

A Review on Artificial Intelligence Applications in Education in Some Countries and Türkiye

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SUMMARY

Today, countries are taking important steps towards providing more effective services to citizens by determining strategies to quickly adapt to artificial intelligence-based digital transformation processes, especially education, health, security, justice and local services. National strategies for artificial intelligence studies are determined in countries in different continents of the world, and priority is given to educational studies in order to create human resources trained in the field of artificial intelligence. In Türkiye, artificial intelligence studies are carried out in line with the National Artificial Intelligence Strategy Document (2021-2025) published by the Presidency. Considering the size of the service it provides to millions of citizens, the thousands of schools/institutions and the number of more than one million personnel, the Ministry of National Education is one of the public institutions that has made the best use of information and communication technologies for many years. Since the early 2000s, when internet access was provided to schools and institutions, the Ministry has accelerated e-transformation studies in administrative and educational activities and has carried out permanent works that have been used for many years, mainly e-School, MEBBIS and EBA projects. The leadership of the Ministry of National Education in the use of technology in education increases the expectations in studies in the field of artificial intelligence. In this study, the points reached by the Ministry of National Education in five countries in different geographies (Malaysia, Singapore, China, South Korea, Estonia) and Türkiye, which carry out effective studies in education in line with artificial intelligence strategies, in the use of artificial intelligence were examined and evaluated. The analysis concluded that individualized artificial intelligence applications of countries started to be implemented with different contents, at different learning levels and in different years.

Keywords: Artificial Intelligence, Ministry of National Education, Education

INTRODUCTION

The great change in information and communication technologies has restructured the public services provided in many areas such as science, economy, social life and education. In this structuring process, it can be said that 21st century information technologies constitute the essence of the developing information society. Artificial intelligence, which has recently become one of the most important tools of the digitalization process of the information society, has the power to shape the welfare levels of societies and the future of countries. It is seen that developed countries are developing policies for the development of artificial intelligence technologies and their use in daily life with the advantage of technological superiority, as in e-government applications (Coşkun, 2022). Artificial intelligence affects not only countries; It is an element of advanced technologies of digitalization that has a transformative effect on societies and other organizations (Tamer and Övgün, 2020). Artificial intelligence, as a term, is used for systems equipped with human-specific cognitive abilities such as reasoning in dynamic and uncertain environments, discovering meaning, generalizing or learning from past experiences (National Artificial Intelligence Strategy Document, 2021). The historical process of artificial intelligence, which started in 1950 when Alan Turing explained how humans can be separated from machines with the "Turing Test" in his article titled "Computing Machinery and Intelligence" and opened the question "Can the machine think?", continues rapidly today with popular applications such as Chat GPT.

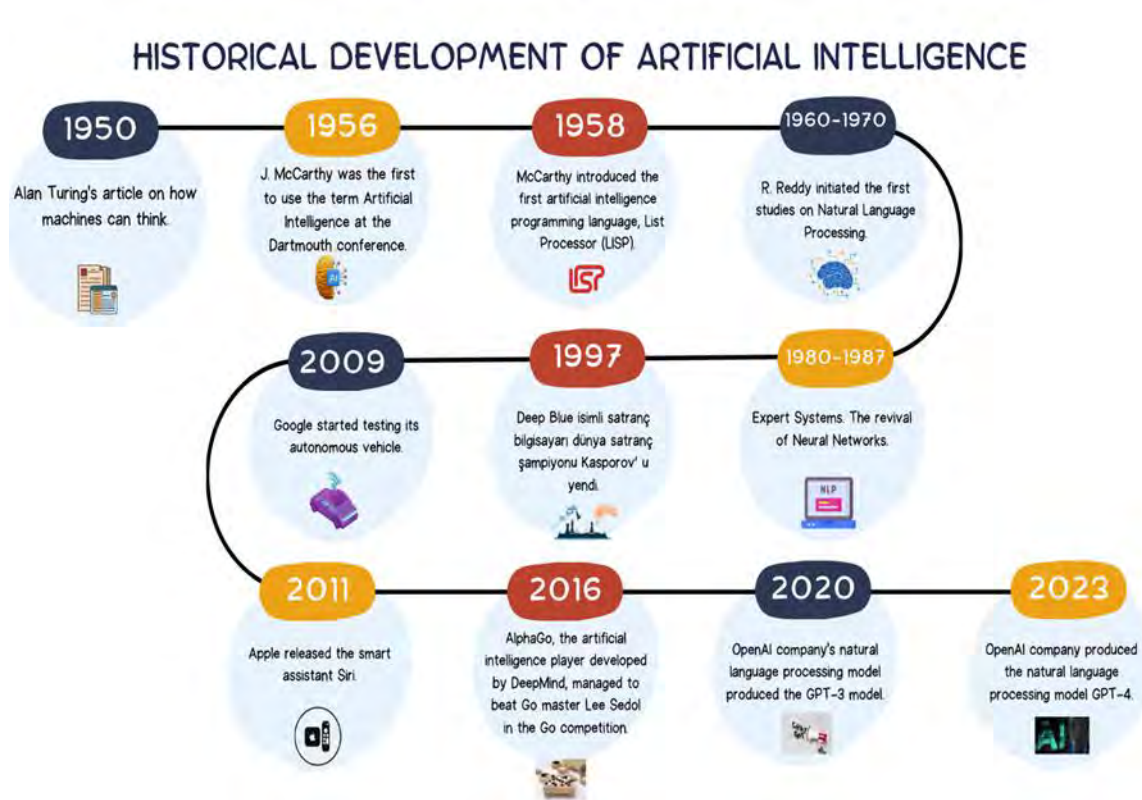


Figure 1. Historical Development of Artificial Intelligence (Source: Developed by the Author using the website www.turkiye.ai, 30.05.2023)

It is seen that studies on artificial intelligence have stagnated in certain periods, but have gained great momentum especially in the last decade.

Machine learning, deep learning and artificial neural networks are critical components that underpin the field of artificial intelligence. These sub-fields, which have the ability of digital systems to improve themselves by analyzing data and learning from experience, the ability to understand and discover complex relationships by processing large data sets with multi-layered artificial neural networks, and the ability to imitate information processing and learning processes similar to brain cells, enable the development of artificial intelligence applications in many sectors.

Today, the process of rapidly developing technologies using artificial intelligence continues. The last 10 years have been called the golden age for artificial intelligence, and developments such as the pandemic period and remote working during this period have become a source of innovation for artificial intelligence (Akman et al., 2022). When looked at in terms of the method used and areas of use; Artificial intelligence contributes to industrial production processes with static image recognition, classification and labeling methods, and can be widely used in different industries with predictive maintenance applications.

It helps patient treatment and care to be more effective and efficient by processing patient data in an efficient and scalable manner. The use of artificial intelligence in the field of health has enabled all possibilities to be calculated, from the possibility of recurrence of the disease to the reason why you may die (Kayim, 2021).

Artificial intelligence has the potential to be used in many sectors, especially in the financial sector with algorithmic trading strategy and protection methods from cyber threats in online payment, and in the driverless car industry with object detection and classification methods (TBD, 2020).

Artificial intelligence has a content distribution role for marketing and provision of public services with the information it obtains on social media. For the spread of e-commerce, existing systems are strengthened with smart question-answer systems (chatbot) and systems that observe and model customer behavior (TBD, 2020).

The use of artificial intelligence in agriculture especially supports decision-making processes. Artificial intelligence functionality comes to the fore in areas such as harvest management, crop management, pest and disease detection, soil and irrigation management, and weed control (Güzel and Okatan, 2022).

Artificial intelligence is also used in education with its applications that make suggestions to teachers based on students' test results and provide feedback to encourage and motivate students. Today, there is a need for much different methods than traditional teaching methods in the education of individuals who will grow up with 21st

century skills. It can be said that artificial intelligence, which has a wide usage area, will be a reference for new methods, scenarios and applications to be developed in education. The existence of standard curriculum and uniform teaching methods for all students has been effective in directing artificial intelligence to the field of education. In particular, by developing artificial intelligence-based systems such as personalized learning systems and smart education systems, individualization of education is ensured and data-based teaching and guidance can be provided (Çetin and Aktaş, 2021). Countries have been carrying out studies to improve student and teacher competencies by including information technologies in education processes for many years. Governments make strategic plans and set goals in order to adapt artificial intelligence to the field of education, as in all fields, and to train citizens who are skilled experts in the field of artificial intelligence.

METHOD

In this article, the educational objectives and studies included in the national artificial intelligence strategy documents of 5 countries selected within the framework of their strategies and studies in the field of artificial intelligence in education, as well as the strategies and studies of the Ministry of National Education in the field of artificial intelligence in Türkiye, were evaluated.

In this research, document analysis approach, one of the qualitative research methods, was used. Qualitative research reveals perceptions and events in a realistic and holistic way in the natural environment and explains previously unnoticed results in an interrelated manner, based on the collected data (Yıldırım and Şimşek, 2008). Document review, on the other hand, involves the analysis of written materials containing information about the phenomenon or cases targeted to be investigated. In the research, in accordance with the document analysis approach, sources on artificial intelligence applications in education in Türkiye, Malaysia, Singapore, China, South Korea and Estonia were examined and listed taking into account their systematic developments.

FINDINGS

The findings based on literature reviews and data are presented below on a country basis.

Estonia

Estonia, with a population of 1.3 million, has achieved remarkable success in digital governance. It can be said that local engineering and information technology competence and the public's trust in this digital development are at the forefront of the success in the development of the digital society in the country. Education has played an important role in these developments, and the creation of digital skills and competencies has been of critical importance in close strategic relations between the state, the private sector and educational institutions (Chabilan, 2020).

In 2019, Estonia prepared a national artificial intelligence strategy through the "Ministry of Economic Affairs and Communications" and the "Estonian Government Office". Estonia, which is among the successful countries in integrating technology into education, aims to provide students with an overview of artificial intelligence technologies and capabilities by including the subject of artificial intelligence in the digital skills curriculum in schools in its strategy document. (Estonia's National AI Strategy, 2019)

In order to benefit from the potential of artificial intelligence technology, the strategy document prioritizes the promotion and development of artificial intelligence in both the public and private sectors, supporting educational processes that can increase knowledge and skills related to artificial intelligence, and regulating legal processes for the purchase of artificial intelligence (Estonia's National AI Strategy, 2019). The Estonian Government has decided to transfer at least 10 million Euros of investment funds to this technology in 2019-2021. It has also been planned to carry out studies such as carrying out educational reforms to harmonize society with advances in digital technology, updating the curriculum and study materials of the "ProgeTiger" program, which includes the curriculum on artificial intelligence, establishing "Digital Innovation Centers", accelerating infrastructure policies to ensure social transformation and preparing ethical guidelines (Estonia's National AI Strategy, 2019)

The "ProgeTiger Program" was launched in Estonia in 2012 as a program aimed at incorporating programming and robotics into the educational curriculum covering pre-school, primary and vocational education. This program is funded by the Estonian Ministry of Education and Research, Educational Information Technology Foundation (Hariduse Infotehnoloogia Sihtasutuse, HITSA). The Estonian Government has set the goal of HITSA as "integrating the use of digital solutions into the entire teaching and learning process to ensure the acquisition of adequate age-appropriate digital competence required for further studies and success in society at all levels of education" (HITSA, 2015). For 2018, approximately 90% of general education schools and 60% of kindergartens participated in the ProgeTiger program, Estonia's main framework that offers students learning opportunities about technology. 98% used the internet on a daily basis and 21% had programming skills. One of the most important trends in these years was to introduce programming education as widely as possible. These activities are concentrated under the ProgeTiger program. The program supports the development of teaching materials, provides free training to teachers, supports the acquisition of specialized equipment for IT training and conducts awareness-raising activities. As of 2018, 87% of general education schools and 60% of kindergartens participate

in the activities of the ProgeTiger program, offering children more advanced information technology skills. HITSA focuses on improving the quality of IT education (Chabilan, 2020).

The ProgeTiger Program approach has three axes, two of which are directly related to the development of AI-related competencies: engineering sciences, including programming, robotics and electronics, and information and communications technology, including computer science and digital communications (HITSA, 2015).

In a study in Estonia investigating the attitudes of teachers, who will be the biggest supporters of these studies in schools, towards artificial intelligence; It shows that the majority of teachers perceive themselves as having limited knowledge (45% of participants) or basic knowledge (35% of participants) about artificial intelligence. On the other hand, when asked about the basic concepts of artificial intelligence, the majority of teachers answered 60% correctly on average. In general, it can be noted that the familiarity of K-12 teachers in Estonia with digital learning technologies and their integration in the classroom also applies to artificial intelligence (Chounta et al., 2022).

In addition to the studies carried out on the use of artificial intelligence in education processes, especially through the ProgeTiger program, Estonia also focuses on the training of individuals equipped with artificial intelligence skills. In this context, the following objectives are included in the National Artificial Intelligence Strategy Document:

- University of Tartu, training at least 50 Master's students between 2020-2023,
- Providing increased specialization and associated learning opportunities in the field of AI at the Master's level (the aim is to have at least 50 Master's students specialize in the field of AI after two years).
- Increasing specialization and related learning opportunities for doctoral students (the aim is to ensure that at least 20 doctoral students specialize in the field of AI within two years).
- Providing support for the development of elective courses on artificial intelligence within the scope of postgraduate studies outside of information and communication technologies disciplines.
- Fast-track launch of a Digital Innovation Center in the field of artificial intelligence in Estonia before the opening of EU grants under the "Digital Europe" Program (Estonia's National AI Strategy, 2019).

Singapore

In Singapore, efforts to develop IT competencies among students begin at a young age. Information technologies and coding have been integrated into teaching processes in the country. In 2016, the country's Information Communications Media Development Authority (IMDA) introduced robots to 160 preschool institutions to develop young students' enthusiasm and competence in robotics, programming and computer science through play (UNESCO, 2019). Since artificial intelligence is accessible and widespread, Singapore has planned to create human resources with individuals ready for artificial intelligence and to support personalized education options by integrating artificial intelligence into the learning processes in the education system. It aims to raise "bilingual individuals" who are proficient in computer science and can apply artificial intelligence concepts. In order to increase students' interest in artificial intelligence, Singapore aims to provide students with opportunities to study artificial intelligence applications in depth during higher education by ensuring that they learn basic concepts at an early age and then develop their basic artificial intelligence competencies and literacy. It has been stated that incentives will be provided in higher education institutions to train undergraduate students who understand how to apply artificial intelligence in their fields and can use it. In this context, Singapore aims to train 25,000 experts in artificial intelligence coding and application and offer artificial intelligence courses to 100,000 Singaporeans, students and adults, with the mottos of Artificial Intelligence for All and Artificial Intelligence for Children by 2025 (Smart Nation Singapore, 2019).

In the National Artificial Intelligence Strategy Document published by Singapore in 2019, it planned to support teaching processes with personalized education options through artificial intelligence. It is aimed to benefit from artificial intelligence through the "Singapore Student Learning Space" (SLS), which was launched in 2018 within the scope of the "Personalized Education Project through Adaptive Learning and Assessment", one of the 5 projects included in the document. SLS is an online learning platform for all students and teachers in the national school system. With SLS, students' learning experiences will be enhanced by the AI-enabled Adaptive Learning System, using machine learning to understand how each student responds to learning materials and activities and recommend a customized step-by-step learning path for each student.

It is aimed that teachers will be able to evaluate students' work more efficiently and effectively with the artificial intelligence-capable automatic evaluation system. The automatic evaluation system will be able to evaluate students' free responses, such as short answer questions and essays, and provide rapid feedback on students' work. In addition, it is envisaged to design an "Artificial Intelligence Learning Friend" to support the holistic development of students, and this "learning companion" will help motivate the student and maintain his interest, as well as evaluate the student's learning experience and suggest additional learning activities. The aim of the study is to provide students with a more personalized learning experience tailored to their individual strengths and

weaknesses. In this way, teachers will spend less time on routine assessment tasks and will be able to guide students' learning more effectively through data-based insights (Smart Nation Singapore).

Singapore has stated in its artificial intelligence strategy document that the SLS platform, which will be supported by artificial intelligence application in education, will be launched at upper primary school and lower secondary school levels for certain subjects in the mathematics curriculum and its pilot studies will be completed by the end of 2022. It is stated in the national plan that with these studies planned in the country, in the long term, students with different learning needs and students making low progress will be better supported and their success levels will be increased (Smart Nation Singapore).

China

China attracts attention in terms of its geography and population size, its latest technological development and its recent economic growth. According to statistics (as of June 2020), the number of internet users in China was approximately 904 million; The spread coefficient of the internet is 67%. The number of mobile internet users is 932 million people; The rate of mobile internet users among all internet users is 99.2%. (Troshchinskiy, 2021)

China developed the Next Generation Artificial Intelligence Plan, which was launched in 2017 (AIDP, 2017). This plan laid out a vision for the country to become the world's center of artificial intelligence innovation by 2030 (UNESCO, 2019). When the New Generation Artificial Intelligence Plan of China is examined;

With Hybrid Advanced Intelligence Support Platforms, building AI supercomputer centers, large-scale superintelligent computing support environments, online intelligent training platforms, "human-informed" driving brains, intelligent platforms for complexity analysis and risk assessment in industrial development, to support nuclear security operations It is aimed to establish research, development and test platforms of intelligent security platforms and human-machine shared driving technology (UNESCO, 2019).

Accelerate the staff training model and reform teaching methods using smart technologies; It is aimed to establish new types of smart education systems, including smart learning and interactive learning. Initiating the construction of smart campuses; Promote full-scale applications of artificial intelligence in teaching, management, resource creation and other fields, develop three-dimensional integrated teaching field based on big data-based intelligent online learning and education platforms, develop intelligent educational assistants; It is aimed to establish an intelligent, fast and comprehensive education analysis system, create a student-centered education environment and provide precisely distributed education services, achieving daily education and lifelong education (UNESCO, 2019).

In order to build the academic discipline of artificial intelligence, to improve the disciplinary order in the field of artificial intelligence, to increase the quotas in undergraduate and graduate programs in the field of artificial intelligence, to establish artificial intelligence institutes in pilot institutions as soon as possible, to encourage universities to expand the content of artificial intelligence professional education based on the original foundation, to create the "Artificial Intelligence + X" composite professional education model, which attaches importance to the cross-integration of professional education for artificial intelligence and mathematics, computer science, physics, biology, psychology, sociology, law and other disciplines, to strengthen cooperation in production and research, to encourage universities, research institutes, enterprises and other institutions to realize the construction of the artificial intelligence discipline are also among the goals. As the Chinese Government aims to accelerate the cultivation of top talent in the field of artificial intelligence, education and training play a major role in realizing this plan. The government aims to achieve this by developing university AI majors, increasing enrollment in master's and doctoral programs in AI, and integrating AI content into studies in other disciplines such as mathematics, biology, psychology, sociology, and law (UNESCO, 2019).

In line with the goals of this plan, the International Artificial Intelligence Education Program was launched for Chinese Universities, which started operating at Peking University in 2018 (China Daily, 22.05.2023). Through this program, China aims to provide artificial intelligence training to at least 500 teachers and 5,000 students in the country's best universities by 2024 (China Daily, 22.05.2023). The government has invested in vocational education, with the Ministry of Education cooperating with three robotic enterprises to jointly establish 10 public vocational activity centers and 90 vocational training centers in Chinese vocational schools by 2020. For this purpose, the Ministry of Education has allocated significant budgets to each activity center and each training center, as well as additional resources for teacher training and equipment supply (He, 2017).

When the goals of the artificial intelligence plan regarding formal education are examined; in order to support artificial intelligence education in primary and secondary schools, it is stated that by offering artificial intelligence-related courses, encouraging programming education and developing software. There are many artificial intelligence education textbooks published in China. The contents of the textbooks consist of various activities that take into account each grade level. Kindergarten activities aim to understand the working mechanisms of robots and objects. Primary school activities include learning basic programming concepts with "Scratch" and "Python" and environmental perception activities with "Arduino". Middle school activities are geared towards

learning how artificial intelligence perceives the world and solves problems with data and algorithms. Middle school activities also include creating simple neural networks for image classification and natural language processing. High school activities are related to artificial intelligence applications and the fundamentals of machine learning (Kim et al. 2021).

Apart from textbooks, artificial intelligence-based learning platforms and applications are also implemented in the country. Digital education company Hujiang, a state-based startup, is developing image and voice recognition software that can understand students' facial expressions so that it can give online feedback to artificial intelligence. "Liulishuo" is an adaptable platform that teaches English to 600,000 students for the cost of a single teacher. Master Learner is developing a "Super Teacher" that can answer 500 million simultaneous questions from students preparing for the Gaokao university entrance exam. An application for automatic article correction was produced with an article rating machine based on an artificial intelligence neural network, with a level of precision that matches humans in 92% of cases. The study started with 60,000 schools, improving the ability to understand human language by using deep learning algorithms to examine essays written by Chinese students and compare notes with teachers' notes and comments (Chen, 2018).

China is one of the leading countries in the global economy. One of the most important factors in the growth of the economy is its serious role in digitalization. The main policy of the Digital China era is that all infrastructures are national (Göçoğlu, 2022). It is foreseen that China's economic power and nationality will be reflected in artificial intelligence policies in education and that it can become a major international power, especially in terms of skilled human resources in the field of artificial intelligence.

Malaysia

Malaysia included education in the National Artificial Intelligence 2021-2025 Road Map (AI-Rmap) published in 2021, in order to increase both the education of artificial intelligence and the functionality and use of artificial intelligence in education. In the published road map, emphasis is placed on the training of future talents who will be equipped with artificial intelligence knowledge. In the document; It has been stated that artificial intelligence training will be comprehensive and will take place at all levels, starting from the lowest level of artificial intelligence to high-level education.

In the road map, the basic content of artificial intelligence will be introduced through the artificial intelligence program for children and young people, modeling will be made and the principles of responsible artificial intelligence such as fairness, reliability and security and control, privacy and security, inclusiveness, transparency, responsibility and the pursuit of human benefit and happiness will be introduced in secondary schools. , Technology, Engineering, Art and Mathematics are included in the curriculum. At the undergraduate level, it was mentioned that a full-scale AI combination curriculum should be offered to ensure the inclusiveness of AI education and not be limited only to the traditional computer science and engineering discipline. (AI-Rmap, 2021)

It was stated that apart from the integrative approach (STEM), which combines the disciplines of science, technology, engineering and mathematics, the curriculum of other disciplines will be reviewed to include artificial intelligence-related subjects such as Data Science and Machine Learning, and it was emphasized that AI programs specific to certain different fields should be offered to ensure exposure to real-world applications of AI in industry. It has also been stated that artificial intelligence experts in the industry will be encouraged to participate in doctoral and master's programs so that they can solve industry problems using artificial intelligence knowledge and skills.. (AI-Rmap, 2021)

In addition to its planned goals for the development of talents in the field of artificial intelligence, Malaysia has also determined its goals for the use of artificial intelligence in education. In this direction, 3 projects were included.

- Personalized Learning System: Developing a personalized learning system to increase students' participation and success using artificial intelligence.
- Intelligent Automatic Evaluation System: Developing an intelligent automatic evaluation system to support the personalized learning system
- Profiling Smart Graduates for the National Future Workforce: Developing an intelligent personalized learning system to increase student engagement and outcomes using artificial intelligence

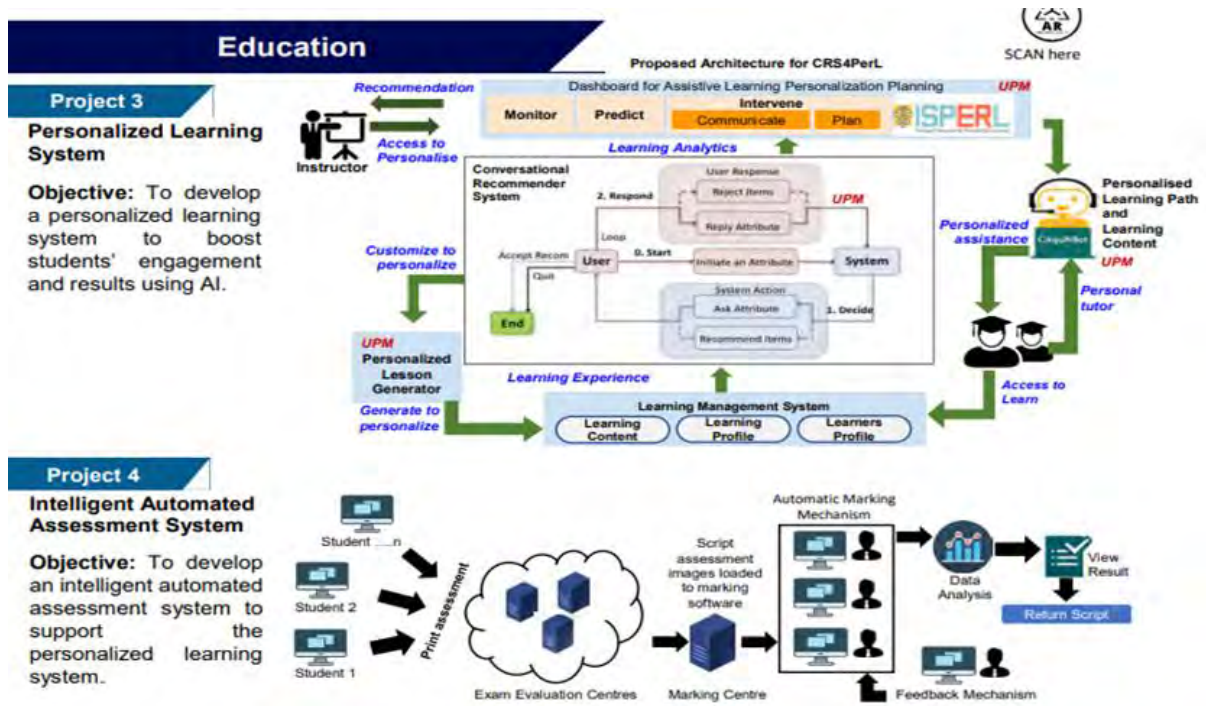


Figure 2. Educational Projects No. 3 and 4 (Source: AI-Rmap, 2021)

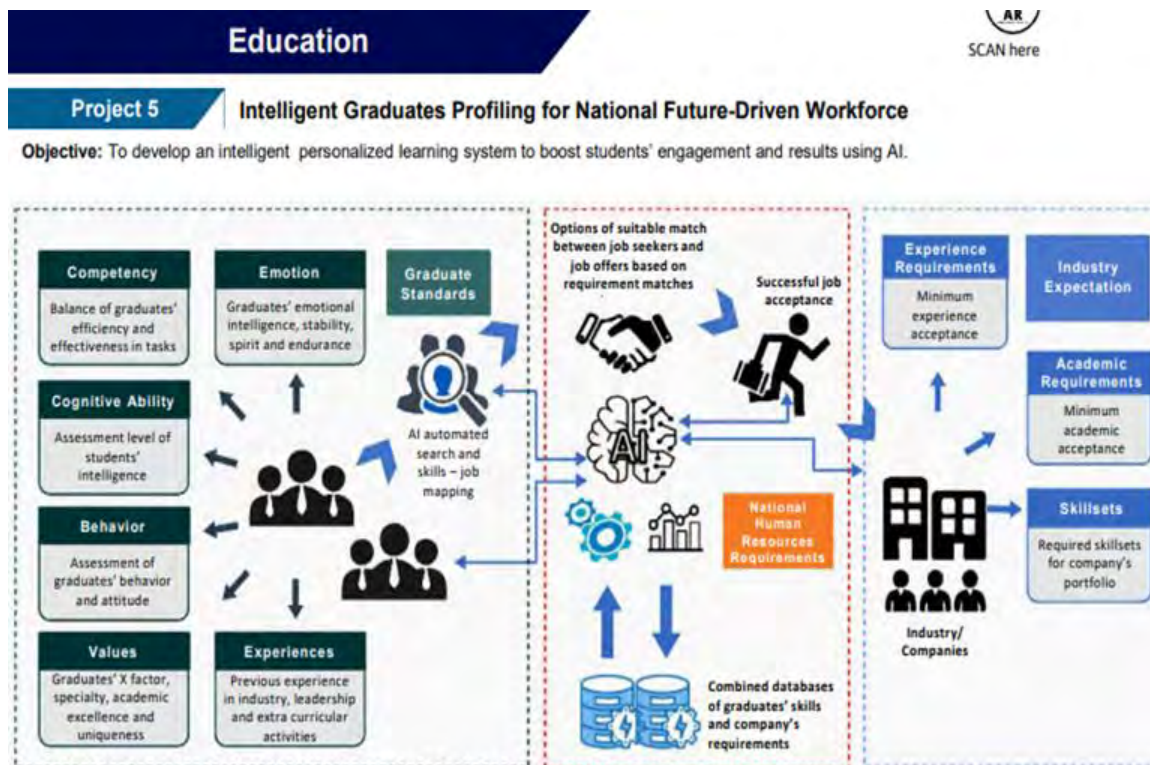


Figure 3. Educational Project No. 5 (Source: AI-Rmap, 2021)

It can be said that Malaysia will be one of the countries that will be taken as a role model in training the talents of the future, with its policies to increase the use of artificial intelligence in the field of education, the strategy and road map it has developed, and the integration of artificial intelligence into learning and evaluation processes.

South Korea

South Korea wants to maintain the advantage of being a country that ranks first among OECD countries in the rate of young people completing higher education levels and has a high market share in information and communication

technologies infrastructure and manufacturing technologies, in the field of artificial intelligence. A study published in 2018 stated that South Korea published a master plan to prepare for what it calls the 'Fourth Industrial Revolution', and it was emphasized that education is an important part of this master plan. In 2016, the Government of the Republic of Korea stated that it aims to train 5,000 new graduates trained in the field of artificial intelligence every year, starting from 2020, and thus add 50,000 new artificial intelligence experts to the talent pool by 2030 (Government of the Republic of Korea, 2016). The country has also planned to provide 10-year support to 'top-tier graduate schools-turned-research centres' to spearhead the development of AI, smart IT, including recruiting international scientists and professors through Research Innovation Grants, resourcing and subsidies. The government committed approximately US\$4.3 million to fund this research initiative in 2018 (Sharma, 22.05.2023). Also in 2018, the government also aimed to allocate 2 billion US dollars for the establishment of six new artificial intelligence graduate institutions, strengthening academy-industry partnerships and creating 4,500 domestic scholarships for artificial intelligence students (Sharma, 22.05.2023).

Education-related targets were largely included in the National Artificial Intelligence Strategy document published in the country in 2019. It is aimed to significantly expand artificial intelligence learning opportunities by strengthening the computational thinking skills of primary, secondary and high school students, and to include artificial intelligence-focused games and curriculum in the education system from an early age. It is envisaged that compulsory artificial intelligence training will be included in the curriculum to ensure that all students can acquire basic artificial intelligence skills for the future society. It is emphasized that primary and secondary school students should develop their artificial intelligence skills through various courses within the expanded curriculum, and that high school students should be in continuous development with advanced artificial intelligence courses (National Strategy for Artificial Intelligence, 2019).

In the Strategy Document; With the motto "Renew the education system so that the world's best talent can constantly develop and all citizens can benefit from artificial intelligence", the human resource target trained in artificial intelligence, which was determined as 300 people for 2019, was determined as 4000 people for 2022 and 8000 people for 2030. (National Strategy for Artificial Intelligence, 2019: 30) In the same document, the following duties are assigned to the Ministry of Education and the Ministry of Science and Technology:

- Allowing teachers related to artificial intelligence to work in the private sector.
- Expanding and diversifying artificial intelligence graduate programs.
- To carry out projects such as the Innovation Academy and Artificial Intelligence Professionals Training Projects for Industry in order to train artificial intelligence experts.
- To facilitate regulations to encourage the creation and operation of interdisciplinary departments.
- Strengthening basic education for AI (Teaching the Teachers, etc.)
- Supporting the training of mid-level technical talents in artificial intelligence sectors (university innovation support project).
- To open national university courses specific to artificial intelligence for high school graduates.
- Creating artificial intelligence departments and courses within the academic credit system.
- Developing online artificial intelligence educational content (K-MOOC, online university).
- Organizing an artificial intelligence curriculum focusing on play and experience in the lower grades of primary school.
- Providing support to teachers in their training and employment processes to complete artificial intelligence courses.
- Creating wireless network infrastructure in primary schools, secondary schools and high schools. (National Strategy for Artificial Intelligence, 2019: 52-53)

In South Korea, the terms/abbreviations "KOFAC" and "ESOF" stand out in scans regarding artificial intelligence applications in education. The Korea Foundation for the Advancement of Science & Creativity (KOFAC) is a quasi-governmental and non-profit organization affiliated with the Ministry of Science and Information Technology of South Korea. The Foundation aims to promote the culture of science and train the researcher community of the future. KOFAC conducted descriptive research on the learning framework of the AI curriculum from primary school to high school and presented its relevant report to the public in February 2020. The report identified artificial intelligence topics for all school levels in South Korea. Elementary and middle school students learn representation methods in propositional logic through disconnected learning focused on games and play activities. While primary school students generally use "Entry", secondary school students use both "Entry" and "Python". High schools, on the other hand, focus on AI subjects, curricula that include basic and intermediate level artificial intelligence concepts, researching the logic of heuristic search algorithms, and programming deep learning models with the Python programming language. In machine learning, the learning goal is to apply machine

learning models to solve real-world problems using block-based programming languages such as Entry and Scratch.

Educational Broadcasting System EBS is a broadcasting organization for public education in South Korea and aims to inform, educate and involve all citizens in lifelong education. EBS provides educational television programs for children, students and families. EBS has been publishing computer science-related programs since 2014, and in 2018, EBS created a platform called EBS Software Learning Platform (ESOF) to offer free online courses on computer science. ESOF has 34 television programs, 125 online lessons, eight games and other learning resources. ESOF's learning contents are classified and developed. The chart below shows the online courses on artificial intelligence offered at ESOF.

Table 1: Sample online courses on artificial intelligence offered by ESOF (Source: Kim et al., 2021: 145)

Lecture title	Language	AI Concept (AI concept)	School Level	Hours
Making rule-based Flappy Bird game	Entry	Rules and inference	K-12	15
Where should we establish the public library? (Where should we build the public library?)	Python	Machine Learning	For All	15
Block coding projects using supervised learning models	Scratch	Machine Learning	K-12	15
Building real life problem solving apps using supervised learning models.	app inventor	Machine Learning	K-12	10
Making Tic-Tac-Toe game with intuitive search Algorithms. (Making Tic-Tac-Toe game with heuristic search Algorithms.)	Entry	Searching algorithms	K-12	15
Effects of Artificial Intelligence in daily life. (Effects of AI in daily life.)	-	Artificial Intelligence ethics (AI ethics)	For all	10

It seems that South Korea, which pioneers training in different fields such as robotics education, STEM education, Virtual Reality education, can be a leading country in creating well-equipped human resources in the field of artificial intelligence and activating the teaching processes of artificial intelligence.

Türkiye

It can be said that issues related to the importance, opportunities and threats, and applicability of artificial intelligence have been widely covered in the public and private sectors in Türkiye for a long time. An artificial intelligence ecosystem is being created to provide high added value, especially in the private sector. As of January 2024, the number of entrepreneurial companies in the artificial intelligence ecosystem in Türkiye is 321 (TRAI, 2024). It is seen that the number of entrepreneurs investing in artificial intelligence technology fields, especially machine learning, natural language processing, image processing and decision support systems, continues to increase every year. It can be stated that this dynamism in the private sector is also continued in the public sector with the public's own paradigm changes and new goals. Aiming to create a society conscious of the potential of artificial intelligence, to provide qualified public services to citizens, to contribute to employment in Türkiye with the artificial intelligence talent pool, to sustainable development by increasing the level of welfare, to prevent possible risks and threats of artificial intelligence, to encourage cooperation, to promote policy and strategies have been determined. Artificial intelligence studies in the public sector are carried out through the Digital Transformation Office, which was established after the transition to the Presidential Government System.

Presidential Circular No. 2021/18, regarding the "National Artificial Intelligence Strategy (UYZS) 2021-2025", prepared in cooperation with the Presidential Digital Transformation Office and the Ministry of Industry and Technology and with the active participation of all relevant stakeholders, entered into force by being published in the Official Gazette dated 20/08/2021 and numbered 31574. In UYZS, it is stated that artificial intelligence is a necessity and is one of the carrier elements of Türkiye's development goals (Akman and Okçu, 2022). The general strategy, whose vision is "to produce value on a global scale with an agile and sustainable artificial intelligence ecosystem for a prosperous Türkiye", is designed around 6 strategic priorities. Within the scope of these strategic priorities, 24 objectives and 119 measures were determined. With these six priority areas, if the goals of

assimilating artificial intelligence technology in education, creating a suitable business environment for entrepreneurs, developing technical infrastructure and data opportunities, increasing cooperation activities in the international arena, accelerating socioeconomic adaptation and completing the transformation of labor markets are achieved, we will be able to benefit from our daily lives, industrial production, education and everything in between. It can be said that radical changes may occur in many sectors, from business to business life. (Çalışkan, 2023)

The first priority in achieving the goals set in the National Artificial Intelligence Strategy Document is to create human resources specialized in the field of artificial intelligence. It is aimed to disseminate thematic programs in which young people, especially before higher education, will receive training on algorithmic and critical thinking, ethics and artificial intelligence applications (UYZS, 2021:8). It is related to many technology fields such as cloud computing, robotics, internet of things, augmented reality, data science, cyber security. It has been emphasized that it is necessary to have researchers and practitioners with advanced technical skills in order to develop artificial intelligence technologies and to successfully implement these technologies in all sectors (UYZS, 2021:14). In this context, it has also been stated that subject-oriented new generation education opportunities should be increased (UYZS, 2021)

In the National Artificial Intelligence Strategy Document, it is stated that young people will be provided with algorithmic thinking, coding and artificial intelligence applied training in line with their interests, abilities and temperaments, in line with their education levels, before higher education, and in order to achieve this goal; Developing digital educational content and encouraging its widespread use by strengthening the relevant curriculum around algorithmic thinking, artificial intelligence technologies and ethical principles, existing teachers with suitable qualifications will be encouraged to implement the curriculum in question and will receive in-service training, and new part-time or full-time education personnel will be trained if needed. implementation of analytics platform, record warehouse and management system components to improve the learning ecosystem, taking into account international standards and open-source solutions, and encouraging the development of training models and programs according to existing and/or new structures that will enable experience, interaction and deepening in the field of artificial intelligence. Awareness-raising digital content will be developed for algorithmic thinking, coding and artificial intelligence applied training, and organizing social events to increase competence have been determined as measures (UYZS, 2021).

Considering the size of the service provided by the Ministry of National Education to millions of citizens, the thousands of schools/institutions and the number of more than one million personnel, it can be said that it is one of the institutions that make the best use of information and communication technologies. This experience of the institution also increases the expectations for the institution in the process, in line with the objectives set by the National Artificial Intelligence Strategy.

In the Ministry of National Education, especially since 2005, permanent e-transformation efforts have been carried out in administrative and educational activities by rapidly providing internet access to schools and institutions, going much further than the previous twenty years. It can be said that the efforts to include Information Technologies (IT) in the service field offered by the Ministry have accelerated since 1984. In addition to national resources, an effective infrastructure and widespread use processes have been carried out with projects and protocols made with international organizations such as the World Bank and the European Investment Bank. (Topuz and Göktaş, 2015) Most of the investments made in IT technology in educational institutions and administrative organizations have been to eliminate the hardware deficiency. Significant progress has been made over many years in the efforts to eliminate the information and communication technology infrastructure deficiencies in education, which started in the mid-80s, and after 2010, efforts were made to increase the quality of IT in education with digital contents and interactive boards within the framework of the project. The Movement to Increase Opportunities and Improve Technology (FATİH) Project, which was launched in 2010, is one of them. With this project, which continues today, studies are continuing to effectively use information technologies and benefit from digital content in lessons. The table below lists some of the prominent studies that the Ministry has put into service by integrating information technology studies in the administrative and educational fields over the years.

Table 2: IT Studies in the Service Field Provided by the Ministry of National Education (Source: Developed by the Author using Topuz, A.C and Göktaş, C. (2015)).

Year	Applications
1984	New Information and Communication Technology Studies
1987	Personnel Management Information System (PERSİS)
1988-1989	Industrial Schools Project
1990-1997	National Education Development Project
1998,2002	Basic Education Project I. and II. Phase

2001	Provincial and District National Education Directorates Management Information System (İLSİS)
2003	MONE Internet Access Project
2003	Intel Education Program for the Future
2005	Microsoft Education Collaboration Program (e-Learning Module)
2007	E-School Management Information System
2007	Ministry of National Education Information Systems (MEBBİS)
2010	Movement to Increase Opportunities and Improve Technology (FATİH)
2011	E-Exam
2012	Document Management System (DYS)
2012	Education Information Network (EBA)
2020	Academic Support System (ADES)
2022	Teacher Information Network (ÖBA)
2022	Student-Teacher Support System (ÖDS)

Over the years, the Ministry has initiated and implemented many projects on the use of information technologies in education and management in line with the targets determined by top policy documents. Prepared by the Ministry of National Education, it is aimed at determining actions for the use of concepts within the field of use of artificial intelligence technologies, such as cloud computing and creating data-based decision mechanisms, in education and management processes. It can be said that it started with the document "2023 Education Vision for a Strong Tomorrow".

In the 2023 Education Vision Document announced in 2018, with the theme of Data-Based Management with Learning Analytics Tools, the Ministry's MEBBİS, E-School, EBA, MEIS, DYS, E-Guidance, E-Mainstream, Open Education Systems, E-Personnel, E-Registration, Books It is aimed to integrate data from existing systems such as Election, Norm Procedures, Physically Disabled Inventory, E-graduate, Central Examination Results in an easily accessible Educational Data Warehouse , thus making all the decisions of the Ministry data-based. Another goal has been determined as the establishment of a "Learning Analytics Platform", which will work on the Educational Data Warehouse and evaluate students' academic data as well as data on their interests, abilities and temperament (MEB, 2018).

One of the steps taken by the Ministry of National Education in the field of artificial intelligence is the Educational Technologies Incubation and Innovation Center, which was established by the General Directorate of Innovation and Educational Technologies within the scope of the "World Bank Safe Schooling and Distance Education Project", in cooperation with the Ministry of Industry and Technology. The center started operating at METU Techno City in 2023. Within the scope of the project, an innovation ecosystem in education will be developed, through this ecosystem, new digital tools and pedagogical models will be developed and presented, and blended education processes will be supported through the cooperation of various stakeholders. In this direction, it is stated that working groups for AI education will be established, and capacity building activities and R&D studies will be carried out for the application of AI in education (UYZS, 2021:55)

The Ministry has launched the Teacher Information Network (ÖBA), a digital education platform where teachers can receive professional development training and access content, starting from the 2021-2022 academic year semester break. There are many online trainings on different subjects on the platform, and there are also trainings that will contribute to the professional development of teachers in the field of artificial intelligence. Artificial Intelligence Applications with mBlock, Introduction to Artificial Intelligence with Python, Artificial Intelligence for Schools, Artificial Intelligence Applications, Artificial Intelligence Applications with Arduino Courses are offered regularly via ÖBA, and teachers can log in with their MEBBİS or e-government information (<https://yegitek.meb.gov.tr/www/ogretmen-bilisim-agi-oba-acildi/icerik/3353> , 30.12.2023)

Artificial intelligence was included in the program as an elective course for the first time in the 2023-2024 academic year by the Ministry of National Education. In the curriculum of the course prepared for 7th and 8th grade secondary school students, it is aimed that students will be able to use at least one of the block-based program development environments for general concepts, ethical principles of artificial intelligence and solution of artificial intelligence problems (MEB, 2023).

The Ministry of National Education also has artificial intelligence-based applications where it tries to support all students in their education processes with web and mobile applications. These applications;

EBA Assistant: In order to provide and manage educational e-content, which is one of the main components of the FATİH project, Education Information Network (EBA) was established in 2012 by the General Directorate of Innovation and Educational Technologies (YEGİTEK) of the Ministry of National Education to provide reliable and accurate e-content suitable for grade levels. has been put into service (Türker and Güven, 2016) The EBA

system is a system that includes educational content as well as educational tools that both teachers and students can use. In addition to text, audio and image resources, EBA also includes resources in the form of video narration. Uploading files and providing digital space, organizing competitions, courses suitable for different levels, making announcements and sharing by users are some of the features that enrich the EBA system (Aktay and Keskin, 2016) The Ministry strengthened EBA, Türkiye's digital education platform, in order to meet the intense demand during the distance education process that started with coronavirus measures. It launched "EBA Assistant", a chatbot application with artificial intelligence, to instantly answer frequently asked questions in distance education. Students, teachers and parents with "EBA Assistant"; They tried to find instant answers to their questions on topics such as getting a password, renewing their password, querying the course schedule, learning the status of their exams, meeting with teachers, repeating courses, etc., by writing on social platforms as if they were asking a question to a live person (<https://www.meb.gov.tr/eba-asistan-uzaktan-egitiorum-cevapsiz-sorubirakacak/haber/20829/tr> , 13.02.2024)

Academic Support System (ADES): The EBA Academic Support program was developed for 11th and 12th grades on EBA, the digital education platform of the Ministry of National Education. This program; It is a program that provides intelligent guidance according to the needs of the student, contains new generation questions and dozens of resource books. With EBA Academic Support, a special program has been prepared to plan which subject and how much they should study, taking into account the students' preference list and current level. Thanks to the program, students are allowed to work with personalized road maps. Students can access detailed lecture videos, sample questions, solution videos, tests and previous years' university entrance exam questions and solutions from EBA Academic Support. The system constantly monitors students' performances, instantly detects the subjects they are deficient in, and offers smart suggestions and tests with special correction lists for students. (<https://yegitek.meb.gov.tr/www/eba-akademik-destek/icerik/3014> , 30.12.2023) In the system, when the student logs into the platform for the first time, he/she encounters the readiness test offered by the artificial intelligence system. EBA Academic Support Platform plans a weekly course schedule by informing the student about their current situation as a result of the readiness test. EBA Academic Support Platform, which offers more than 250,000 questions to students during the education process, provides students with solved questions and trial exam results; It gives feedback such as start over, correct your deficiencies and solve many questions. Feedback by the system is given after the solution of each test or trial exam. In this way, the student can immediately see his/her subject-based deficiencies and make up for them without any delay. (İbili and Yalçın, 2021)

Student-Teacher Support System (ÖDS): The Student-Teacher Support System (ÖDS) was put into practice by the Ministry of National Education in order to support students' individual learning and to monitor the development of teachers by following students more closely. Thanks to the system, students can access tests and materials about units and subjects whenever and wherever they want. The system includes 62 textbooks with lectures on 62 subjects at secondary and high school levels, approximately 60 thousand multiple choice questions, 2 thousand 550 lecture videos and 12 thousand question solution videos. The system, which works according to an algorithm developed to identify students' deficiencies based on the questions they solve and eliminate these deficiencies, supports students' regular study and recommends textbooks and lecture videos when they need them. The system aims to make the auxiliary resources distributed free of charge by the Ministry of National Education more useful by supporting them with visual and audio elements. The system also provides opportunities for students preparing for exams to obtain high-level academic knowledge, thanks to the Support Training Course, Higher Education Institutions Exam, and High School Entrance Exam modules. Students can log in with their EBA passwords to the Student-Teacher Support System, which also allows teachers to follow up on lessons by sending different assignments to different branches. (<https://eskisehirodm.meb.gov.tr/www/ogrenci-ogretmen-destek-sistemi-ods-erisime-acildi/icerik/208>, 30.12.2023)

It is seen that these studies, which benefit from artificial intelligence, which has recently been made available to students, teachers and parents, will continue with the targets specified in the five-year Strategic Plan of the Ministry of National Education covering the years 2024-2028. In the plan, the lack of trained human resources in strategic areas (space technologies, artificial intelligence, cyber security, defence industry) was defined as one of the weaknesses. (MEB, 2024) In this context, ensuring the development of artificial intelligence applications in education is one of the main goals (MEB, 2024)

In the Strategic Plan; in order to meet the need for trained human resources, the number of postgraduate education quotas abroad will be expanded around strategic areas (agriculture, defense industry, artificial intelligence, cyber security, clean and sustainable energy, space technologies, etc.), and studies will be carried out in countries/regions of strategic importance in the light of our country's international vision. The fields were determined and the aim was to increase the number of students studying in these fields (MEB, 2024). The following are included as artificial intelligence-based targets in the plan: creation of an artificial intelligence-supported individual learning platform where textbooks and materials will be designed to give students responsibility for learning and develop their high-level thinking skills and social and emotional skills (MEB, 2024) and implementation of an artificial

intelligence-supported application that makes predictions regarding the determination of school investments by using data such as student placement information and transfer movements (MEB, 2024).

CONCLUSION AND DISCUSSION

Countries state in their strategy documents that they need expert human resources trained in the artificial intelligence ecosystem. Many of the strategies and goals put forward to meet this need are related to education. While all of the countries examined determine artificial intelligence training programs, incentives and employment policies at undergraduate and postgraduate levels for higher education for expert human resources, it is seen that countries such as China and South Korea started artificial intelligence training earlier, from the primary and secondary school levels. Particularly, these two countries are investing in the artificial intelligence talent pool at young ages in education with content, textbooks and project-based studies in Scratch, Python and Arduino programming languages within the scope of artificial intelligence training. Artificial intelligence-supported personalized learning systems, prepared with a specific data-based algorithm that will enable students to learn individually, are included in the strategy documents of all countries under review. It serves as ProgeTiger in Estonia, ESOF in South Korea, SLS in Singapore, and Student-Teacher Support System (ÖDS) in Türkiye. Industry 4.0, which brings together informatics and industry, represents a digital production process that reduces the workforce with advanced technological products. Among the countries examined, it was seen that only China focused on artificial intelligence studies in vocational education in this context.

It is seen that strategic planning and studies started earlier in the five countries where artificial intelligence strategies and applications in education were examined compared to Türkiye. However, with the National Artificial Intelligence Strategy Document published in 2021, it is seen that institutions in Türkiye are rapidly adapting to the process. Distance education portals, which have become a mandatory need in education especially during the pandemic period, have contributed to the development of innovative applications. The EBA Assistant chatbot application, which is on the EBA platform of the Ministry of National Education in Türkiye, has become one of these artificial intelligence-based applications. While there are countries that start education at the primary school level in order to create a talent pool in the field of artificial intelligence, it can be said that in Türkiye, the process started with the optional artificial intelligence applications course for only 7th and 8th grades in 2023. The Strategic Plan covering the years 2024-2028 published by the Ministry of National Education aims to develop artificial intelligence applications in education, but looking at the sub-goals, it can be said that more goals should be included to support this goal. Considering that policies aimed at creating trained expert human resources are included in top policy documents such as the 12th Development Plan, Presidential Government Programs and the National Artificial Intelligence Strategy Document, it is important to transfer knowledge about artificial intelligence to students from the first years of education in Türkiye and to introduce basic programming languages in the field. will be in place.

It is seen that artificial intelligence-related units have been established within ministries in other public service areas other than education in Türkiye. For example; "Big Data and Artificial Intelligence Applications Branch Directorate" under the General Directorate of Information Technology within the Ministry of Justice, General Directorate of Health Information Systems within the Ministry of Health, "Artificial Intelligence and Wearable Technologies Unit" under the National Projects Management Coordinator, Communications and Information within the Ministry of National Defense. Under the System Department, the "Process Management and Artificial Intelligence Applications Branch Directorate" was established (UZYS, 2021). Looking at these examples, it is seen that it is essential to establish a separate unit within the Ministry of National Education, under the General Directorate of Innovation and Educational Technologies or the General Directorate of Information Technology, to coordinate the Ministry's artificial intelligence studies.

In this context, it is important to integrate, develop and implement artificial intelligence applications within the education and training platform, and it is expected to be reflected in the permanent learning of future generations.

REFERENCES

- Akman, E., Topçu, T.B. ve Chiftchi, A. (2022) Yapay Zeka ve Ülkelerin Yapay Zeka Politikaları, (1.Baskı) içinde, (1-13). Ankara: Nobel Yayınları.
- Aktay, S.ve Keskin, T. (2016). Eğitim Bilişim Ağı (EBA) İncelemesi, 2(3), 27-44
- Chabilan, A.H. (2020). Tiger Leap For Digital Turn In The Estonian Education, Educational Media International,57(1),61-72, <https://doi.org/10.1080/09523987.2020.1744858> (Erişim Tarihi 26.03.2023)
- Chen, S. (2018). China's schools are quietly using AI to mark students' essays... but do the robots make the grade? Society, South China Morning Post. <https://www.scmp.com/news/china/society/article/2147833/chinas-schools-are-quietly-using-ai-mark-students-essays-do> (Erişim Tarihi: 05.07.2023)

- China Daily. (2023) China launches first university program to train intl AI talents. http://www.chinadaily.com.cn/m/beijing/zhongguancun/201804/04/content_35979394.htm (Erişim Tarihi: 22.05.2023)
- China's New Generation Artificial Intelligence Devepolment Plan (AIDP). (2017). <https://digichina.stanford.edu/work/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/> (Erişim Tarihi: 10.05.2023)
- Chounta, A.I., Bardone, E., Raudsep, A., Pedaste, M.(2022). Exploring Teachers' Perceptions Of Artificial Intelligence As A Tool To Support Their Practice In Estonian K-12 Education, *International Journal of Artificial Intelligence in Education*, 32, 725-755, <https://doi.org/10.1007/s40593-021-00243-5>, (Erişim Tarihi 22.03.2023).
- Coşkun, B. (2022). Almanya'nın Yapay Zeka Politikası. E.Akman, T.Bayram Topçu, A.Chıftchi (Ed.), *Yapay Zeka ve Kamu Politikası Ülke İncelemeleri* (1.Baskı) içinde. (15-35). Ankara: Nobel Yayınları.
- Çalışkan, Z.D., (2023). Yapay Zeka Strateji Belgesi Üzerine Bir İnceleme. *Social Science Development Journal*, (Sayı:36), 149-158.
- Çetin, M. ve Aktaş, A. (2021). Yapay zeka ve eğitimde gelecek senaryoları. *OPUS–Uluslararası Toplum Araştırmaları Dergisi*, 18(Eğitim Bilimleri Özel Sayısı), 4225-4268. DOI: 10.26466/opus.911444 (Erişim Tarihi: 09.08.2023)
- Estonia's National AI Strategy, (2019). Estonia's national artificial intelligence strategy 2019-2021,https://ai-watch.ec.europa.eu/countries/estonia/estonia-ai-strategy-report_en
- Government of the Republic of Korea (2016). Mid- to Long-Term Master Plan In Preparation For The Intelligent Information Society: Managing the Fourth Industrial Revolution. <https://k-erc.eu/wp-content/uploads/2017/12/Master-Plan-for-the-intelligent-information-society.pdf> (Erişim Tarihi: 06.04.2023)
- Göçoğlu, V. (2022). Çin'in Yapay Zeka Politikaları. E.Akman, T.Bayram Topçu, A.Chıftchi (Ed.), *Yapay Zeka ve Kamu Politikası Ülke İncelemeleri* (1.Baskı), 107-130. Ankara: Nobel Yayınları.
- Güzel, B. ve Okatan, E. (2022). Tarım ve Yapay Zeka, M. Bilen (Ed.), *Yapay Zekanın Değiştirdiği Dinamikler*, (1.Baskı) içinde. (199-224) Konya: Eğitim Yayınevi
- Hariduse Infotehnoloogia Sihtatutus (HITSA). (2015). ProgeTiger Programme 2015-2017, https://media.voog.com/0000/0034/3577/files/Programm%20ProgeTiiger%202015_2017eng.pdf (Erişim Tarihi: 30.04.2022)
- He, Y. (2017), How China is Preparing for an AI-powered Future, *Wilson Briefs*, Wison Center.
- İbili, H. ve Yalçın, S. (2021). Liselerde Görev Yapan Yönetici ve Öğretmenlerin, EBA Akademik Destek Platformu Hakkındaki Görüşleri (Erzincan İli Örneği), *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*, 23(2), 462-487.
- Kayım, N. (2021). *Yapay Zekanın Halkla Uygulamalarındaki Yeri* (Yayınlanmamış Doktora Tezi). İstanbul Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.
- Kim, S., Jang, Y., Choi, S., Kim, W., Jung, H., Kim, S., Kim, H. (2021). Analyzing Teacher Competency with TPACK for K-12 AI Education, *KI - Künstliche Intelligenz*, 35. 139-151, <https://doi.org/10.1007/s13218-021-00731-9> (Erişim Tarihi: 05.05.2023)
- Malaysia National Artificial Intelligence Roadmap 2021-2025 (AI-Rmap). (2021). Ministry of Science, Technology & Innovation, <https://airmap.my/wp-content/uploads/2022/08/AIR-Map-Playbook-final-s.pdf> (Erişim Tarihi: 28.05.2023)
- Milli Eğitim Bakanlığı (MEB). (2018). Milli Eğitim Bakanlığı 2023 Eğitim Vizyon Belgesi, http://2023vizyonu.meb.gov.tr/doc/2023 EGITIM_VIZYONU.pdf (Erişim 20.04.2020)
- Milli Eğitim Bakanlığı (MEB). (2024). T.C. Milli Eğitim Bakanlığı 2024-2028 Stratejik Planı. <https://sgb.meb.gov.tr/yayinlarimiz/yayin/112>, (Erişim Tarihi 02.02.2024)
- Milli Eğitim Bakanlığı (MEB) Temel Eğitim Genel Müdürlüğü (2023). *Yapay Zeka Uygulamaları Dersi Öğretim Programı* (I-II), Ankara.
- National Strategy for Artificial Intelligence, (2019). National Strategy for Artificial Intelligence. The Government of The Republic of Korea, <https://www.msit.go.kr/bbs/view.do?sCode=eng&nttSeqNo=9&bbsSeqNo=46&mId=10&mPid=9> (Erişim Tarihi: 27.05.2023)

- Okcu, M. ve Akman, Ç. (2022). Türkiye'nin Yapay Zeka Politikası, Yapay Zeka ve Kamu Politikası Ülke İncelemeleri (1.Baskı), 433-477. Ankara: Nobel Yayınları
- Sharma, Y. (2018). 'Boost to university-industry AI research collaboration'. University World News. <https://www.universityworldnews.com/post.php?story=20181012084845359> (Erişim : 22.05.2023)
- Smart Nation Singapore, (2019), National Artificial Intelligence Strategy. Smart Nation and Digital Government Office, <https://www.smartnation.gov.sg/initiatives/artificial-intelligence/> (Erişim Tarihi: 06.06.2023)
- Tamer, Y.H. ve Övgün, B. (2020). Yapay Zeka Bağlamında Dijital Dönüşüm Ofisi. Ankara Üniversitesi SBF Dergisi, (Sayı 75), 775-803.
- Topuz, A.C. ve Göktaş, C. (2015), "Türk Eğitim Sisteminde Teknolojinin Etkin Kullanımı İçin Yapılan Projeler: 1984-2013 Dönemi", Bilişim Teknolojileri Dergisi, (Sayı 2), 99-110.
- Troshchinskiy P.V. (2021). Main Directions of Digitalization in China, Advances in Economics, Business and Management Research, 164, 451-454, <http://dx.doi.org/10.2991/aebmr.k.210222.090>, (Erişim Tarihi: 04.04.2023).
- Türker, A. ve Güven, C. (2016). Lise Öğretmenlerinin Eğitim Bilişim Ağı (Eba) Projesinden Yararlanma Düzeyleri Ve Proje İle İlgili Görüşleri, Eğitim ve Öğretim Araştırmaları Dergisi, 5(1), 244-254.
- Türkiye Bilişim Derneği (TBD). (2020). Türkiye'de Yapay Zekanın Gelişimi İçin Görüş ve Öneriler. <https://www.tbd.org.tr/pdf/yapay-zeka-raporu.pdf>
- Türkiye Yapay Zeka İnsiyatifi (TRAI), (2024). <https://turkiye.ai/hakkimizda/> (erişim tarihi: 30.01.2024).
- Ulusal Yapay Zeka Stratejisi (UYZS). (2021), <https://cbddo.gov.tr/SharedFolderServer/ Genel/File/TR-UlusalYZStratejisi2021-2025.pdf> (Erişim Tarihi: 01.02.2023)
- UNESCO, (2019). Artificial Intelligence in Education:Challenges and Opportunities for Sustainable Development, Working Papers on Education Policy.
- Yıldırım, A., ve Şimşek, H. (2008). Sosyal Bilimlerde Nitel Araştırma Yöntemleri (6. Baskı). Ankara: Seçkin Yayıncılık.