

The Role of Education in Türkiye's Technological Transformation

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Türkiye's education system is pivotal to the nation's technological transformation, integrating efforts from public, private, and non-governmental sectors. Key initiatives like the FATİH Project in Education and the EdTech platform Eğitim Bilişim Ağı (EBA) enhance digital literacy and provide essential education resources, particularly during the COVID-19 pandemic. Turkish universities are aligning specialized programs with industry needs, supported by TÜBİTAK programs. Collaborations with Turkish corporations foster practical learning, while NGOs bridge educational divides and improve equity in digital education. Ongoing investment in STEM education, coupled with strengthened international partnerships, will further bolster Türkiye's position as an emerging global technology powerhouse.

Introduction

Türkiye's journey toward technological advancement has been significantly driven by its strategic investment in education. From early digital literacy at the primary and secondary levels to advanced research and practical applications at the vocational and university stages, Türkiye's educational system has become a foundation for technological growth. The government's policies have created a pathway for youth to gain crucial skills, with collaborations between public institutions, the private sector, and non-governmental organisations (NGOs) further bolstering this transformation. The COVID-19 pandemic, although challenging, accelerated the development of a robust EdTech infrastructure and highlighted the importance of ensuring equity in education. This analysis will explore the role of education in driving Türkiye's technological transformation, focusing on key initiatives at different educational levels and how the pandemic showcased the country's resilience in adapting to digital learning.

Technology Initiatives at the Primary and Secondary Education Level

Türkiye's education system is predominantly [public and highly centralised](#), with the Ministry of National Education managing nearly all aspects of public education, including hiring and paying staff, maintaining facilities, and administering programs. Despite a small share of private education institutions, the public system remains dominant. Recognising the importance of technological literacy from a young age, the government has worked diligently to ensure that students nationwide have access to digital tools, fostering an early interest in technology. Türkiye's approach is rooted in the belief that primary and secondary education lay the groundwork for future tech talent.

Türkiye participated in the Program for International Student Assessment (PISA) assessment for the first time in 2003. The results [revealed](#) that the average score in math literacy was 425, which experts indicated fell below basic proficiency levels. The Turkish government recognised the need for a nationally coordinated focus on Science, Technology, Engineering, and Mathematics (STEM) education. Important education reforms were introduced in 2006, and Türkiye's PISA scores rose from 425 to 446 by 2009, reflecting a notable improvement in science literacy and a commitment to enhancing educational outcomes on the international stage. Buoyed by this encouraging development, the Turkish government developed the [FATİH Project](#) (Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi), representing a groundbreaking shift in the na-

tion's educational landscape. Evoking the legacy of Sultan Mehmet II, also known as "FATİH" (the conqueror), the project's name signified a major, long-term transformation in how education would be delivered in the country. FATİH was envisioned as a comprehensive initiative to enhance equality of opportunity in education while improving the integration of Information and Communication Technology (ICT) into Turkish schools. The initiative was designed to supply Interactive Whiteboards (IWBs), tablet computers, and internet network infrastructure to all basic education institutions, with the eventual goal of covering 40,000 schools and 620,000 classrooms across the country.

As noted above, the origins of the FATİH Project trace back to the early 2010s. The initiative officially launched in the 2010-2011 school year, starting with installing IWBs, laptops, and projectors in selected secondary school classrooms. This early phase excluded tablets but laid the groundwork for larger-scale implementations. In its second phase, spanning 2012-2013, FATİH expanded to 17 provinces and 52 schools, where students received tablets with intranet access, which was later upgraded to full internet connectivity in schools. By April 2013, over 120,000 teachers had already received ICT training, with plans for 680,000 teachers to eventually complete two specialised training modules. This training was supported by establishing 110 distance learning centres across 81 provinces, enabling ongoing professional development for educators. These centres not only ensured widespread access to training but also solidified the role of ICT in the Turkish education system. The Turkish government introduced [coding courses](#) in secondary schools in May 2013 to ensure students were also familiar with essential programming languages. The aim was not only to enhance students' tech proficiency but also to foster a mindset of problem-solving and innovation that will serve them well in future tech-related careers.

FATİH's ambitions are divided into [five main components](#) that target both the hardware and the educational ecosystem needed to support technology-driven learning:

1. It focused on setting up the necessary hardware and software infrastructure to ensure schools were adequately equipped with ICT tools, including IWBs, tablets, and internet networks.
2. The initiative worked to generate and manage e-content that aligned with the new ICT-supported learning environments, ensuring that students had access to interactive, technology-enhanced learning materials.
3. FATİH emphasised integrating ICT into the curriculum, seeking ways to fuse digital tools with course content to enhance teaching and learning.
4. The project aimed to promote the conscious, reliable, and measurable use of ICT and the internet, focusing

on educating students and teachers on effectively and safely navigating digital resources.

5. The project included a significant teacher training component, ensuring that educators were fully equipped to use ICT tools in their classrooms.

The FATİH Project's [implications](#) for technology advancement in Türkiye extend far beyond the classroom. By fostering technological literacy from an early age, the initiative is helping to equip future generations with the skills necessary to thrive in an increasingly digital world. Additionally, FATİH has laid the groundwork for digital equity by attempting to bridge the digital divide, providing students across urban and rural areas with equal access to advanced learning tools. The project also contributes to the broader digital transformation of Turkish society, preparing a future workforce adept in ICT skills and poised to contribute to the country's economic and technological development. Despite challenges in implementation—particularly in ensuring consistent internet access in rural areas—FATİH represents a pivotal moment in Türkiye's journey toward becoming a leader in technology-enhanced education.

At the centre of Türkiye's digital education transformation is the [Education Information Network](#) (Eğitim Bilişim Ağı or EBA), an online platform created by the government as part of the FATİH Project to serve as a comprehensive digital resource for both teachers and students. Research on EBA has highlighted various strengths of the platform: in 2016, Fidan and his fellow researchers [found](#) that primary school teachers viewed EBA as a useful and effective tool, while Timur et al. (2017) [noted](#) that secondary school students appreciated the educational content it offered. Bertiz (2017) [found](#) EBA to be very usable, while Arkan and Kaya (2018) [emphasised](#) that the platform is seen as a social necessity aligned with Türkiye's 2023 Education Vision. Lastly, Kapidere and Çetinkaya [noted](#) in 2017 that EBA's mobile content offered users an effective and streamlined experience.

Given that, nearly 1 million teachers and 18 million students in Türkiye were impacted by school closures and restrictions during the COVID-19 pandemic. To address these challenges, the Ministry of National Education implemented several initiatives to ensure the continuity of education. One of these was building on top of the EBA infrastructure by introducing the EBA Live Classroom Application, which was seen as a [crucial tool](#) in maintaining continuity in education by allowing interactive lessons between teachers and students, especially during periods of school closures. Its expansion to cover various grade levels helped bridge the gap in access to education, and teachers found it effective in delivering lessons remotely. The platform also played a role in addressing educational inequalities by providing digital access to those without other learning options.

Besides setting up the infrastructure of EBA, the Ministry [collaborated](#) with the Turkish Radio and Television Corporation (TRT) to broadcast educational content on national television, making learning accessible to students with limited internet access. Third, teachers received additional training to adapt to digital teaching tools and methods, ensuring they could effectively deliver lessons remotely. Fourth, efforts were made to provide devices and internet connectivity to disadvantaged students, helping to reduce the digital divide. Lastly, the Ministry [closely monitored](#) student engagement and learning outcomes to adjust and improve the delivery of remote education as needed throughout the pandemic. Even before the pandemic, Türkiye had already begun integrating EBA into daily classroom instruction, offering a broad range of content such as lesson plans, quizzes, videos, and other resources tailored to different grade levels. The country's early adoption of EBA proved instrumental during the pandemic, ensuring that students continued their education seamlessly. Alongside these infrastructure developments, Türkiye also invested in extracurricular and project-based learning, including STEM competitions and science fairs, to encourage students to pursue careers in technology. These efforts reflect the government's vision of nurturing future leaders in technology who can drive Türkiye's economic growth forward.

As noted above, Türkiye has made significant strides in integrating technology into its primary and secondary education systems in recent years, particularly by introducing STEM programs. These initiatives strongly emphasise coding, robotics, and digital literacy, starting from early grades. In May 2013, the Turkish government [introduced coding courses](#) in secondary schools, aiming to familiarise students with essential programming languages. This move sought not only to improve students' technological proficiency but also to foster problem-solving and innovation skills—essential for future careers in technology. In April 2014, Istanbul Aydın University launched the project '[STEM for Disadvantaged Students, Especially Girls](#)'. This initiative focused on engaging socioeconomically disadvantaged students, particularly girls, in STEM education. It aimed to improve students' scientific skills, creativity, problem-solving abilities, and attitudes toward STEM-related careers. The importance of such efforts was underscored by the Türkiye [STEM Education Report](#) (Akgündüz et al., 2015), which highlighted the need for integrating comprehensive STEM education into the K-12 curriculum. The STEM Workforce Report (TÜSİAD, 2014) further emphasised the necessity of cultivating a qualified STEM workforce for Türkiye's future economy.

In alignment with these goals, Türkiye's Ministry of National Education incorporated STEM education as part of its broader strategy under the [2011-2016 Science Technology Development Plan](#), initiated by the Scientific and Technological Research Council of Türkiye (TÜBİTAK). This plan involved organising science fairs, space science activities,

and mathematics initiatives in primary and secondary schools. TÜBİTAK also spearheaded various projects and contests to recognise outstanding students and teachers in STEM fields while establishing science centres across different cities to promote scientific interest and reduce societal biases. Furthermore, a [key evaluation](#) of Türkiye's early STEM education programs was conducted by Poyraz and Kumtepe (2019). Their study analysed the STEM program designed by the Kayseri Provincial Directorate of National Education, which was piloted in selected schools, including kindergartens, secondary schools, and a centre for gifted students. The study highlighted the effectiveness of integrating distance education to enhance the sustainability and accessibility of STEM education. The program showed notable success, particularly after the surge in STEM-related initiatives and publications from 2017 onwards. The findings underscored the value of effective in-service teacher training, continuous academic support, and strategic partnerships in ensuring successful STEM curriculum implementation.

Moreover, the program emphasised diversifying STEM materials beyond robotics and coding. Creative approaches such as the 3R rule (Reduce-Reuse-Recycle) were promoted, encouraging resourcefulness among students. Additionally, shared resources provided a cost-effective solution, helping to overcome budget constraints while ensuring that all students had access to quality STEM education.

Technology Initiatives at the University and Vocational Education Level

While primary and secondary education initiatives have laid the groundwork for tech skills, Türkiye's university and vocational education systems have further strengthened the country's technological capabilities. Universities across Türkiye are increasingly offering specialised technology programs, ensuring that graduates are equipped with the knowledge and skills necessary for a rapidly evolving job market. Additionally, vocational education institutions emphasise hands-on training and practical experience, enabling students to develop technical competencies that align with industry needs. Partnerships between educational institutions and tech companies foster innovation and provide students with real-world exposure, enhancing their employability. As a result, these efforts contribute to a robust pipeline of skilled professionals ready to drive technological advancement and economic growth in Türkiye.

Specifically at the university level, Türkiye's top state universities, such as Istanbul Technical University and Middle

East Technical University (METU), have introduced degree programs in machine learning and other emerging tech fields. Middle East Technical University (METU) is particularly making strides by establishing an artificial intelligence (AI) hub. These programs are designed to meet the growing demand for skilled professionals who can contribute to national and global innovation in key sectors.

In the [context of AI](#), institutions like Bilkent University, Boğaziçi University, and Koç University are leading the charge through their commitment to AI research and education. These universities offer specialised AI programs and engage in cutting-edge research, reflecting the growing interest among students and academics in AI and data science. With initiatives such as Bilkent University's advanced AI curriculum and Koç University's AI research centre, these institutions are equipping students with the necessary skills to thrive in the tech-driven landscape. The Turkish public education ecosystem, supported by TÜBİTAK, plays a crucial role in this transformation. TÜBİTAK has funded and promoted AI research projects nationwide through initiatives like the Artificial Intelligence Ecosystem Call 2024. Its efforts encompass grants for AI-related research, support for innovative projects, and the establishment of AI-focused research centres, all enhancing the nation's technological capabilities. While these initiatives represent significant progress, Türkiye still needs increased investment and international collaboration to emerge as a global leader in AI. In addition, universities such as Hacettepe University and Bahçeşehir University have begun offering majors in AI engineering, reflecting a shift towards more focused education in technology. Though these programs are relatively new and currently limited in scope, they represent a growing commitment within Türkiye's public and private education ecosystems to foster technological innovation and prepare the workforce for a rapidly evolving digital economy.

Another important development has been the establishment of tech incubators and startup ecosystems linked to universities. Bilkent [CYBERPARK](#), established in 2002 by Bilkent University and Bilkent Holding, is Türkiye's first foundation university technopark and plays a crucial role in the nation's technology-based entrepreneurial ecosystem. Housing over 300 technology companies across various sectors, the technopark is a hub of innovation supported by four dedicated Research Centers and more than 5,400 research personnel. It enhanced its contributions to Türkiye's technological development capacity with the introduction of Ankara Technology Bridge, the country's first incubation centre. A second example is [CUBE Beyoğlu](#) Incubation Centre, which has been established as a collaborative initiative involving Boğaziçi University, Teknopark Istanbul, and Beyoğlu Municipality, aimed at fostering innovation among young companies since April 2023. The centre has been designed to offer significant advantages, including support and incentives for research

personnel, as well as tax exemptions, creating a conducive environment for startups to thrive. Leveraging Boğaziçi University's extensive scientific knowledge and research background, professors have been assigned to assist with corporate R&D activities, ensuring that companies benefit from academic insights. With a focus on sectors like deep tech, IoT, and biotech, these university-linked incubators are positioning Türkiye as a hub for tech innovation in the region.

At the [policy and programmatic support level](#), the Turkish government is actively advancing its technological transformation through various initiatives at the university and vocational education levels. Research, development, and innovation (RDI) are prioritised by allocating substantial funding to projects aligned with national goals. For instance, TÜBİTAK's recent Priority R&D and Innovation Areas Study identified 264 priority topics, with a significant focus on digitalisation and green technologies. Key programs, such as the Technology-Oriented Industrial Move and the "Turcorn 100" Program, support innovation and entrepreneurship, fostering a robust ecosystem for tech startups and SMEs. KOSGEB's support programs for SMEs encourage the development of innovative products, while TÜBİTAK provides international funding opportunities for outstanding researchers through initiatives like the Marie Skłodowska-Curie Actions and the European Research Council.

Furthermore, collaboration between academia and industry is promoted through various initiatives, enhancing Türkiye's research and innovation ecosystem and contributing to the country's technological advancement. University-level initiatives have also benefited from international collaborations with prestigious institutions, allowing Turkish students to participate in exchange programs, joint research and internships with leading global tech firms. These collaborations have significantly strengthened Türkiye's reputation as a country committed to technological advancement through education. In April 2024, a [cooperation protocol](#) was signed between the Council of Higher Education (CoHE), the Presidency for Turks Abroad and Related Communities (YTB), and the Turkish Maarif Foundation (TMF) to enhance collaboration in education, research, development, and university fairs. Türkiye's commitment to science diplomacy was highlighted, which aims to strengthen international collaborations and enhance its role in regional and global affairs through strategic partnerships.

Meanwhile, vocational education has also evolved to meet the needs of Türkiye's growing tech industries. The [Turkish vocational education system](#) offers secondary and higher education programs, providing students with options to pursue specialised training early on. At the secondary level, vocational education is a four-year program where students can choose between two main types of institutions: Vocational and Technical Anatolian High Schools (VTAHs)

and Vocational Training Centers (VTCs). VTAHs integrate academic and vocational skills, allowing students to enter the workforce or continue their education. In the 9th grade, students follow a general academic curriculum similar to other high school types, but by the 10th grade, they can select a vocational field based on their interests and academic performance. In the 11th grade, students specialise further by choosing specific branches within their vocational field. The program covers 54 fields and 199 branches, and students receive their diplomas upon completing the 12th grade.

The development of the VET sector in Türkiye was informed by the comprehensive reforms and initiatives outlined in the Turkish Ministry of Education's [Education Vision 2023](#). A major focus has been on collaborating with key industries and universities to align vocational education with the demands of the labour market. These collaborations aim to provide students with real-world training through on-the-job experiences, internships, and updated curricula in both existing and emerging fields. The establishment of VTAHs in partnership with [top institutions](#), such as ASELSAN and Istanbul Technical University, ensured that VET students received high-quality, specialised education, attracting top-performing students. Additionally, the Turkish Ministry of Education significantly increased professional development opportunities for VET teachers, enhancing the quality of instruction. To improve the perception and accessibility of VET, [digital platforms](#) like the Vocational Training Map and My Job My Life were launched to offer updated information on employment opportunities, while the VET quality assurance system ensured that schools maintained high standards. Social inclusion projects, particularly for disadvantaged groups such as Syrian students and prisoners, further broadened VET's impact. By integrating VET into sectors like engineering, manufacturing, and tech-related fields, Turkish authorities are utilising the VET system to foster innovation and build a skilled labour force equipped for the demands of modern technology-driven industries.

Turkish vocational schools are now focusing on sectors like renewable energy, smart agriculture, and automotive tech (specifically electric vehicles or EVs). For example, vocational schools in Bursa have [partnered](#) with automotive manufacturers to provide specialised training in EV production, reflecting Türkiye's ambitions to lead the region in green technology. In the renewable energy sector, vocational programs focus on training technicians and engineers in solar and wind energy production. These initiatives help meet the growing demand for skilled workers in Türkiye's energy transformation as the country shifts towards sustainable energy sources. The collaboration between vocational schools and private sector companies is also a key driver of success. Local companies have partnered with vocational schools to offer hands-on training and apprenticeships, with some, like Arçelik, even [offering](#)

[STEM education and training](#) to young women in Türkiye as well as in countries where they have subsidiaries, such as Pakistan and South Africa.

The Turkish government's [efforts to promote digital transformation](#) in higher education are significantly enhancing access to technology education. By implementing initiatives like the 'YÖK Goes Digital' project and establishing Learning Management Systems (LMS), students across the country can engage with a diverse range of digital learning materials and interactive educational experiences. This approach democratises access to high-quality education, allowing students from various regions, including underserved areas, to benefit from advanced teaching methods and resources. The [establishment](#) of Massive Open Online Course (MOOC) platforms such as Akadema and AtademiX further broadens access to technology education, enabling individuals of all ages to pursue personal and professional development online. These platforms not only provide flexibility in learning but also offer courses designed by experts from different universities, thereby enhancing the overall quality of education available to students. Moreover, scholarships for doctoral students in critical technology fields reflect the government's commitment to cultivating a skilled workforce that can meet the demands of a rapidly changing job market. These initiatives are expected to increase enrollment in technology-related programs, improve digital literacy, and equip students with the necessary skills to thrive in a tech-driven economy.

Incorporation of Private Sector and NGOs in Education

The private sector and non-governmental organisations (NGOs) have been instrumental in driving Türkiye's technological transformation, especially in education. Their involvement has bridged gaps in government efforts and provided critical resources for developing a tech-driven educational system. The private sector, particularly major tech companies, has supported the government's push for digital education by providing critical infrastructure and tools.

One of the most effective ways the private sector contributes to education is through funding [research infrastructure](#) development. A prime example of this is the Life Sciences and Technologies Application and Research Center (LifeSci) at Boğaziçi University. This centre focuses on key areas such as in-body microsystem-based medical devices and nanomedicine, employing nearly 50 researchers. Among its industrial partners is Arçelik, a leading Turkish multinational appliance manufacturer known for its innovative technology and commitment to sustainability.

LifeSci also collaborates with prominent international institutions, including the University of California, Irvine, and University College London.

A second example is the Deneysel Fen Bilimleri Araştırma ve Uygulama Merkezi (DEFAM) at Celal Bayar University in Manisa. One of its industrial partners is Vestel, a major Turkish electronics and home appliance manufacturer. DEFAM specialises in molecular biology, chemical analysis, and thermal analysis, amongst other technologies, leveraging its industrial ties to enhance research capabilities and educational opportunities. In the context of robotics and telecommunications, there is Teleiletişim ve Enformatik Teknolojileri Uygulama ve Araştırma Merkezi (TETAM) at Boğaziçi Üniversitesi. One of its industrial partners is Türk Telekom, with IBM, Google, and Ericson as its international collaborative partners. Such partnerships that involve universities and the private sector not only facilitate cutting-edge research but also bridge the gap between academia and industry, fostering an environment where practical applications of scientific knowledge can power national growth at the behest of technology.

NGOs in Türkiye are [significantly contributing](#) to the country's tech transformation through education, which particularly got a boost during the Covid-19 pandemic by enhancing digital distance learning and supporting students' access to technology. Many NGOs have developed robust digital platforms that enable online evaluations, personalised feedback, and systematic educational programs. This approach fosters a more methodical approach to distance education, helping bridge the digital divide in regions with limited resources. NGOs like the Educational Volunteers Foundation of Türkiye (TEGV) and Teachers Academy Foundation (ÖRAV) have provided digital tools for teaching subjects such as basic science, math, and even coding, expanding students' technological literacy nationwide. Additionally, NGOs play a critical role in content creation, developing digital materials such as books, videos, and podcasts to enhance learning in a variety of fields, from cybersecurity to physical education. By contributing their materials to national education platforms like the above-mentioned EBA, they make these resources accessible to a broader audience. Turkish NGOs also organise specialised online education programs and short-term courses in technology-related areas, helping students and teachers develop skills necessary for the digital age. Furthermore, Turkish NGOs provide direct support to students by offering computer, tablet, and internet access, particularly targeting disadvantaged groups. By ensuring that students have the technological tools they need, NGOs help expand digital education's reach and efficacy, playing a key role in Türkiye's broader tech transformation by empowering future generations with the skills and tools needed to thrive in a tech-driven world.

Conclusion

Türkiye's education system is a cornerstone of the nation's technological transformation, reflecting a multifaceted approach that integrates public, private, and non-governmental contributions. The government's commitment to enhancing digital literacy is evident in key initiatives like the FATİH Project, which was launched in 2010 to modernise classrooms across urban and rural areas. By providing interactive whiteboards, tablets, and robust internet infrastructure, the FATİH Project ensures that students gain essential tech skills from an early age, preparing them for future careers in a rapidly evolving digital landscape. Additionally, the EBA emerged as a crucial platform during the COVID-19 pandemic, facilitating remote learning and addressing educational disparities by making educational resources accessible to students with limited internet access. EBA's Live Classroom Application exemplifies how digital tools can be leveraged to maintain educational continuity and enhance student engagement in challenging times.

Moreover, Türkiye's universities and vocational education institutions are at the forefront of technological advancement, offering specialised programs that align with the needs of emerging industries. Renowned universities such as Istanbul Technical University and METU are introducing degree programs in machine learning and artificial intelligence, further supported by TÜBİTAK's initiatives. This alignment of higher education with technological innovation is critical for developing a skilled workforce to drive economic growth and competitiveness in the global market. The collaboration between universities and the private sector, exemplified by partnerships with leading Turkish behemoths like Arçelik and Vestel, facilitates cutting-edge research while bridging the gap between academic theory and practical application. Such collaborations are crucial for fostering an environment where students can gain hands-on experience in high-demand fields, such as renewable energy and EV production.

Non-governmental organisations like TEGV and ÖRAV also play a vital role in enhancing digital education, particularly for underserved communities. Their efforts in providing online tools, content, and access to technology, especially during the pandemic, have significantly contributed to reducing the educational divide. As Türkiye strives for global leadership in future forward fields such as AI and green technologies, it is imperative to continue investing in STEM education and fostering international collaborations. By nurturing future tech leaders and strengthening its educational infrastructure, Türkiye can continue solidifying its place in the global digital economy, driving technological innovation and growth for future generations.