

ANALYSING THE NEEDS OF LEARNING ARTIFICIAL INTELLIGENCE AND ROBOTICS IN GENERAL SECONDARY EDUCATION OF UZBEKISTAN

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Abstract

In this article, research was conducted within the framework of the project on improving the teaching of programming and artificial intelligence in the field of computer science and information technology for upper classes of general secondary education. Within the framework of the project, it is planned to establish a laboratory in 12 schools in Tashkent, improve the qualifications of teachers and develop educational content. In order to determine the relevance of the project, a survey on programming and artificial intelligence was conducted in 12 schools in Tashkent with the participation of 10th and 11th grade students and their parents, teachers of relevant subjects and school principals. Models for analyzing the results of school surveys were researched. Similarly, the state of training and introduction of personnel in the field of artificial intelligence in Uzbekistan was analyzed.

Keywords: Artificial intelligence, robotics, software programming.

Introduction

Government of Uzbekistan has assigned high priority to education sector since its independence, though the major focus within education sector has always been on ensuring and maintaining high enrollment rates in basic education sector. Uzbekistan has been able to maintain high enrollment rates in general secondary education compared to other developing countries in the world, and the average number of years of schooling has been consistently maintained at around 11-12 years in the past 30 years [1].

Uzbekistan is a compelling case for investigation and implementation for educational innovations due to various factors such as its openness of the government, educational reforms, and investment opportunities. XXI century skills are concise promotional pieces for its keen-to-learn and potential students.

The country enters a new era of growth and development, its educational sector stands poised for transformation and expansion. As of 2023 October, www.stat.uz, with 36.6 million population, there are 10438 primary and middle schools, nearly half a million teachers and 6.4 million 1-11 grade students (about twice the population of Oklahoma). The educational sector in Uzbekistan is experiencing significant reforms and modernization efforts. With a focus on enhancing educational infrastructure, fostering innovation, and

aligning curriculum with global standards, the country is poised to become a hub for quality education.

The investment in Uzbekistan's education will not only help to the country's socio-economic development but will also shape the future of thousands of aspiring learners. By fostering XXI-sentry excellence, we aim to empower a new generation of leaders, innovators, and global citizens.

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 [2]:

- 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 [2,3].

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 [2,4]. Practical skills are those required to use and manipulate materials, tools, equipment, and artefacts to achieve particular outcomes [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 considering his or her experiences, personal and societal goals, what he or she has been taught and told, and what is right or wrong [2]. 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.

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.

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 [5].

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 [6].

It is important to teach students Artificial Intelligence (AI) and Robotics to develop metacognitive thinking and 21st century skills. The above-mentioned factors incorporate elements of STEM and ICT promotion. Teaching of STEM in school education can be organized as interesting with project-based tasks [7].

The development of Artificial Intelligence has risen to the level of state policy of the Republic of Uzbekistan. The President of the Republic of Uzbekistan and the Cabinet of Ministers have approved decrees on the accelerated implementation of Artificial Intelligence technologies in the Republic of Uzbekistan in recent years. President Resolution of the Republic of Uzbekistan No. PR-4996 dated 17.02.2021 “On measures to create conditions for the accelerated implementation of Artificial Intelligence technologies” was signed. In accordance with the Strategy “Digital Uzbekistan – 2030”, the resolution identifies the issues of accelerated implementation and widespread use of Artificial Intelligence technologies in Uzbekistan, ensuring access to digital data and their high quality and creating favorable conditions for training qualified personnel in this field [8].

To ensure the implementation of the above Decisions and Decrees, the following priorities are set:

- establishment of cooperation and implementation of joint projects with leading foreign Institutions on the development of Artificial Intelligence education.
- Introduction of AI in the textbooks of high schools and develop open educational resources.
- opening of special directions of Artificial Intelligence in Higher Education Institutions and targeted training of personnel for priority sectors of the economy, social sphere and public administration.
- joint research projects of national and foreign Higher Education Institutions and Research organizations in the field of artificial intelligence.
- sending young scientists engaged in research activities on the basis of exchange programs in the field of Artificial Intelligence for short-term foreign scientific internships.

Existing problems

For the development and implementation of study programs in AI aimed at educating personnel in accordance with the government development strategy, it is required to integrate two areas of education. As is known from experienced countries, while the development of hybrid curricula will create new jobs in the economic field in the near future, it will also serve as the basis for new areas of research and industries.

Currently, there is the need to train potential personnel for digitalization and automation of the Economy (Digital Economy, Business Intelligence), Medicine (medical image processing using ML and DL), Information Security (Information Protection, Cybersecurity) in the Republic of Uzbekistan. Training staff with knowledge of ICT and AI in these areas and filling gaps in staffing has raised the level of public policy. According to the Presidential Decree, by 2030, the Strategy "Digital Uzbekistan 2030" aims to train 100,000 programmers, young people with knowledge in the field of ICT and AI.

To implement the objectives of the development strategy of the Republic of Uzbekistan, it is required to update the existing disciplines and courses in the general secondary education system or develop new disciplines and courses. The sphere of business should always be inextricably linked with the study process.

The process of digitization and automation of economic sectors (such as Medicine, Economy and others as well as providing information security in the digital environment) and staffing, are currently the responsibility of only the universities in the field of ICT in Uzbekistan.

In Uzbekistan, from year to year, the need for personnel with knowledge and skills in the field of artificial intelligence and software products for every sector of the economy, especially in the fields of medicine, ecology, information security and heavy industry, is growing.

An IT Park has been opened in each region of Uzbekistan, and the volume of digital products is planned to reach 100 million USD. In the future, it is planned to increase the volume of IT services by 35% to 21 trillion soums, and a total of 21,000 workers in the field of information technology will be needed, of which 10% will be AI staff. Within the framework of the Joint Alliance for the Development of Artificial Intelligence, the total cost of which is 300 million USD, a total of 16 practical, innovative, fundamental and international projects planned for 2021-2024 are being implemented. The Department for the Implementation and Development of Artificial Intelligence Technologies has been created in the central office of the Minister of Digital Technologies, and there is the need for specialists in a narrow field, consisting of 30 personnel.

According to the Ministry of Employment and Labor of Uzbekistan, the workforce is projected to increase by 7.3 million by 2035, with jobs growing at an average rate of 2.54% per year since 2001, and the working age population growing by 2.69%. The main requirement falls on IT professionals.

Expected outcomes:

- development, testing and adaptation of Artificial Intelligence related topics to the existing Informatics and Information Technologies subject laboratory by introducing key competences and transversal skills for the labor market needs,
- to modernize curricula of Informatics and Information Technologies to include state-of-the-art topics in Artificial Intelligence,
- to establish AI and S/W laboratory in each school for 50 students,
- to enhance the employment possibilities and potential of graduates by empowering and equipping them with latest skills and competences in responsible AI, hence creating green jobs in the area of computer science,
- Improving teacher training and continuous professional development impacts the longer-term quality of the general secondary education system in Uzbekistan,
- to enhance the teaching, inclusion, innovation, knowledge base, digital and entrepreneurial capacities, as well the internationalization in Uzbekistan,
- to incorporate key competencies and skills into the education process, such as entrepreneurship and problem solving with problem-based learning,
- to bring structure (i.e., modular) to the syllables of courses taught at target HEIs,
- to implement new teaching methods, including the use of open educational resources, and Massive Open Online Courses,
- to stimulate cooperation of schools, capacity building and exchange of good practice among schools themselves and internationally.

Project objectives

In this article and project is to unveil the potentially interested youth – in school education with suitable appropriate learning environment for AI and robotics. The project intended to cover 12 schools chosen from Tashkent city, Uzbekistan. The mission part of the project is exploring learners' and stakeholders' perceptions on AI and S/W.

Exploring students' and stakeholders' perception on AI and S/W offers valuable information. It uncovers how the intended technologies are understood and accepted by the users. It helps a smooth adoption of the technology into the curriculum.

Students are invited for an interview first and according to the final list of students who are willing to participate, their parents are also asked for their perceptions.

Current trends of interest and status in the educational system are observed by inviting school leaders and ICT teachers. Their suggestion for the best need for support is necessary. The development of tailored methodical support is conducted for exploring need analysis. Teacher training, designing suggestions for designing.

The proposed project aims to build, improve and strengthen the education, innovation and transfer capacities of schools in the area of sustainable digitalization and innovative technologies in general and in the area of artificial intelligence in particular. The focus of the project lies specifically in the creation, modification and enhancement of the existing school

study programs (mostly S/W programming and AI related topics) with modules that are currently missing in their study programs.

The specific objectives are as follows:

- development of new/modernized/updated study program for Informatics and IT;
- development of modular components of AI-based study programs and courses (such as Artificial Intelligence, Robotics);
- development of new Responsible AI laboratories at each of the participating schools;
- capacity building of Informatics and IT teachers for AI and S/W.

Training ICT teachers

The creation of a plan for training ICT teachers in artificial intelligence and software programming includes several main stages. A need assessment was acquired by conducting a survey of teachers to understand their existing knowledge, skills and areas that need to be improved (which was found as highly demanded). According to the research specific training goals for AI and programming education are defined. In case of obtain the grand we choose a team of coaches by identifying qualified trainers: who are experienced AI and programming professionals or collaborate with specialized training institutions. After the trainers are equipped to effectively complete the training program, the project manager collaborates with target institutions for training logistics.

Proposed methods

For measuring the perception of teaching and learning of AI and S/W in secondary education in Uzbekistan we chose to take a survey with four group of participants. They are high school students (10th and 11th grade school students), their parents, ICT teachers and school principals. are invited to participate. 12 schools were included for the survey located in Tashkent city. The positive respond for the survey invitation was as follows: 735 students and 542 parents; 33 ICT teachers, and 12 School principals.

Table 1. Number of questions for the two types of items

Question Types	Number of questions for each participant			
	Student	Teacher	Principal	Parent
Education status	3	6	1	2
Necessity and direction of educational support	5	4	9	3
Total	8	10	10	5

Two types of survey items were designed (Table 1): questions indicating the learning and teaching status of AI and S/W (Education status); questions indicating the need for further support (Necessity and direction of educational support). The student survey consists of 8 questions. Parents were asked 5 questions. Teachers and school principals were asked 10 questions each. Observing responses are coded to make analysis.

Survey instruments

Table 2. shows observed responses for survey instruments used to analyze perception of 10th –11th grade students and stakeholders. As a discussion observed results are also presented at the end of the section.

Table 2. List of schools participated in survey and the summary of participants

No	Region name	School name (given number)	Number of students	Number of ICT teachers	Number of parents
1	Mirobod	328	80	3	0
2	M.Ulug'bek	275	75	3	76
3	Olmazor	196	32	3	80
4	Sergeli	104	80	3	58
5	Uchtepa	14	53	2	53
6	Chilonzor	201	77	3	44
7	Yangihayot	329	46	3	44
8	Shayxontohur	41	61	3	10
9	Yunusobod	273	66	3	66
10	Yakkasaroy	319	61	2	61
11	Yashnobod	255	61	3	25
12	Bektemir	347	43	2	25
Total			735	33	542

Coding of respondents

For students: Region-101; Type of respondent-1; Grade-10; Numb-101

Sample:

10111133 – Mirobod-101, student-1, 11th grade, number 133 (starting from 101).

10121: Mirobod-101, teacher-2, number-1.

1013: Mirobod-101, director – 3;

1014133: Mirobod-101, parent-4, number 133 (starting from 101).

Developing tailored methodical supports

For designing tailored methodical supports for teaching and learning AI and software programming in high school, we plan several key steps.

For a better environment and methodical approach, we measured learning and teaching needs and status by a survey, more details and outlining results can be found in section: Survey instrument. The survey reveals useful information. Getting to know students' current knowledge and teachers' perceptions. Responses observed from students, parents and other stake holders guided us and helped to identify potential gups and design clear methods.

Create or gather engaging teaching materials, such as presentations, videos, interactive tutorials, and online resources. Incorporate multimedia elements to make learning more dynamic and accessible.

Emphasize hands-on projects to reinforce learning. Assign programming tasks and AI-related projects that encourage creativity and problem-solving. Projects could include creating simple AI models, developing basic software applications, or working on coding challenges.

Offer continuous support and guidance to students. Encourage questions and discussions, provide extra resources for those who want to explore further, and create a supportive environment for experimentation and learning from mistakes.

Design varied assessment methods that align with the learning objectives. Assess both theoretical knowledge and practical skills through quizzes, coding assignments, project presentations, and peer evaluations. The field of AI and programming is rapidly evolving. Stay updated with the latest trends, tools, and technologies. Integrate relevant advancements into your curriculum to keep it current and relevant.

Encourage teachers to participate in workshops, online courses, and professional development programs to enhance their own knowledge and teaching skills in AI and Robotics programming.

Tailoring your approach to the specific needs and interests of your high school students will enhance their learning experience in AI and software programming. Flexibility, hands-on experience, and staying updated with the field are crucial elements for success.

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