Educating for Artificial Intelligence
National Programs and International Standards

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Already a number of years ago, pioneering countries around the world began to execute comprehensive changes to their education policy in order to prepare for the era of artificial intelligence. As part of their national programs for artificial intelligence, these countries defined a chapter dedicated to education. In consequence, they are taking significant steps related to curriculum changes, teacher training, and in the integration of advanced technologies, which are currently at varying stages of progress.

At the same time, international education organizations, led by the OECD, The International Monetary Fund, and UNESCO, as well as the US National Science Foundation (NSF), began to define joint professional standards for artificial intelligence education. These standards are intended to create a common platform which, in the coming years, will serve the experts and the countries in adapting their education systems to the different learning levels of students and their stage of education.

To learn from practice abroad, we turned to a doctoral candidate studying teaching of artificial intelligence, at the Department of Science Teaching at the Weizmann Institute of Science with a request that she review policy documents, national programs, and international standards and present an in-depth analysis and key insights.

Main findings

1. Countries around the world classify artificial intelligence literacy into three levels: a level of basic comprehension and use for all students (AI for all); a level of advanced comprehension and use (future scientists); a level of development intended to prepare those who in the future will develop artificial intelligence technologies (future developers).

2. According to international standards, at each one of the literacy levels, three areas of content must be distinguished: basics, skills, and ethics. Basics includes the understanding of "how a computer thinks and learns on its own"; skills include the use of artificial intelligence tools to address different problems; and ethics, which includes aspects of fairness, equality, privacy, transparency, and morals.

3. According to UNESCO's standards, three levels of skills must be distinguished: comprehension, application, and creation. For example, at the "basics" level, it is possible to be satisfied with an understanding of how artificial intelligence tools work, at the intermediate level, how to use them efficiently, and at the advanced level students must be able to develop AI tools on their own.

4. According to the OECD's Future of Skills project, in an era in which artificial intelligence can successfully solve the PISA assessment tests, "man's superiority to the machine" needs redefinition. The project recommends strengthening computational thinking, programming skills, and the literacy level for all students so that they will be able to evaluate, critique, and interpret the outputs of artificial intelligence.

5. The OECD recommends the integration of AI tools in science and mathematics subject areas which will prepare future scientists. Regarding future developers, the recommendation is that the science and mathematics curricula include topics of data science and machine learning as well as advanced facets of ethics and morals.

6. According to the International Monetary Fund, widening gaps can be expected on the basis of gender, education, age, and economic status and therefore, policy must emphasize giving special opportunity to those likely to be left behind.

7. The US National Science Foundation raises concerns regarding the ability of teachers to teach such advanced content and therefore recommends training and developing skilled teaching staffs.

8. In 2019, the Singaporean government established a national artificial intelligence program. Within its framework an educational organization named AI Singapore was created, which works together with the education ministry in building learning materials for use starting in second grade up to university. The material is taught in schools as part of both required and elective courses, in after-school science-oriented clubs, and as enrichment activities

9. In 2021, the education ministry in South Korea revised the national curriculum and developed learning materials for data science, machine learning, and the social implications of artificial intelligence. In regular high schools, a required course in artificial intelligence was added. In schools for the sciences, there is a requirement for a matriculation examination in advanced mathematics for artificial intelligence; diverse study tracks and elective enrichment courses are offered.

10. In China, already in 2017, the education ministry upgraded the high school computer science curriculum, integrating comprehension and application of machine learning, data analysis, and artificial intelligence. The program is mandatory but allows districts the flexibility to make adaptations as they see fit. In 2024, the program was expanded to primary schools and includes group learning which integrates AI tools. Teacher training was upgraded and all the teachers in the program are required to engage in ongoing professional development.

11. In the United States, beginning in 2018, professional organizations were established, such as "AI for K12" and "AI for All," which promote standards, development of learning materials, and teacher training. These undertakings were spurred by the Computer Science Teachers Association, and the bulk of their activities is funded by the NSF. The activities are not carried out under the auspices of the national federal policy.

12. In Canada, the core of the endeavor focuses on the area of the computer sciences through the "Actua" program developed in collaboration with Google, Microsoft, and the American "AI for K12" organization. It is a comprehensive program which focuses on data science and modelling and solutions to complex problems. Due to a shortage of teachers in the field, the program is conducted by instructors from professional organizations.

13. In England, the curriculum does not adhere to standards nor is there required content related to artificial intelligence. The National Centre for Computing Education (NCCE) is attempting to promote the field through development of learning materials and offering them to secondary schools. Since the program is not mandatory, in practice, the materials are learned only in non-formal frameworks and enrichment courses.