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Smart skills and education in a future economy

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Whether the role of education is to prepare people for employment or to have meaningful lives in general, it will identify and develop skills and competencies, as well as vocational and personal attributes. Skills, such as critical thinking, novel ideation, and complex cognitive and social skills, are areas where humans continue to outperform smart machines. The purpose of this article is to review the skills and competencies that will be in demand in the future, with an eye to recent technological changes. First, macroeconomic data concerning higher education will be reviewed in order to illustrate the situation of tertiary education, with a focus on Poland. A significant decline in demand for tertiary education has been observed in Poland in the last few years, despite the good returns on investment in education, which are the highest among the OECD countries. The empirical part of this paper presents results of a pilot survey that aimed to provide insight into several key competencies and vocational attributes that are perceived to be relevant for a future economy, according to Polish employers. The primary data was collected manually, using a quantitative survey on three occasions at two different job fairs in Gdansk in March 2017. Work experience, new media literacy, and formal education were assessed as least relevant variables (x=13); learning and diligence were assessed as most relevant according to the studied target group (n=55). Furthermore, the study showed specific differences in perception, depending on the size of the employer.

Higher education and demographic decline

The exact idea of the appropriate role of higher education institutions (HEI) today is widely discussed. The focus is typically either on economic competitiveness and efficiency or on social and cultural objectives. In other words, the competing visions regard education from a macro perspective – national or global, such as in human capital theory – or micro aspects that emphasize individual capabilities – such as in the human development and capabilities approach. Education can be also treated as a tool for spreading democracy and human rights (Boni and Walker, 2013, pp. 1–3). From yet another perspective, education can serve as the development of skills and competencies, and professional and personal attributes (Brewer, 2013, after ILO, 2015, p. 2).

In the OECD countries, universities experienced an exceptional enrollment boom during the 1990's, where students were abandoning vocational education for the sake of an academic one (OECD, 2016a, p. 48). This educational boom should have already reached its zenith in all of the 27 EU countries and other OECD countries (Kwiek, 2015, p. 186). In Poland, the number of students grew by almost 500%, from 390.409 in 1990 to over 1.900.000 students in total[1] in 2006, and has been on decline ever since, falling to 1405.133 by the end of 2015 (MNiSW, 2013). Kwiek argues that the drastic decline in demand for education in Poland is a result of the cumulative effect of shrinking demographics and outmigration. The number of students in Poland might shrink by half, from the 2006 levels to 1.000,000 by 2025; while other more conservative predictions forecasts the number to fall to 1.260,000, a 55–65% decrease (Vincent-Lancrin, 2008, p. 45; Antonowicz, Godlewski, 2011, pp. 10–14; IBE, 2011, 110–111; EY/IBNGR, 2010, p. 20, after Kwiek, 2016, pp. 7–8).

In response to the urgent demographic issues and the challenges of globalization and the financial crisis, the European Commission set a series of objectives for achieving smart and sustainable economic growth. As means to protect European societies from the risk of poverty, three of these targets address the better use of human resources. Special attention has been paid to improving employment, skills, and labor through education, aiming for at least 40% of the younger generation to have a tertiary education degree (European Commission, 2010). Yet, as Sulkowski and Zawadzki note, having a university diploma does not necessarily guarantee that someone will be educated. On the contrary, they argue that there is a phenomena of "certified philistines" that can be observed today (Sulkowski, Zawadzki, 2016, p. 122).

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[1] The number of students participating in tertiary education in Poland includes private and public sectors and full and part time students.

It seems that universities and other higher education institutions must justify their existence. Enrollments in schooling are declining, especially in the United States. The costs of higher education are increasing faster than inflation, while the value of a university degree is falling (Barber, Donnelly, Rizvi, 2013, pp. 13–15). The returns are lower in the high-income OECD countries and lowest for non-OECD European, Middle East, and North African countries (Psacharopoulos, Patrinos, 2004, p. 112). A significant decline in demand for education has been observed in Poland, but the returns of investment in education are the highest among the OECD countries. Meanwhile, the return for skills in Poland is a little above the average (OECD, 2016a, p. 47). This observation is supported by a study of Psacharopoulos and Patrinos (2004), according to which the returns to education are higher in low- and middle-income countries. They point out that there are tangible and measurable returns to investment in education on a micro level, although "such evidence is not as consistent and forthcoming in the macro literature" (Psacharopoulos and Patrinos, 2004, p. 118). Limitations of macroeconomic evidence of schooling benefitting different individuals should involve consideration of wider benefits. Such benefits – sometimes called externalities, spillover benefits, or social rates of return – are hard to capture for the educated person, his/her society, and economists (Psacharopoulos, Patrinos, 2004, p. 117; Temple, 2002, pp. 5–46).

Over-education and skills mismatch are some macroeconomic reasons for the dissatisfaction of highly educated workers (Kocór, 2015, pp. 12–25). Even though people with a HE diploma have higher earnings in Poland than lower educated people do, the qualifications mismatch has tripled in the years 1988–2008 (Kiersztyn, 2011, p. 11). According to Budria and Moro-Egido's research, "significant proportion of the labor force in developed countries has more education than is actually required for their jobs, i.e. is overqualified" (Budria, Moro-Egido, 2014, p. 2). Nevertheless, one of the limitations in gaining reliable data regarding the relation between education (or acquired competencies, knowledge, qualifications, and skills) and demand of particular labor characteristics is the fact that it is done subjectively by the employees (Kiersztyn, 2011, p. 10; Pacuska, 2014, p. 8).

Future skills

Automation should facilitate and improve productivity, and it could also help offset the impact of a declining share of the working-age population that many countries are struggling with (McKinsey Global Institute, 2017, p. 9). Tasks that cannot be substituted by automation are often complemented, as most work processes involve multifaceted set of inputs, e.g., creativity and rote repetition or technical mastery and intuitive judgment. The complementation of work processes occurs typically in the routine cognitive and routine manual tasks, hence increasing the economic value of remaining tasks (Author, 2015a, pp. 129–179).

Computerization substitutes better for tasks that are routine-based, rather than non-routine-based tasks, because they are easily codifiable and characterized with high predictability. An increase in computer capital reduces the labor input of routine cognitive and manual tasks, but increases the labor input of non-routine cognitive tasks. This has led to favoring educated workers – people who are able to solve tasks characterized by high unpredictability and complexity and non-routine cognitive abilities such as creativity, critical thinking, or complex communication (Autor, Levy, Murnane, 2003, pp. 2–4; McKinsey, 2017, p. 8). Critical thinking is not about swapping opinions, but is rather about reasoning in a constructive manner involving evaluation of reasoned judgment in a sophisticated epistemic manner. For Kuhn (1999), "critical thinking by definition involves reflecting on what is known and how that knowledge is justified" (p. 23). Sulkowski and Zawadzki (2016) advocate for the idea of higher education as a sphere where young people can critically think about the knowledge they gain. They note that individuals lacking critical thinking become alienated and disengaged consumers, which in turn fosters cynicism. Moreover, they argue that critical thought is under assault in Western democratic societies; social environments of universities require a renewal in order to educate "engaged thoughtful citizens" instead of a "swarm of manipulated consumers" (Sulkowski, Zawadzki, 2016, pp. 122–123). According to a study by Richard Arum and Josipa Roksa, 45% of the studied samples (more than 2300 students) from American colleges and universities did not demonstrate any significant improvement on a Collegiate Learning Assessment during two years of higher education studies (Brynjolfsson, McAfee, 2014, p. 90).

On the other hand, computers (smart machines) are inferior to humans in coming up with new good ideas or engaging in complex communication. They are specialized in one or a few tasks, one at a time, while a single human being can be specialized e.g., in journalism, photography, gardening, and cooking simultaneously. People can conduct multiple and highly differentiated tasks, whereas robots require deprogramming depending on the task. Humans still excel in generating novel patterns, logical reasoning, coordination between multiple agents, communication in natural language, emotional intelligence, and moving around in diverse environments (McKinsey Global Institute, 2017, pp. 1–148). Good communication skills not only provide human labor with a competitive advantage over machines, but they also constitute a source of job satisfaction and wellbeing for workers and service recipients. According to Maguire and Pitceathly's (2002) study on doctor-patient communication, healthcare benefits from good communication skills of the doctors: patients' problems were identified more accurately, patients were more willing to comply with treatment, their distress and depression were lessened, and they showed more satisfaction with their care (p. 325).

Skills that relate to social interaction are also crucial for knowledge creation and learning. Some theorists argue that knowledge is created through cognitive experience and starts from socialization (Nonaka, Toyoma, 2003, p. 4), which in turn, according to Piaget, entails the learning of cognitive, personal, and social skills that allow people to function appropriately in their communities (Piaget, 1929; 1965, after Gould, Howson, 2015, pp. 1–6). Similarly, Wenger et al. (2002, pp. 3–7) argue that social interaction generates knowledge and facilitates knowledge sharing and learning.

Acemoglu and Autor suggest a two-by-two matrix, where work is divided into cognitive versus manual and routine versus non-routine work. They found that non-routine manual work (e.g., hairdressing) and cognitive work (e.g., financial analysis) are still in demand, while a dramatic decrease in demand for routine tasks, whether cognitive or manual, is observable. Based on Acemoglu's and Autor's work, Jaimovich and Siu found that, between 2001 and 2011, "routine cognitive tasks such as cashiers, mail clerks, and bank tellers and routine manual tasks such as machine operators, cement masons, and dressmaker" (Brynjolfsson, McAfee, 2014, p. 66) plummeted by 11%, and that this was the third decade in a row that they had decreased. On the contrary, non-routine cognitive and manual jobs had increased during that same period. Autor (2015) notes that the possibility of replacing human employment with computers is exaggerated and that human intuition and the value of interaction of human labor, human judgment, and automation are often underestimated in productivity growth measurements (after Parviainen et al., 2017, p. 13).

Empirical study

"Education prepares people for employment and, importantly, for meaningful lives" (Nussbaum, 2010, p. 9). Having this in mind, it is relevant to identify attributes that should be emphasized in education, from the perspective of students, academics, researchers, and employers. For the purpose of this article, a pilot study was conducted. Its objective was to provide insight into employer perception of chosen competencies and skills in Poland. Note that the terms "competence" and "skill" are sometimes used interchangeably in English (ILO, 2015, p. 2); this constituted the biggest problem for the author in planning the research. How to denote an indifferent set of variables with a common name? The logic behind naming the set of variables as competences follows partly an explanation from Prahalad and Hamel (1990): "… a portfolio of core competencies – the company's collective knowledge about how to coordinate diverse production skills and technologies" (p. 3) In line with this quote, the author understands competences as a set that comprises both skills and knowledge. Contrary to "employer's expectations", competencies are not limited to the employer-employee relation; they are transferable to various contexts in life.

The survey was conducted in Gdansk (Poland) in March and May, 2017, as a part of a doctoral dissertation. The research question was: what attributes will be on demand in a robotized future economy according to Polish employers? Furthermore, is there a consensus regarding key competencies between Polish employers and the international data presented by large international research institutions?

Method

A quantitative survey was used to answer the research question. The sample frame was chosen using the convenience sampling method, as the point was to test the measuring instrument. Hence two significant job fairs were chosen on the basis of similarity in terms of time (March) and place (Pommer voivodship). The sample was selected using the probabilistic systematic sampling method.

The primary data was collected manually, using a quantitative survey on three occasions at two different job fairs in Gdansk. The first job fair – International Metropolitan Fairs of Job, Education and Entrepreneurship (Metropolitalne Targi Pracy Pomorza) – was held at The AMBEREXPO Exhibition and Convention Centre of the MTG SA Gdańsk International Fair Co. in March 2nd 2017 and the second – Engineering Job Fair (Inżynierskie Targi Pracy) – was held at the University of Technology Gdansk, March 8–9, 2017. The questionnaires were handed out personally by the researcher to the participants. Thirty-one usable questionnaires were collected from employers at the AmberExpo Fair (n=100), and 24 at the Engineering Job Fair (n=59), totaling 55 usable questionnaires.

The survey variables were selected on the basis of outlined competencies and skills within the recent scientific discourse – most notably in the works of Autor, Levy, Murnane (2003); Acemoglu, Autor, (2011); Brynjolfsson, McAfee (2014); Sulkowski, Zawadzki, (2016) – and the variables most frequently mentioned in the following studies and reports: "Future Work Skills 2020 Report" (IFTF, 2011); "The future of work: jobs and skills in 2030" (UK Commission for Employment and Skills, 2014); "The Future of Education and Skills: an OECD Education 2030 Framework" (OECD, 2016b); and "A future that works: automation, employment, and productivity" (McKinsey Global Institute, 2017). Moreover, the author decided to include two traditional attributes that were omitted in the aforementioned studies and reports: 1) diligence,[2] 2) obedience, and loyalty.[3]

The list of variables was shortened down to 13 to fit A4-sized paper, which should facilitate sustained participant engagement. One optional line was also added to allow respondents to type in a variable of

[2] Diligence indicates work ethic and is mentioned as a virtue in all of the largest religions/philosophies.
[3] Apart from technical and social skills, competencies include professional and personal attributes.

their own choice. All variables were measured with a multiple five-point Likert-type scales ranging from 1 to 5, from totally unimportant to very important, respectively. The purpose of the study was presented and respondents were then asked to assess the importance of particular variables for a future economy. Finally, respondents were asked about the size of the firm (M=micro-enterprise; SME=small and medium-sized enterprise; L=large enterprise), as defined in the European Union recommendation 2003/361[4] and to define the branch they operate in.

Analysis, results and comments

Due to the chosen non-probabilistic sampling method (convenience sampling) and the relative small size of the sample (n=55), the author has decided not to conduct advanced statistical tests. Hence statistical inference will be unsuitable (Szreder, 2004); the results should be treated with utmost prudence. Table 1 presents a full list of studied variables and the mean values for n=55. The sample group consisted of 14 SMEs, 38 large, and 3 micro enterprises. The chart in figure 1 includes six variables that gained largest and smallest mean absolute deviations for the two main sample groups, based on the size of respondents' firms. Controlling these variables provide a better idea of the spread of the dataset than controlling the mean values would. According to the mean absolute deviation of this data set (n=55), the smallest deviation among respondents was observed for "Diligence," which also gained the largest mean value (4.67 for n=55) of all assessed variables, and the largest deviations were observed for "Proficiency in the use of new media" (D=1.01; m=3.45), "Formal education" (D=0.89; m=3.2), and "Work experience" (D=0.89; m=3.43), which signifies a relatively small consistency in respondent opinions given the Likert scale used for this study, where 1 equals "totally unimportant".

Three especially interesting things can be said about the results:

1. Loyalty is relatively irrelevant for a future economy, according to the tested target group, and this does not differ much from the actual trend of the corporate Western world, where quick staff turnover has become a norm.
2. Relatively low mean value for "*Work experience*" (m_{Large}=3,29) for large enterprises and relatively high rates for *Complex problem solving*" (m_{SME}=4,79) for SME's could be explained by the fact that most of the large companies were seeking low-skilled workers, while the SME's had open vacancies for high-skilled workers. These are nevertheless inferences of disputable value since such variables were not empirically measured in this study.
3. The low values (m=3,45; n=55) for the "Proficiency in the use of new media" differs significantly from noteworthy international studies on future skills, according to which such skills as "Data literacy" or "New media literacy" will be some of the top ten skills demanded in 2020 (UK Commission for Employment and Skills, 2014, p. 54; IFTF, 2011, pp. 8–12).

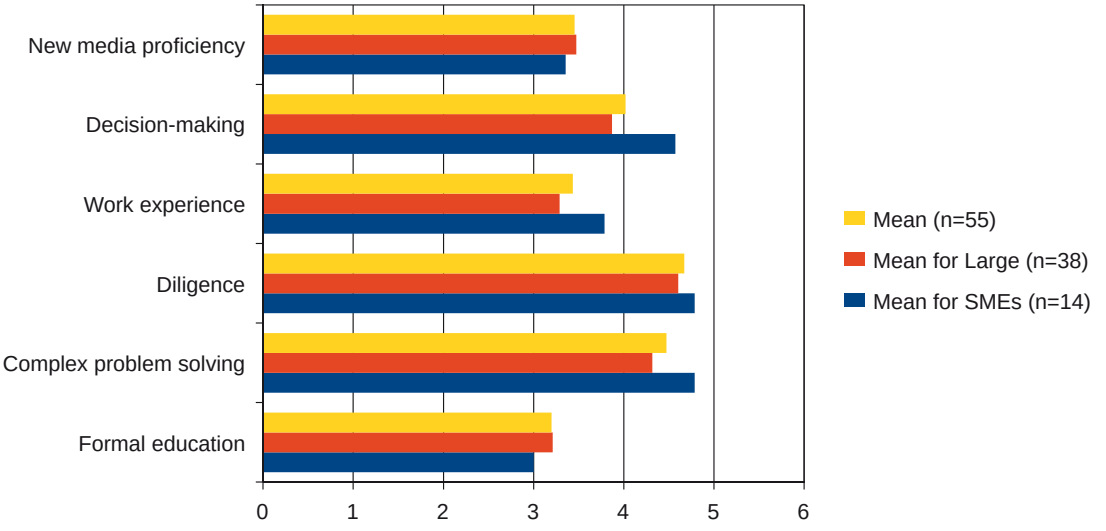
Table 1. Assessed variables, mean values and mean absolute deviation for n = 55

Future economy needs people that:	m	MAD
1. have formal education	3.20	0.89
2. have critical thinking skills	3.98	0.79
3. have complex problem solving skills	4.47	0.58
4. are creative	4.40	0.59
5. are diligent	4.67	0.46
6. are obedient and loyal	3.79	0.83
7. have learning skills	4.49	0.59
8. have work experience	3.43	0.89
9. make decisions	4.05	0.55
10. manage complex cognitive skills	4.02	0.73
11. can work in a culturally diverse environment (incl. foreign language skills)	3.93	0.87
12. have emotional intelligence (communication, empathy, interpersonal skills, flexibility, teamwork)	4.16	0.67
13. are proficient in the use of new media (online videos, blogs, presentations, portals, social media, etc.)	3.45	1.01

Source: author's findings.

[4] < 10 employees and < 10 million € = Micro; < 250 employees and < 50 million € = SME; > 250 employees and > 50 million € = Large.

Figure 1. Three Max(MAD) and three Min(MAD) values compared between two control groups (n_{Large}=38 and n_{SME}=14)



Source: author's findings.

If development of the competencies and skills mentioned in the reviewed theory is one of the keystones for building a knowledge-based, ICT-intensive economy that relies on smart machines both in production and services, then not enhancing these skills should lessen both individuals' and economies' competitiveness relative to offered technological solutions. Therefore, the author suggests referring to such skills collectively as "smart skills." Smart skills are *skills that make people outperform smart machines*. This term could be used in opposition to skills that are needed for performing routine, whether cognitive or manual, repetitive and rote tasks. The term smart skills is meant to be an open class of variables with a stable definition, so that the particular skills could be changed when necessary, as soon as they become outdated – i.e., as soon as machines have outclassed people in a particular skill. The term smart competencies is defined as *competences that make people outperform smart machines.*

Conclusions

Technological development has provoked organizational changes that favors skilled over unskilled labor. Workers that have general skills and are familiar with multitasking can better adapt to organizational changes and thus benefit from such transformations. The skills that will be in demand in the future smart economy will rely highly on complex cognitive abilities. As smart machines take over routine manufacturing and rote service jobs, skills that are closely related to complex social interaction (people management, emotional intelligence, problem solving skills, creativity, critical thinking, and adaptability – all of which are mostly characterized by high level of cognitive complexity) should be developed, if human labor is to be competitive against machines. Knowledge workers especially can maintain their competitive advantage over machines by improving the skills of complex communication, ideation, and large-frame pattern recognition rather than the skills required for performance of easily codifiable tasks. Theoretically, any task that is codifiable can be conducted by a smart machine, but only task one at a time – multifaceted jobs are still far out of reach of the newest technology. Tasks that require complex problem solving, critical thinking, creativity, and complex communication will likely be performed by humans. Unlike low labor costs, complex skills will gain competitive advantage in the long run and those with them will be better off during technological transformations (Parviainen et al., 2017). If, along with the decreasing population in Poland, the decreased nominal value of formal education causes a decline in demand for tertiary education, then future research should evaluate whether education is offering adequate training and frames for future social agents to meet the competence expectations of the labor market.

According to the conducted empirical study, attributes such as "New media literacy" skills and "Formal education" gained the lowest rates of all measured variables. Regarding the former, the reason behind such a low rate could be the content of the variable itself. "New media literacy," s used in the UK commissions report on future skills, unlike the IFTF report, includes Big Data analysis, interpretation, and efficient use of data, whereas the variable used in this study interprets new media as online videos, blogs, presentations, portals, or social media – instruments that are either not yet efficiently used by Polish enterprises or/and used for entertainment purposes only. Secondly, the surprisingly low rate of formal education could imply yet another, qualitative reason for the low demand for education in Poland. Nevertheless, the author suggests skepticism of the

validity of this pilot study, considering the number of assessed companies. For instance, according to an extensive study on diagnosis and competence development conducted by Miś, Pocztowski and Urban (2013), formal education is extremely importance for employers in Poland; 59 out of 60 job positions, which were offered by almost 200 companies taking part in the research, declared higher education as one of the competency requirements (Miś, Pocztowski, Urban, 2013, pp. 50–79).

Apart from "New media literacy" and the "Ability to work in a culturally diverse environment (incl. foreign language skills)", which gained a mean value slightly below average, the perception of future skills between the studied target group and analyzed secondary data is consistent. Analysis of the indications of or reasons behind that could be subject to further research. Most importantly, though, the study should be validated on a representative study group.

Development of smart skills and smart competences seems to be necessary for any individual to be attractive on the labor market, taking into account increasing automation. The question is: what should higher education's role be in smart skills and competencies? Future research should investigate whether smart skills and competences are embraced in particular education programs and how they are dealt with.

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Abstract

Regardless of whether the adopted role of education is to prepare people for pursuing employment or building general values, it will include the identification and development of skills and competences as well as professional and personal attributes. Critical thinking, ingenuity and complex cognitive-social skills are precisely those areas in which people continue to outdo intelligent machines. The purpose of this article is to review the skills and competences that will be desirable in the future in relation to recent technological changes. They are preceded by selected macroeconomic data to illustrate the situation of higher education with an emphasis on Poland, where, despite positive returns on investment in education (the highest among OECD countries), since 2005 a systematic fall in demand for higher education has been observed. The empirical part presents the results of a pilot study aimed at determining the desired future skills and professional attributes of Polish employers. The basic data was collected manually using a quantitative study during three sessions at two different job fairs in Gdańsk in March 2017. According to the surveyed respondents (n = 55), professional experience, proficiency in the use of new media and formal education were indicated as the least important features, while learning and diligence – as the key competences for the future economy. In addition, the studies have shown the differences in the perception of these abilities and competences depending on the employer's position on the market, the number of employees and the internal policies of the companies.

Keywords: smart skills, higher education, critical thinking, smart competencies, future economy

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