



What Do Excellence Students Need to Learn in the Era of Artificial Intelligence?

The Israel Academy of Sciences and Humanities

In the first quarter of the 21st century, the best predictor of becoming part of the Israeli science and high-tech fields in the future was studying in the high-tech matriculation track in high school, that is, matriculation that includes studies at the five-unit level in the subjects of mathematics, English, physics and/or computer science. However, significant changes have been made to curricula worldwide, as reflected in the PISA conceptual framework. These changes emphasize the skills needed in an era where computers perform tasks accurately and quickly, while people should focus on the abilities required to solve complex problems under conditions of uncertainty.

As we approach the artificial intelligence revolution, the question of “man’s superiority to the machine” arises once again, and even more relentlessly. International bodies and many countries are confronting the question: What do students need to learn in school in an era where computers learn, think, and create on their own? For the Trump Foundation and its partners, the central issue focuses on what excellence students need to learn in school today in order to be prepared for future careers as scientists and developers, and what can be done to maintain Israel’s status as a world leader in the fields of science and technology?

To take several steps in this direction, the foundation turned to the Israel Academy of Sciences and Humanities to convene a team of experts comprised of leading researchers and scientists in Israel. The team examined the knowledge and skills utilized in scientific research in the rapidly developing technology era. From this perspective, the expert team also reviewed the curricula studied in the excellence tracks and was asked to offer insights and directions for consideration.

The team of experts included: Michal Armoni, David Ginat, Amiram Yehudai, Talli Nachlieli, Raz Kupferman, Oren Kurland, and Shimon Schocken.

Main insights and recommendations

1. The team of experts distinguished between the needs of all students who require basic knowledge and skills to function well in the AI era (“AI for All,” “AI Literacy”) and the needs of students who have the option of advancing to a technology career and study in excellence tracks in high school and who, already at an early stage, need advanced knowledge and tools.
2. The field of teaching artificial intelligence is in its infancy and there is still no consensus regarding what should be taught and what the outlines of a relevant curriculum are. In Israel, this issue still does not receive the attention and resources it needs. Initial steps being taken in this country are in the field of computer science teaching and focus on basic aspects of data science and learning through projects. Likewise, the rapid development of the field makes it difficult to predict the competencies that will be required of tomorrow’s developers. As such, the team recommends focusing on teaching the foundations of the field and on the development of universal competencies that do not rely on a specific technology.
3. The expert team identified a critical obstacle in that there are almost no teachers in Israel who are capable of teaching the field of machine learning and artificial intelligence. An advanced training program for teachers will be required, which will include studies in programming, data science, linear algebra, and algorithms, alongside practical experience using materials provided

for the students. There will also be a need to establish teacher communities of learning for the purpose of professional development.

4. The expert team recommends that the instruction of artificial intelligence in Israel be based on a data-centric AI approach which focuses on systematic work with data for the purpose of building a successful system using real life and "dirty" data.
5. In addition to knowledge and skills, emphasis should be placed on ways of thinking. The type of thinking excellence students need to engage in is analytic thinking, the ability to break down complex problems into components and identify patterns that aid in reaching solutions. Along with this, students will need to engage in critical thinking, computational thinking, teamwork, and possess a high level of English-language competence.
6. The expert team identified opportunities for gender parity in this area. While computer science is perceived as a male area of knowledge, data science is actually a neutral field from the gender perspective, perhaps due to the field's relevance to other diverse areas. The assessment is that teaching data science as an independent field, and not in the computer science framework, as is customary today, will contribute to gender parity.