupations, and industries, thus increasing their employability. This will not only reduce technological unemployment resulting from digitalization. It will also reduce polarization and social tensions in the digital age.

## **2 Solution: Adult training programs for employed workers with a focus on skills that complement technology**

The G20 should launch and spearhead a new initiative to establish national adult training programs that focus on strengthening workers' resilience to technological change. This initiative should encourage and support countries in establishing institutionalized national lifelong training programs for employed workers. The programs should focus on workers with limited general skills who are less mobile across jobs and occupations, and whose jobs are susceptible to being replaced by the new technologies. These programs should aim at upgrading workers' proficiencies of theoretical, non-cognitive or digital skills in order to

- keep them employable in the digital age,
- strengthen their resilience to technological change,
- enable them to utilize new technologies in order to increase their own productivity,
- enhance their mobility across tasks, jobs, occupations and industries, particularly their upward mobility, and
- spare them from the need to take lower-paying services jobs that cannot (yet) be automated.

The adult training program should define criteria for eligibility according to workers' susceptibility to automation. Eligible workers shall be granted the right to participate in certified off-the-job courses that focus on improving their proficiencies in general skills, notably in theoretical, non-cognitive and digital skills. By focusing on general skills, the program will complement rather than replace employer-initiated training of practical (task-, job-, occupation- or industry-specific) skills. The program should also raise the workers' awareness of the challenges from the new technologies for job security, incentivize them to participate in the program, and support them in choosing the measures that fit their needs best.

## **2.1 Training objectives**

The adult training programs should focus on enhancing workers' proficiencies in those skills that will further gain in importance in the digital age, and that enhance workers' mobility across tasks, jobs, occupations and industries. We label these skills 'general' skills to distinguish them from (task-, job-, occupation- or industry-) 'specific' skills.<sup>4</sup> Unlike specific skills, general skills can be used in a broader variety of jobs and occupations. They also enable workers to complement—rather than compete with—the new technologies to come (Autor et al. 2003, Deming 2017). To characterize them in more detail, we categorize these general skills into three dimensions, theoretical, non-cognitive and digital skills, which complement each other in both learning and application (UNESCO 2016b).

By theoretical skills we mean cognitive (intellectual) skills that determine the ability to learn, evaluate, solve problems, and take initiative.<sup>5</sup> They are typically acquired in classroom-based education at school or university. Theoretical skills go beyond the applied occupational skills that are required for performing every day's job routines in specific jobs or occupations. They enable workers to better understand and critically reflect why they do what they do, to creatively solve non-routine problems, and to acquire new knowledge or problem-solving routines. Higher proficiencies in these skills do not only enable workers to adapt more flexibly to new technologies, work requirements, and work environments in their current jobs. They also

---

<sup>4</sup> Alternative labels of general skills are “transversal” or “transferable” skills. See, among others, <http://www.unevoc.unesco.org/go.php?q=TVETipedia+Glossary+A-Z> or [https://ec.europa.eu/esco/portal/escopedia/Skill\\_reusability\\_level?resetLanguage=true&newLanguage=en](https://ec.europa.eu/esco/portal/escopedia/Skill_reusability_level?resetLanguage=true&newLanguage=en).

<sup>5</sup> Apart from literacy and numeracy, theoretical skills include learning skills, i.e., the ability to acquire and remember knowledge, thinking skills, i.e., the ability to combine and re-combine available information and knowledge, and metacognitive skills, i.e., the ability to purposefully combine the various skills and critically reflect their usefulness in a specific context. See Carroll (1993) or Ackerman and Heggestad (1997) for a detailed taxonomy of cognitive skills.

enhance workers' mobility across tasks, jobs, occupations or industries (e.g., Poletaev and Robinson 2008, Geel and Backes-Gellner 2011).

Non-cognitive skills are the characteristic patterns of values, behaviors and attitudes that determine a person's stance on learning and taking initiative. Non-cognitive skills, also termed "soft" skills, include (see, e.g., Lerman 2017: 184; Van de Werfhorst 2014: 129–130; OECD 2015b):

- Basic "employability" skills, such as punctuality, reliability, responsibility, integrity, honesty and work discipline, which are important for all jobs, especially for those with low requirements of cognitive or, for that matter, theoretical skills. Employers arguably value these skills as highly as, or even higher than, basic cognitive skills like reading or writing (Lerman 2013).
- Values, behaviors and attitudes that constitute a precondition for learning, problem solving and creativity such as curiosity, open-mindedness, determination, self-confidence and self-motivation. These non-cognitive skills facilitate the accumulation of theoretical skills by enhancing the willingness to learn (Almlund et al. 2011; Kautz et al. 2014). This is why deficits in non-cognitive skills such as a lack of curiosity, determination or self-confidence frequently go hand in hand with lower cognitive skills and lower creativity (Cunha et al. 2010; Whitmore Schanzenbach et al. 2016; Sternberg 2006).
- Social (interpersonal) skills, such as the ability to communicate or to work in teams, which are important in several respects (Borghans et al. 2008). On the one hand, the ability to direct, coordinate and motivate co-workers is a valuable managerial skill that complements theoretical skills. On the other hand, caring for others' well-being is a valuable skill in various services, including health and domestic services. In any case, social skills will be difficult to replace by technology in the foreseeable future.

Recent evidence suggests that non-cognitive skills may in fact change over the life cycle and may be affected by own investments or changes in external life circumstances (Almlund et al. 2011: Section 8, Schäfer 2017). For example, people tend to become more conscientious, more agreeable and emotionally more stable over the (adult) life cycle (Almlund et al. 2011: 119). More research is needed on the extent to which non-cognitive skills may be shaped through deliberate investments during adulthood, though (Almlund et al. 2011: 150).

Digital skills are cognitive skills that are specific to using digital technologies and working in digitized environments. While a generally accepted taxonomy of digital skills is not available, we emphasize that they essentially include (i) ICT skills, i.e., the ability to utilize ICT and the Internet to access, process, and exchange information, (ii) software and programming skills, i.e., the ability to autonomously use computer programs and to adjust them to the users' requirements, and (iii) digital literacy, i.e., the basic understanding of how digital technologies function, which opportunities they offer and which risks they involve (e.g., cybersecurity).<sup>6</sup>

---

<sup>6</sup> Several taxonomies of digital (or IT) skills like that by the OECD additionally include "ICT-complementary skills", among which are "the capability to process complex information, communicate with co-workers and clients, solve problems, plan in advance and adjust quickly" (OECD 2016c: 6). These are essentially those skills that we label theoretical skills and non-cognitive skills in this paper.

Adult training programs should generally aim at enhancing all three skill dimensions simultaneously, and at the same time help workers with particular deficits in certain dimensions to enhance their proficiencies in these skills. In fact, motivating eligible workers to voluntarily participate in adult training will be one of the programs' most crucial and most difficult tasks. One of the most disappointing insights from evaluations of voluntary training measures is that the workers who needed the training the most show the least willingness to participate (OECD 2016a; Schwerdt et al. 2012; Caliendo et al. 2016). Possible reasons for workers' non-participation are manifold, including economic and psychological barriers. Economic barriers include age, capital-market imperfections and incomplete information (McCall et al. 2016). Higher age leaves less time for active labor market participation to recoup the training costs through future higher wages. Capital-market imperfections may prevent particularly low-income workers from borrowing the tuition fees of training courses. And incomplete information creates uncertainty about the future returns from training, which results in suboptimally low investments in training. Psychological barriers include a lack of motivation that may be rooted in workers' personalities or personal experiences. Workers with more external locus of control (who believe their actions to have less influence on future outcomes) tend to participate less in adult training, for example, because they expect lower returns (Caliendo et al. 2016). Bad personal experiences at school during young ages may also discourage workers from participating in classroom-based adult training. And less patient students are more likely to drop out of vocational training, be it because they underestimate its long-term benefits or because they are less willing to bear the immediate costs of learning (Backes-Gellner et al. 2018).

The willingness to participate also differs considerably across countries, depending, among others, on the peculiarities of the countries' economic and cultural institutions as well as on their education systems (e.g., Boeren et al. 2012, Cincinnato et al. 2014, Roosmaa and Saar 2017). Since forced participation in training is not an option because participants cannot be forced to learn, the programs must devote utmost effort to motivating the targeted workers to participate voluntarily. Motivation-enhancing measures should include information and awareness-raising. Eligible workers should, for example, be informed about the reasons why they were selected to participate in a training program, and about the aims of the training program. A recent study by Barr and Turner (2017) suggests that a well-designed campaign of awareness-raising may increase the willingness to participate more than financial incentives. Measures should also include extensive coaching, attractive design of training courses, success monitoring and feedback. How precisely these measures should be designed is impossible to say *ex ante*, and will likely differ across countries. Exploring successful ways of motivating eligible workers to participate in the program will likely take several years of trial and error, and will have to be supported by careful scientific evaluations and extensive exchange of experiences. The G20 should encourage and substantiate these evaluations and exchanges.

## **2.2 Target group**

The adult training programs should specifically target workers who are highly susceptible to automation. Empirical evidence suggests that workers self-select into those occupations and jobs whose skill requirements match their own skill endowments comparatively well (Almlund



et al. 2011). As a consequence, workers with low proficiencies in general skills tend to self-select into jobs that can be automatized comparatively easily. After losing their jobs to digital technologies, these workers will face particularly high risks of suffering permanent economic and social deprivation. They will not only have to write off their job-specific skills. They will also be ill-prepared to take new jobs that complement the new technologies. Recent experience from the U.S. (Autor and Dorn 2013, Acemoglu and Restrepo 2017) indicates that many of these workers will have little chance but to take lower-paying jobs in service industries. And those who keep their jobs may have to accept lower pay (Dauth et al. 2017). The proposed adult training programs shall gradually reshape these workers' skill endowments toward higher proficiencies in theoretical, non-cognitive and digital skills. Even if these higher proficiencies do not help them keep their current jobs, they may better qualify them for other, decently paying jobs that are less easily automated. At least, training of general skills should help workers earn their living. Even better, it should spare them from the need to move down the income ladder. At best, it may enhance their upward mobility toward jobs that complement the new technologies.

### **2.3 Funding**

Public funding of the adult training programs is justified by lowering social costs of polarization. The program costs should generally be covered by all relevant stakeholders in proportion to their benefits from the program. The costs include the costs of the courses themselves, workers' wage losses during the training, employers' organizational costs, and administrative costs. The beneficiaries include the trained workers as well as employers and society as a whole. The trained workers themselves benefit from improved long-run income prospects. Employers as a whole benefit from a larger pool of better educated workers from which they may draw their workforces. And society benefits from less social tension, if polarization can be alleviated, as well as from higher income tax revenues and lower costs of social assistance. The computerization of jobs during recent decades has contributed to aggravating the polarization of employment and wages in several G20 countries (Autor and Dorn 2013, Autor 2015). Arguably, it has also fostered political populism supported by those who feel left behind by the technological changes (Taylor 2017). The costs of social polarization and political instability are difficult to quantify in dollars and cents, and will likely differ across countries. However, the prospects of greater social and political stability alone may justify a significant public contribution to funding the program. In addition to this, incomplete information, psychological barriers of eligible workers, restrictions imposed by countries' economic, cultural and education institutions as well as capital market imperfections like the unavailability of educational training loans may justify public investments into adult training (McCall et al. 2016).

Governments should cover the lion's share of the programs in the first years when the programs are being established. In each country, the initial phase of the programs will be characterized by high uncertainty about program success and extensive learning about effective incentive systems for eligible workers, appropriate curricula, preferred course designs, and effective administration. This learning will require a good deal of trial and error. It may even be

designed as a series of controlled, scientifically evaluated experiments that expose randomly chosen workers to different incentive systems, curricula and course designs. While trial and error will likely limit the program's benefits for individual participants during this initial phase, the longer-term social benefits in terms of institutional and operational learning will be comparatively high. This is why the initial phase should be financed mainly by public funds. Public funding accounts for the fact that institutional and operational learning benefits society as a whole. It also compensates those workers who participate in explorative but ex post potentially ineffective training measures. Governmental funding may possibly be supported by low-interest loans by the World Bank or regional development banks. As the program becomes more popular and converges to a stable, effective institutional design and workable operational structures, the governments may gradually divert financial burdens to other stakeholders.

## **2.4 Administration and control**

Governments should set up the program's legal framework and appoint a single, national agency to administer the entire program. This agency should be embedded in the national education system. The governments should grant the program agency far-reaching autonomy, enabling it to explore feasible ways to design and implement the program. In particular, the agency should be responsible for

- Determining and occasionally adjusting the range of eligible workers, possibly based on reliable studies of the susceptibility of occupations or, for that matter, tasks, to being automated in the respective foreseeable future,
- Issuing periodical training vouchers or training accounts that entitle the eligible workers to participate in one or two weeks of off-the-job training per year,
- Serving as a one-stop shop for all concerns of the eligible workers,
- Trying out and selecting appropriate measures to incentivize and to coach eligible workers,
- Accrediting and supervising the—private or public—training institutions,
- Exploring effective ways of offering courses online,
- Deciding on the magnitudes of tuition fees and compensations for wage losses,
- Continuously evaluating incentive schemes for workers and the effectiveness of the courses,
- Keeping the program budget and deciding on how it is spent, and
- Deciding on to what extent non-eligible workers, including unemployed, may participate in training courses.

The detailed task profile of this agency, which may be an existing national agency or a newly created one, will have to be adjusted to the specificities of the country's institutional, economic, and social framework. Governments should ensure that it fits smoothly into this framework and complements existing agencies rather than competing with them. They should

ensure in particular that program success will not be compromised by conflicts of interest on the side of the agency's stakeholders.<sup>7</sup>

Governments should appoint a supervisory body for the program that advises and monitors the program agency. This supervisory body should represent all relevant stakeholders, including the government (notably the Ministries of Education and Labor), the national unemployment agency, employers' associations, trade unions and researchers (notably from education, psychological and economic sciences). The supervisory body should, on the one hand, serve as an advisory council to the program agency. It should continuously communicate the needs of all relevant stakeholders to the agency. On the other hand, it should critically supervise the agency's policy. It should, for example, regularly commission independent evaluations of the agency's policies regarding the eligibility of workers, the incentive systems, the courses' contents and cost-effectiveness. The results of these evaluations should be fed directly into the program agency to facilitate timely improvements of the system. They should also be published to keep the public informed about the development of the adult training program, thus raising people's awareness of changing skill demand in the digital age.

The G20 should support regular exchange of information on successes—and failure—of the national training programs. To facilitate learning across national borders, and to establish an additional layer of checks and balances, the G20 should request comparative periodical reports on all national adult training programs. These reports should be prepared by international organizations specialized in the field, for instance the UNESCO, the OECD or the ILO. The comparative reports should include elements of evaluation. They may, for example, identify best practices in the various activities of the national agencies or limitations to the international transferability of specific activities. Such evaluations will not only help improve the effectiveness and reduce the costs of national programs in the G20 countries. They will also help third countries in establishing their own adult training programs to better meet the challenges from digitalization.

## References

- Acemoglu, D., and D.H. Autor (2011). Skills, Tasks and Technologies: Implications for Employment and Earnings. In D. Card and O. Ashenfelter (eds.), *Handbook of Labor Economics* Vol. 4, Part B, Elsevier, Amsterdam, pp. 1043–1171.
- Acemoglu, D., and P. Restrepo (2017). Robots and Jobs: Evidence from US Labor Markets. NBER Working Paper 23285. <http://www.nber.org/papers/w23285>
- Acemoglu, D., and P. Restrepo (2018). Artificial Intelligence, Automation and Work. Working Paper 18-01, Massachusetts Institute of Technology, Department of Economics. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3098384](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3098384)

---

<sup>7</sup> The agency should, for example, not be dominated by employers' organizations who might try diverting program funds for training of job-, occupation- or industry-specific skills, i.e., use the program as a substitute for their own training investments. Neither should it be dominated by unemployment agencies that might try diverting program funds to training of unemployed workers.

- Ackerman, P.L., and E.D. Heggstad (1997). Intelligence, Personality, and Interests: Evidence for Overlapping Traits. *Psychological Bulletin* 121(2): 219–245.  
[https://www.researchgate.net/profile/Eric\\_Heggstad/publication/14115879\\_Intelligence\\_Personality\\_and\\_Interests\\_Evidence\\_for\\_Overlapping\\_Traits/links/53dba8460cf2cfac9928f604.pdf](https://www.researchgate.net/profile/Eric_Heggstad/publication/14115879_Intelligence_Personality_and_Interests_Evidence_for_Overlapping_Traits/links/53dba8460cf2cfac9928f604.pdf)
- Almlund, M., A.L. Duckworth, J.J. Heckman and T.D. Kautz (2011). Personality Psychology and Economics. In E.A. Hanushek, S. Machin and L. Woessmann (eds.), *Handbook of the Economics of Education* Vol. 4. Elsevier, Amsterdam, pp. 1–181.  
<https://doi.org/10.1016/B978-0-444-53444-6.00001-8>
- Autor, D.H. (2015). Why Are There Still So Many Jobs? The History and Future of Work-place Automation. *Journal of Economic Perspectives* 29(3): 3–30. <https://doi.org/10.1257/jep.29.3.3>
- Autor, D.H., and D. Dorn (2013). The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review* 103(5): 1553–1597.  
<https://www.aeaweb.org/articles?id=10.1257/aer.103.5.1553>
- Autor, D.H., F. Levy and R.J. Murnane (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *Quarterly Journal of Economics* 118(4): 1279–1333.  
<https://doi.org/10.1162/003355303322552801>
- Backes-Gellner, U., H. Herz, M. Kosfeld and Y. Oswald (2018). Do Preferences and Biases Predict Life Outcomes? Evidence from Education and Labor Market Entry Decisions. CEPR Discussion Paper 12609. <https://ideas.repec.org/p/cpr/ceprdp/12609.html>
- Barr, A., and S. Turner (2017). A Letter and Encouragement: Does Information Increase Post-Secondary Enrollment of UI Recipients? NBER Working Paper 23374. National Bureau of Economic Research, Cambridge, Ca. <http://www.nber.org/papers/w23374.pdf>
- Becker, G.S. (1962). Investment in Human Capital: A Theoretical Analysis. *Journal of Political Economy* 70 (5, Part 2): 9–49. <https://www.jstor.org/stable/1829103>
- Bode, E., S. Brunow, I. Ott and A. Sorgner (2018). Worker Personality: Another Skill Bias beyond Education in the Digital Age. *German Economic Review*, forthcoming  
<https://doi.org/10.1111/geer.12165>
- Boeren, E., J. Holford, I. Nicaise and H. Baert (2012). Why Do Adults Learn? Developing a Motivational Typology Across 12 European Countries. *Globalisation, Societies and Education* 10: 247–269.  
<https://doi.org/10.1080/14767724.2012.678764>
- Borghans, L., B. ter Weel and B.A. Weinberg (2008). Interpersonal Styles and Labor Market Outcomes. *Journal of Human Resources* 43(4): 815–858. <https://doi.org/10.3368/jhr.43.4.815>
- Brynjolfsson, E. and A. McAfee (2011). *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Digital Frontier Press, Lexington, Ma.
- Caliendo, M., D.A. Cobb-Clark, H. Seitz and A. Uhlendorff (2016). Locus of Control and Investment in Training. IZA DP 10406, Institute of Labor Economics, Bonn.  
<http://ftp.iza.org/dp10406.pdf>
- Carroll, J.B. (1993). *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*. Cambridge University Press, New York.

- Cincinnati, S., B. De Wever and M. Valcke (2014). The Learning Divide in Formal Adult Education: Why Do Low-qualified Adults Participate Less? In: P. Guimarães, C. Cavaco, L. Marrocos, C. Paulos, A. Bruno, S. Rodrigues and M. Marques (eds.), *Local Change, Social Actions and Adult Learning: Challenges and Responses*. University of Lisbon, pp. 401–415.
- Cunha, F., J.J. Heckman and S.M. Schennach (2010). Estimating the Technology of Cognitive and Noncognitive Skill Formation. *Econometrica* 78(3): 883–931. <https://doi.org/10.3982/ECTA6551>
- Dauth, W., S. Findeisen, J. Südekum and N. Wößner (2017). German Robots – The Impact of Industrial Robots on Workers. CEPR Discussion Paper 12306. <https://ideas.repec.org/p/cpr/ceprdp/12306.html>
- Deming, D.J. (2017). The Growing Importance of Social Skills in the Labor Market. *Quarterly Journal of Economics* 132(4): 1593–1640. <https://doi.org/10.3368/jhr.43.4.815>
- Frey, C.B., and M.A. Osborne (2017). The Future of Employment: How Susceptible and Jobs to Computerization? *Technological Forecasting and Social Change* 114: 254–280. <https://doi.org/10.1016/j.techfore.2016.08.019>
- Geel, R., and U. Backes-Gellner (2011). Occupational Mobility Within and Between Skill Clusters: An Empirical Analysis Based on the Skill-weights Approach. *Empirical Research in Vocational Education and Training* 3 (1): 21–38. <https://core.ac.uk/download/pdf/33980891.pdf>
- ILO [International Labour Office] (2010). *A Skilled Workforce for Strong, Sustainable and Balanced Growth: A G20 Training Strategy*. International Labour Office, Geneva <https://www.oecd.org/g20/summits/toronto/G20-Skills-Strategy.pdf>
- Kautz, T., J.J. Heckman, R. Diris, B. ter Weel and L. Borghans (2014). Fostering and Measuring Skills: Improving Cognitive and Non-cognitive Skills to Promote Lifetime Success. NBER Working Paper 20749. National Bureau of Economic Research, Cambridge, MA. <http://www.nber.org/papers/w20749>
- Lerman, R.I. (2013). Are Employability Skills Learned in U.S. Youth Education and Training Programs? *IZA Journal of Labor Policy* 2: 6. <https://doi.org/10.1186/2193-9004-2-6>
- Lerman, R.I. (2017). Skill Development in Middle Level Occupations: The Role of Apprenticeship Training. In: C. Warhurst, K. Meyhew, J. Buchanan and D. Finegold (eds.), *Oxford Handbook of Skills and Training*, Oxford University Press, Oxford, pp. 180–200. <https://doi.org/10.1093/oxfordhb/9780199655366.013.9>
- Maloney, W.F., and C. Molina (2016). Are Automation and Trade Polarizing Developing Country Labor Markets, Too? Policy Research Working Paper 7922. World Bank, Washington, DC. <http://documents.worldbank.org/curated/en/869281482170996446/Are-automation-and-trade-polarizing-developing-country-labor-markets-too>
- McCall, B., J. Smith and C. Wunsch (2016). Government-Sponsored Vocational Education for Adults. In: E.A. Hanushek, S. Machin and L. Woessmann (eds.), *Handbook of the Economics of Education* Vol. 5. Elsevier, Amsterdam, pp. 479–652. <https://doi.org/10.1016/B978-0-444-63459-7.00009-9>
- OECD (2003). *Beyond Rhetoric: Adult Learning Policies and Practices*. Organisation for Economic Co-operation and Development, Paris. <https://doi.org/10.1787/9789264199446-en>
- OECD (2005). *Promoting Adult Learning*. Organisation for Economic Co-operation and Development, Paris. <http://dx.doi.org/10.1787/9789264010932-en>

- OECD (2010). Learning for Jobs. Organization for Economic Development and Co-Operation, Paris. <http://dx.doi.org/10.1787/9789264087460-en>
- OECD (2015a). Education at a Glance 2015: OECD Indicators. Organisation for Economic Co-operation and Development, Paris. <http://dx.doi.org/10.1787/eag-2015-en>
- OECD (2015b). Skills for Social Progress: The Power of Social and Emotional Skills. Organisation for Economic Co-operation and Development, Paris. <http://dx.doi.org/10.1787/9789264226159-en>
- OECD (2016a). Education at a Glance 2016: OECD Indicators. Organisation for Economic Co-operation and Development, Paris. <http://dx.doi.org/10.1787/eag-2016-en>
- OECD (2016b). Survey of Adult Skills (PIAAC) (Database 2012, 2015). [www.oecd.org/site/piaac/publicdataandanalysis.htm](http://www.oecd.org/site/piaac/publicdataandanalysis.htm)
- OECD (2016c). Skills for a Digital World – 2016 Ministerial Meeting on the Digital Economy: Background Report. OECD Digital Economy Papers 250. Organisation for Economic Co-operation and Development, Paris. <http://dx.doi.org/10.1787/5jlwz83z3wnw-en>
- Pastore, F. (2015). The European Youth Guarantee: Labor Market Context, Conditions and Opportunities in Italy, *IZA Journal of European Labor Studies* 4 (11): 1–22. <https://doi.org/10.1186/s40174-015-0033-2>
- Poletaev M., and C. Robinson (2008). Human Capital Specificity: Evidence from the Dictionary of Occupational Titles and Displaced Worker Surveys, 1984–2000. *Journal of Labor Economics* 26 (3): 387–420. <https://www.jstor.org/stable/10.1086/588180>
- Roosma, E.-L., and E. Saar (2017). Adults Who Do Not Want to Participate in Learning: A Cross-national European Analysis of Their Perceived Barriers. *International Journal of Lifelong Education* 36 (3): 254–277. <https://doi.org/10.1080/02601370.2016.1246485>
- Schäfer, K.C. (2017). An Investigation Into the Stability of the Big-Five in Germany. Hannover Economic Papers 600. Leibniz University Hannover. [http://diskussionspapiere.wiwi.uni-hannover.de/pdf\\_bib/dp-600.pdf](http://diskussionspapiere.wiwi.uni-hannover.de/pdf_bib/dp-600.pdf)
- Schwerdt, G., D. Messer, L. Woessmann and S.C. Wolter (2012). The Impact of an Adult Education Voucher Program: Evidence from a Randomized Field Experiment. *Journal of Public Economics* 96 (7-8) 569–583. <https://doi.org/10.1016/j.jpubeco.2012.03.001>
- Taylor, P. (2017). Parsing Populism and Its Impact at Davos. *Forbes BrandVoice*, Jan 16, 2017. <https://www.forbes.com/sites/sap/2017/01/16/parsing-populism-and-its-impact-at-davos/#44e377f5830b>, accessed 27.05.2017
- Sternberg, R.J. (2006). The Nature of Creativity. *Creativity Research Journal* 18: 87–98. [https://www.cc.gatech.edu/classes/AY2013/cs7601\\_spring/papers/Sternberg\\_Nature-of-creativity.pdf](https://www.cc.gatech.edu/classes/AY2013/cs7601_spring/papers/Sternberg_Nature-of-creativity.pdf)
- UNESCO (2009). Belém Framework for Action: Harnessing the Power and Potential of Adult Learning and Education for a Viable Future. Sixth International Conference on Adult Education, Belém, 4 December 2009. United Nations Educational, Scientific and Cultural Organization, Geneva. [https://www.unesco.de/fileadmin/medien/Dokumente/Bildung/CONFINTEA\\_VI\\_Belem\\_Framework\\_for\\_Action\\_Final.pdf](https://www.unesco.de/fileadmin/medien/Dokumente/Bildung/CONFINTEA_VI_Belem_Framework_for_Action_Final.pdf)

- UNESCO (2016a). Education for People and Planet: Creating Sustainable Futures for All. *Global Education Monitoring Report 2016*. United Nations Educational, Scientific and Cultural Organization, Geneva. <http://unesdoc.unesco.org/images/0024/002457/245752e.pdf>
- UNESCO (2016b). A Conceptual Framework for Competencies Assessment. In-Progress Reflection No. 4 on Current and Critical Issues in the Curriculum and Learning. United Nations Educational, Scientific and Cultural Organization, International Bureau of Education, Geneva. <http://unesdoc.unesco.org/images/0024/002451/245195e.pdf>
- Van de Werfhorst, H.G. (2014). Changing Societies and Four Tasks of Schooling: Challenges for Strongly Differentiated Educational Systems. *International Review of Education* 60: 123–144. <http://hermanvandewerfhorst.socsci.uva.nl/IRE2014.pdf>
- Whitmore Schanzenbach, D., R. Nunn, L. Bauer, M. Mumford and A. Breitwieser (2016). Seven Facts on Noncognitive Skills from Education to the Labor Market. Economic Facts, October 2016. Hamilton Project, Brookings Institution, Washington, DC. [http://www.hamiltonproject.org/assets/files/seven\\_facts\\_noncognitive\\_skills\\_education\\_labor\\_market.pdf](http://www.hamiltonproject.org/assets/files/seven_facts_noncognitive_skills_education_labor_market.pdf).

Please note:

You are most sincerely encouraged to participate in the open assessment of this article. You can do so by either recommending the article or by posting your comments.

Please go to:

<http://dx.doi.org/10.5018/economics-ejournal.ja.2018-36>

The Editor