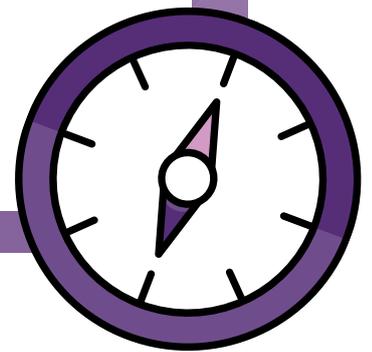


OECD Future of Education and Skills 2030

Conceptual learning framework

Concept note: Skills for 2030



IN BRIEF

SKILLS FOR 2030

Skills are the ability and capacity to carry out processes and be able to use one's knowledge in a responsible way to achieve a goal. Skills are part of a holistic concept of competency, involving the mobilisation of knowledge, skills, attitudes and values to meet complex demands. The OECD Learning Compass 2030 distinguishes between three different types of skills: cognitive and meta-cognitive skills; social and emotional skills; and physical and practical skills.

As trends such as globalisation and advances in artificial intelligence change the demands of the labour market and the skills needed for workers to succeed, people need to rely even more on their uniquely (so far) human capacity for creativity, responsibility and the ability to “learn to learn” throughout their life.

Social and emotional skills, such as empathy, self-awareness, respect for others and the ability to communicate, are becoming essential as classrooms and workplaces become more ethnically, culturally and linguistically diverse. Achievement at school also depends on a number of social and emotional skills, such as perseverance, efficacy, responsibility, curiosity and emotional stability.

Physical and practical skills are not only associated with daily manual tasks, such as feeding and clothing oneself, but also with the arts. To date, researchers have been unable to identify a comparable activity that develops the cognitive capacity of children in the same ways or to the same extent as music and arts education does. Engaging with the arts also helps students develop empathic intelligence, which enhances their emotional engagement, commitment and persistence.

Social and emotional skills, such as empathy and respect for others, are becoming essential as classrooms and workplaces become more diverse.

KEY POINTS

- As computer technologies have displaced labour in routine tasks, they have also created new employment opportunities for workers with non-routine cognitive skills, such as creativity, and social and emotional skills.
- To remain competitive, workers will need to acquire new skills continually, which requires flexibility, a positive attitude towards lifelong learning and curiosity.
- Social and emotional skills can be equally – and in some cases even more – as important as cognitive skills in becoming a responsible citizen.



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Skills for 2030

As defined by the international group of stakeholders involved in the OECD Future of Education and Skills 2030 project, skills are the ability and capacity to carry out processes and to be able to use one's knowledge in a responsible way to achieve a goal. Skills are part of a holistic concept of competency, involving the mobilisation of knowledge, skills, attitudes and values to meet complex demands.

The OECD Learning Compass 2030 distinguishes between three different types of skills (OECD, 2018_[1]):

- cognitive and meta-cognitive skills, which include critical thinking, creative thinking, learning-to-learn and self-regulation
- social and emotional skills, which include empathy, self-efficacy, responsibility and collaboration
- practical and physical skills, which include using new information and communication technology devices

Cognitive skills are a set of thinking strategies that enable the use of language, numbers, reasoning and acquired knowledge. They comprise verbal, nonverbal and higher-order thinking skills. Metacognitive skills include learning-to-learn skills and the ability to recognise one's knowledge, skills, attitudes and values (OECD, 2018_[1]).

Social and emotional skills are a set of individual capacities that can be manifested in consistent patterns of thoughts, feelings and behaviours that enable people to develop themselves, cultivate their relationships at home, school, work and in the community, and exercise their civic responsibilities (OECD, 2018_[1]; OECD, n.d_[2]).

Physical skills are a set of abilities to use physical tools, operations and functions. They include manual skills, such as the ability to use information and communication technology devices and new machines, play musical instruments, craft artworks, play sports; life skills, such as the ability to dress oneself, prepare food and drink, keep oneself clean; and the ability to mobilise one's capacities, including strength, muscular flexibility and stamina (OECD, 2018_[1]; OECD, 2016_[4]). Practical skills are those required to use and manipulate materials, tools, equipment and artefacts to achieve particular outcomes (OECD, 2016_[4]).

Cognitive skills, such as creative thinking and self-regulation, and social skills, such as taking responsibility, require the capacity to consider the consequences of one's actions, evaluate risk and reward, and accept accountability for the products of one's work. This suggests moral and intellectual maturity, with which a person reflects upon and evaluates his or her actions in light of his or her experiences, personal and societal goals, what he or she has been taught and told, and what is right or wrong (OECD, 2018_[1]). While good decision making and ethical judgement are encompassed in the concept of skills, these competencies are addressed in the [concept note on Attitudes and Values](#).

The transfer of knowledge and skills takes place in social contexts

The concept notes on [Knowledge](#) and on [Attitudes and Values](#) mention that knowledge, skills, and attitudes and values are not competing competencies but rather are developed interdependently. The acquisition of knowledge requires certain cognitive skills. Those skills and relevant content knowledge are not only intertwined, they also reinforce each other. In addition, attitudes and values are integral to developing knowledge and skills – as motivation for acquiring and using knowledge and skills, and in framing the definitions of what constitutes “well-being”, good personhood and citizenship (Haste, 2018^[4]).

The transfer of knowledge and skills from one situation to another takes place in social contexts. Abuzour, Lewis and Tully (2018^[20]) completed a study that supports this social foundation of transfer. They find that, first, students must have sufficient basic knowledge to be able to transfer skills. Then, support from colleagues and adherence to guidelines helps students transfer their skills from the classroom to the workplace. Reinforcement is an important component of transfer as, without it, students and employees may perceive that the transfer is not valued and thus not bother to apply learned skills in new contexts (Benander, 2018^[7]). Educators can help beginners apply routine skills, such as information processing, in a range of unfamiliar and loosely defined situations. That will help learners practice applying their knowledge and skills in different ways.

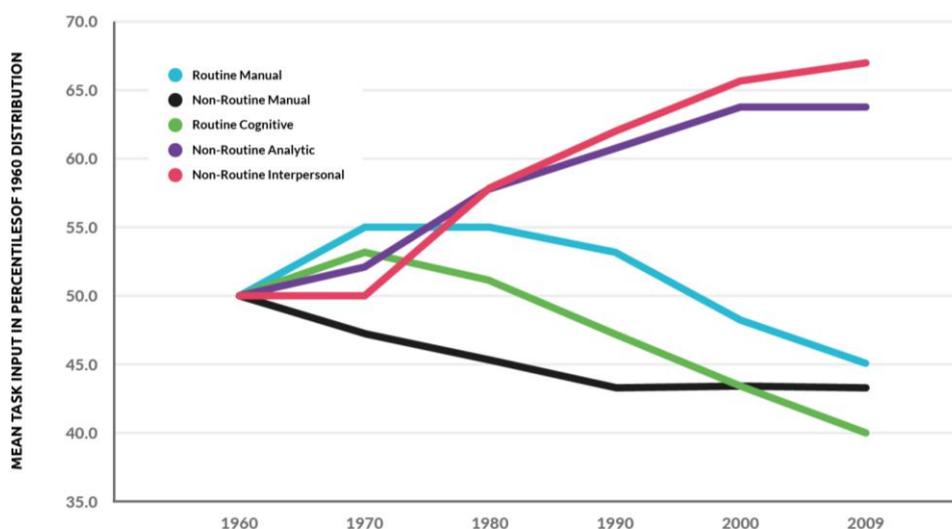
Some research has been conducted on the transfer of knowledge and skills through formats such as play (DeKorver, Choi and Towns, 2017^[8]) and project-based learning (Lee and Tsai, 2004^[9]). Considerably more research has focused on the cognitive and metacognitive transfer between languages. For example, Baker, Basaraba and Polanco (2016^[21]) review the literature on student learning in bilingual education. They find that bilingual language instruction helped students perform better in reading skills in both languages, although they report that there are few studies on writing skills and bilingual programmes. See Ciechanowski (2014^[22]), Martinez-Alvarez, Bannan, and Peters-Burton (2012^[23]), Keung and Ho (2009^[24]) for other studies.

Cognitive skills are essential; metacognitive skills are becoming so

Creativity and critical thinking are needed to find solutions to complex problems

Technology influences how we think about human intelligence and the demand for the types and level of skills needed for the future. Over recent decades, computer-controlled equipment has replaced workers in a wide range of jobs that consist of routine tasks – tasks that follow well-defined procedures that can easily be expressed in computer code. Most routine work, such as repetitive calculating, typing or sorting, and production tasks that revolve around performing repetitive motions, have been automated since the early 1980s (Figure 1). At around the same time, the demand for non-routine interpersonal and analytical skills increased dramatically. The explanation is straightforward: as computer technologies have displaced labour in routine tasks, they have also created new employment opportunities for workers with non-routine cognitive skills, such as creativity, and social and emotional skills (Berger and Frey, 2015^[14]; Bialik and Fadel, 2018^[15]). Non-routine manual jobs at first declined in number then plateaued at a baseline level, an indication that there remains some demand for the products and services these jobs provide.

Figure 1. Changing prevalence of types of tasks required for work over time



Note: This figure shows how the task composition performed by US workers changed between 1960 and 2009. *Source:* Autor and Price (2013) in Bialik and Fadel (2018_[15]), p.7, https://curriculumredesign.org/wp-content/uploads/CCR_Knowledge_FINAL_January_2018.pdf.

Artificial intelligence (AI) is adding depth and scale to the challenges posed by technology. Societies will need to determine what is wanted from human intelligence, how best human intelligence can work with AI, how human and artificial intelligence can complement each other and, as a consequence, what new knowledge and skills must be acquired and cultivated. By creating AI systems that are able to learn in increasingly sophisticated ways, human intelligence also becomes more sophisticated (Luckin and Issroff, 2018_[16]).

Compared with other technologies, AI has an unprecedented range of applications that can only be maximised through the creativity and imagination of the users and designers of AI. This malleability is a major advantage for AI, robotics and big data; but the benefits of these technologies can be reaped only if they are put to the service of original, visionary ideas developed by humans (Berkowitz and Miller, 2018_[17]). These advances will profoundly affect the demand for skills by 2030 (Berger and Frey, 2015_[14]). According to some researchers (Avvisati, Jacotin and Vincent-Lancrin, 2013_[12]), the skill that most clearly distinguishes innovators from non-innovators is creativity – more specifically, the ability to “come up with new ideas and solutions” and the “willingness to question ideas”.

AI appears less likely to replace jobs that require creativity. Workers in jobs that require originality – “the ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem” – are substantially less likely to see themselves replaced by computer-controlled equipment, reflecting the current limitations of automation. Art directors, fashion designers and microbiologists are thus unlikely to be out of work anytime soon. In other words, although computers are making inroads into many domains, they are unlikely to replace workers whose jobs involve the creation of new ideas. Thus, in order to adapt to current trends in technology, many workers and future learners will need to acquire creative skills (Berger and Frey, 2015_[14]).

Higher-order skills, such as problem solving, critical thinking, goal setting and decision making, overlap with other domains. Critical thinking includes inductive and deductive

reasoning, making correct analyses, inferences and evaluations (Facione et al., 1995_[19]). Components of cognitive skills are interwoven with social and emotional skills so closely that it is difficult to tease apart and attribute the acquisition of these skills to one category or another. For instance, critical thinking involves questioning and evaluating ideas and solutions. This definition encompasses components of metacognition, social and emotional skills (reflection and evaluation within a cultural context), and even attitudes and values (moral judgement and integration with one's own goals and values), depending on the context. Critical thinking skills are also significantly affected by both traditional school experiences and by life experiences outside the classroom (OECD, 2016_[4]).

Citizens with critical thinking skills are also more likely to be self-sufficient and, thus, less dependent on the state's social spending (Facione, 1998_[19]). They are more likely to be equipped to give back to society, for example through social entrepreneurship and prosocial behaviours (Peredo and McLean, 2006_[21]). Critical thinking skills are seen as necessary to enter the workforce. Critics of the quality of higher education frequently cite the proportion of recent college graduates who are ill-prepared to enter the workforce and deficient in critical thinking skills (Flores et al., 2012_[22]; OECD, 2016_[4]).

Metacognition, lifelong learning and understanding other cultures are needed to adapt to a changing environment

Metacognition refers to the skills of “thinking about thinking”. Metacognition can be understood as “non-routine analytical skills” in which awareness of one's own learning and thought processes leads to the intentional application of specific learning techniques to different situations (Bialik and Fadel, 2018_[15]; Berger and Frey, 2015_[14]). Learning strategies, or “learning to learning”, are also widely seen as a key competency for lifelong learning, and are emphasised as a goal for education in many European countries (Kikas and Jõgi, 2016_[17]).

Metacognitive skills are vital to education because of their impact on the process of learning (Veenman, Kok and Blöte, 2005_[18]). For instance, metacognition significantly predicts critical thinking, a key component of learning (Magno, 2010_[19]). Components of metacognition become increasingly important as children enter secondary school, where reasoning, regulation and reflection become more integral to the curriculum. A proliferation of mindfulness-based interventions in schools specifically targets these skills. Preliminary findings show that these interventions can reduce stress and anxiety, increase optimism, help improve social and cognitive skills, and raise academic achievement (Schonert-Reichl et al., 2015_[26]; Schonert-Reichl and Lawlor, 2010_[27]; Beauchemin, Hutchins and Patterson, 2008_[28]).

As trends such as globalisation and advances in artificial intelligence change the demands of the labour market and the skills needed for workers to succeed, people need to rely even more on their ability to “learn to learn” throughout their life. The *OECD Skills Outlook 2017* (OECD, 2017_[23]) reports that “workers’ cognitive skills and readiness to learn play a fundamental role in international integration, as workers need them to share and assimilate new knowledge, allowing countries to participate and grow in evolving markets”.

Given the hyper connectivity of today's – and tomorrow's – world, another key area of cognitive development is the knowledge and understanding of other cultures. Some developmental scientists (Eccles and Gootman, 2002_[26]) identify in-depth knowledge of more than one culture as crucial to cognitive development, particularly as young people mature.

Humans are likely to be able to handle uncertainty better than AI

Humans can cope with uncertainty through their actions, by developing their beliefs and understanding of what is happening in the world, and through their ability to discard beliefs when they are inaccurate or damaging. In other words, humans navigate through uncertainty by being adaptable learners. When placed in a novel circumstance – such as a new country, new school or new workplace – people learn the new structure in the environment and adapt or replace old structures or beliefs that are no longer relevant.

Machines are not (yet) able to respond to uncertainty. AI can complete specific tasks efficiently, and respond effectively to complexity and to some characteristics of uncertainty, but if the goals and context of the task are ambiguous or change, then a “breakdown” often occurs. Put simply, humans possess the capacities to deal with volatility, uncertainty, complexity and ambiguity but sometimes fail to do so productively, while, in many cases, machines lack those capacities entirely (Laukkonen, Biddell and Gallagher, 2018^[24]).

Students’ digital skills need to evolve with technological developments

As digital technologies are adopted in the workplace, acquiring and maintaining a set of digital skills is becoming increasingly important for the vast majority of workers. The OECD also foresees employment in ICT industries increasing as advances in “smart-grid” technology reshapes the management of energy systems, infrastructure and transportation. According to the European Commission, the demand for workers with specialist digital skills is already growing by about 4% each year (Berger and Frey, 2015^[14]).

As the workplace continues to undergo substantial restructuring in response to new technologies, many digital skills will rapidly become outdated. For example, coding skills tend to become obsolete in only a few years’ time. According to a study by the European Centre for the Development of Vocational Training, 16% of workers in Finland, Germany, Hungary and the Netherlands saw their skills become obsolete over the previous two years; digital and ICT-related skills were identified as particularly vulnerable to rapid obsolescence (Cedefop, 2012^[27]).

Thus, to remain competitive, workers will need to acquire new skills continually, which requires flexibility, a positive attitude towards lifelong learning and curiosity. While ICT specialists will be needed, a combination of skillsets that makes workers adaptable to technological change will be even more important. Therefore, education should focus on imparting “fusion skills” – the combination of creative, entrepreneurial and technical skills that enable workers to shift into new occupations as they emerge (Berger and Frey, 2015^[14]). Box 1 provides an overview of new and emerging jobs.

Box 1. Examples of new and emerging jobs

Occupation	Description	Examples of skills	Examples of knowledge	Example of attitudes and values
Robotics engineers	Research, design, develop or test robotic applications	Critical thinking, complex problem solving, quality-control analysis	Engineering and technology, robotics, design	Exploration, precision, observation
Biostatisticians	Develop and apply biostatistical theory and methods to the study of life sciences	Inductive reasoning, oral expression, mathematical reasoning	Mathematics, English language, education and training	Project/programme management, execution, inquisitiveness
Fuel-cell engineers	Design, evaluate, modify or construct fuel-cell components or systems for transportation, stationary or portable applications	Judgement and decision making, writing, critical thinking	Physics, mathematics, chemistry	Focus, reliability, feedback
Solar sales representatives and assessors	Contact new or existing customers to determine their solar equipment needs, suggest systems or equipment or estimate costs	Active listening, persuasion, social perceptiveness	Sales and marketing, engineering and technology, customer and personal service	Accountability, focus, results orientation
Video game designers	Design core features of video games; specify innovative game and role-play mechanics, story lines, and character biographies; create and maintain design documentation; guide and collaborate with production staff to produce games as designed	Programming, critical thinking, complex problem solving	Design, communications and media, psychology	Inquisitiveness, playfulness, passion

Source: O*NET (www.onetonline.org/find/bright?b=3&g=Go) in (Berger and Frey, 2015_[14])

Social and emotional skills are increasingly recognised as essential

Workers whose jobs require social and emotional skills are unlikely to be replaced by technology

As discussed above, AI is unlikely to replace workers whose jobs require creativity; similarly, AI is unlikely to replace workers whose jobs require complex social interactions. Thus, in order to adapt to advances in technology, workers will also have to acquire social skills, including persuasion and negotiation (Berger and Frey, 2015_[14]).

There is a danger that the increasing reliance on sophisticated machines will lead some people to devalue others; some scholars (Turkle, 2017_[32]) are convinced this devaluation is already occurring. If these scholars are right, then it will be increasingly important for people to learn how to recognise the value of their own humanity, and that of others (Putnam, 2000_[33]). Valuing the contributions that people make to society is necessary not only for individual and societal well-being, but also for the health and relevance of institutions (Berkowitz and Miller, 2018_[17]).

Demographic and societal changes demand more social and emotional skills

As populations age, the demand for healthcare will continue to rise. This is reflected in the wide range of new and emerging healthcare-related occupations, which require both scientific skills, and social and emotional skills, such as caring, sociability and respect. For example, acute care nurses and hospital staff require a high degree of social perceptiveness to understand emotional patterns and interact with patients (Berger and Frey, 2015_[14]).

In addition, social and emotional skills, such as empathy, self-awareness, respect for others and the ability to communicate, are becoming essential as classrooms and workplaces become more ethnically, culturally and linguistically diverse. To acknowledge and respond to these global connections, education may promote certain social and emotional skills that are considered to be related to cognitive skills. For example, social emotional skills such as “empathy” would require cognitive skills such as “perspective-taking”. Education may also foster the types of attitudes and values, such as openness and respect for others as individuals, that students need in order to be more inclusive and reflective of more diverse societies. In this context, this particular set of skills has come to be known as global competence (OECD, 2018_[26]).

Social and emotional skills improve academic and labour market prospects

Achievement at school depends on a number of social and emotional skills, such as perseverance, self-control, responsibility, curiosity and emotional stability. Some social and emotional skills are a prerequisite for successful participation and performance in academic settings. In other words, poor social and emotional skills can impede the use of cognitive skills. For example, studies that investigated the relationships between social and emotional indicators and years of schooling show that conscientiousness and openness to experience is a good predictor of how many years students will spend in school (OECD, n.d._[3]).¹

Another study (Heckman and Kautz, 2012_[19]) finds evidence of the relationship between personality and cognitive skills in results from the General Education Development (GED) programme. The GED allows high-school dropouts to earn a high-school diploma by passing an academic performance test. The study finds that GED graduates who had dropped out of high school and later passed the GED test to earn a high-school diploma have similar levels of cognitive skills as regular high-school graduates, but poorer social and emotional skills (OECD, n.d._[3]).

While cognitive skills have also long been considered the most important determinants of success in employment, recent studies show that social and emotional skills also directly affect occupational status and income. In fact, social and emotional skills can be equally – and in some cases even more – important as cognitive skills in determining future employment (OECD, n.d._[3]).

Practical and physical skills help students develop other types of skills

Developing physical skills through music and arts can help promote cognitive and metacognitive skills

Music and the arts are learned physically. To both understand and demonstrate learning in the arts, children must experience them. To date, researchers have been unable to identify a comparable activity that develops the cognitive capacity of children in the same ways or to the same extent as music and arts education does. In undertaking the acquisition of physical skills in the arts, significant cognitive and metacognitive processes must take place. While the arts are expressed through physical skills, mastery of the arts requires cognitive and metacognitive processes too (OECD, 2016_[4]).

The effects of including high-quality, meaningful and ongoing arts education in children’s education experience has been researched extensively (Winner, Goldstein and Vincent-Lancrin, 2013_[30]). The Dana Consortium (Ashbury et al.) conducted a meta-analysis of arts research in the area of intelligence and found that engagement in arts activities improves a

child's attention, which, in turn, can improve their cognition (Posner and Patoine, 2010_[31]). Engagement with the arts develops students' empathic intelligence (Davis, 2008_[32]), which enhances their connectivity, emotional engagement, and sense of identification with and responsibility for others. Studying and producing visual arts enables students to engage, persist, commit to a project and follow through with a task (Hetland et al., 2007_[33]). These skills, used in conjunction with divergent thinking, are rarely developed elsewhere in the school curriculum. Hetland et al. also find that the arts teach students to "envision", that is, think about that which they can't see. These skills are transferable to other areas, such as developing hypotheses or imagining past events or predicting future ones. The intelligences developed through the arts have positive impacts on external measures of students' success too. For example, Walker, Tabone and Weltsek's (2011_[34]) study in the United States finds that students who received an integrated arts curriculum were 77% more likely to pass their state assessment (OECD, 2016_[4]).

Physical and practical skills are essential for students' overall functioning and well-being

Practical skills are often associated with manual dexterity and craftwork. Yet, practical skills have a far wider range of applications. For instance, many daily functions, such as getting dressed, keeping clean, preparing food, engaging in written work or using technologies of any kind, require practical skills. For example, the use of smartphones and communicating by text presumes mastery of a set of practical skills that allow the user to create messages and send them using a small keypad (OECD, 2016_[4]).

Student health and well-being is a global priority. Physical education can help students develop healthy habits and acquire knowledge about health. Research increasingly shows that the habits established in youth carry over into adulthood, so establishing healthy habits early helps young people make healthy choices as adults.

Over the past few decades, research has revealed the benefits of exercise on children's physical and mental health, cognition and academic achievement. Longitudinal research shows that the development of fundamental motor skills at preschool age predicts cognitive efficiency and academic achievement (Roebbers et al., 2014_[35]) when children transition to school (van der Fels et al., 2015_[36]). Recent research links motor co-ordination and skills competence to cognitive efficiency and academic achievement in children (Haapala, 2012_[44]; Haapala et al., 2014_[45]; Rigoli et al., 2012_[46]) and adolescents (Marchetti et al., 2015_[47]; Rigoli et al., 2012_[48]). These associations are consistent with neurodevelopmental research that reveals linkages among brain structures involved in controlled motor actions and executive functions (Diamond, 2012_[42]). Another review provides additional support for the inter-relationship between physical activity and motor-skill proficiency, on the one hand, and children's cognitive function and academic achievement on the other (Vazou et al., 2016_[43]).

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Note

¹ Conscientiousness and openness to experience are two of the five dimensions of the Big Five, a well-known framework for social and emotional skills (Rothmann and Coetzer, 2003_[38]).