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Emerging Challenges in Iran's Technical and Vocational Education and Training System: Lessons for Developing Countries

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ABSTRACT

This article presents the findings of a content analysis of research documents and a synthesis of empirical studies on technical and vocational education and training (TVET) in Iran. The study examined 97 research reports and official documents from Iran's Ministry of Education to depict the current state of formal TVET. Additionally, several key international reports were reviewed to identify emerging labor market conditions and appropriate policy responses. A systematic review approach was employed to analyze the content and implications of these documents. The findings reveal that Iran's education system has failed to overcome its chronic weakness in preparing human resources equipped for the labor market. This structural deficiency has been further exacerbated by rapid technological advancements and shifting labor market demands, placing the current skill-training model in technical and vocational schools under severe pressure. Developments in artificial intelligence and automation are diminishing employment prospects for graduates of formal TVET programs, as many tasks traditionally performed by mid-level skilled workers can now be executed by robots. Consequently, the continuation of existing TVET programs appears unjustifiable. Instead, it is imperative to adopt policies aligned with emerging labor market needs. In line with the transition toward an innovation-driven economy, this study recommends that Iran and other developing countries pursue the vocationalization of general education combined with STEM-based technological education. This approach not only enhances the quality of universal education but also reduces educational inequalities, offering a realistic and viable pathway forward.

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1. Introduction

Since the turn of the 21st century, globalization and rapid technological change have prompted many countries to reorient their industrial and educational systems toward creativity, entrepreneurship, and the development of foundational skills through a holistic approach. This shift has extended beyond technical and vocational education to encompass general and secondary education as well. Several developing countries—including Singapore, South Korea, China, Malaysia, and Australia—have achieved notable economic success by transforming their education systems in this direction. In contrast, Iran's education system has been less successful in fostering creativity and entrepreneurial competencies among its workforce.

A historical review of education in Iran indicates that prior to the establishment of Dar al-Fonun (1850), no formal institutions existed for technical and vocational education. Skills in arts and crafts were traditionally transmitted through the master-apprentice model (Plan and Budget Organization, 1980). Influenced by global developments during the Industrial Revolution, Dar al-Fonun marked the beginning of modern technical education in Iran (Naveedy & Khalaghi, 2014). Over the subsequent century and a half, TVET programs experienced relative quantitative growth despite numerous challenges. According to official statistics, the proportion of students enrolled in technical and vocational streams rose from 31% in 2001 to 43% in 2024.

During the past five decades, secondary education policies and curricula have undergone repeated revisions, primarily aimed at integrating work and education and better preparing students for the workplace (Naveedy, 2018). However, the core problems of Iran's education system have persisted and have become even more complex amid new realities, such as expanded access to higher education and evolving labor market demands. Policymakers have frequently responded by increasing the share of TVET; yet, substantial research evidence (e.g., Institute for Educational Studies and Planning, 1994; Jafari Harandi, 2007; Naveedy & Barzegar, 2003; Mirhadi, 2007; Nafisi, 2000) indicates that the inputs, processes, and outputs of formal TVET remain unsatisfactory. Key issues include: mismatch between graduates' fields of study and employment; low student interest in TVET tracks; lack of alignment with labor market needs; high unemployment rates among graduates; inadequate facilities, equipment, and qualified teachers; and overall low external efficiency. Naveedy and Khalaghi (2018) identified major barriers, including misalignment between TVET programs and societal/employment needs, weaknesses in general education and foundational skills, and the low social prestige of TVET. Nafisi (2000) concluded that the expansion of TVET has not been driven by current or future labor market requirements, while the structure of industry, services, and agriculture remains unsupportive.

More recently, advancements in artificial intelligence and automation have further diminished the relevance of mid-level skills. The practical value of conventional formal TVET is increasingly questioned by experts. The present study seeks to provide a realistic assessment of the current state of TVET in Iran, highlight emerging challenges, and propose effective strategies to address them.

2. Research Method

The methodology of this study approximates—but is not fully consistent with—a systematic review. A systematic review involves the rigorous synthesis of evidence on a specific topic through critical identification, appraisal, and analysis of relevant studies, culminating in evidence-based conclusions (Kavale & Glass, 1981). Due to practical constraints, this study relied on available research reports. From 360 studies summarized in six volumes by the Research Institute for Education, 97 reports were purposively selected based on relevance, methodological soundness, and clarity of findings. Official Ministry of Education documents were also examined to portray the current status of formal TVET.To explore emerging challenges and international alternatives, two key sources were analyzed in depth: UNESCO (2013) and Esmaili (2022). Conventional systematic search criteria could not be fully applied due to the nature of the topic; therefore, readily available high-quality sources were utilized.

3. Findings

The findings are presented in three main sections: (A) the current state of formal TVET in Iran; (B) emerging challenges; and (C) strategies for addressing them.

A) Current State of Formal TVET in Iran

Historically, technical skills were acquired through the master-apprentice system. Modern TVET began in the Qajar era with the establishment of Dar al-Fonun in 1850. Subsequent developments included limited European-influenced schools and gradual expansion after the 1950s.Significant quantitative growth occurred over time.Following the establishment of Dar al-Fonun, significant efforts were made to found new schools, primarily of a military character, in Tabriz, Isfahan, and Tehran (Marjani, 1994). Nevertheless, throughout the century after Dar al-Fonun's inception, the capacity of technical and vocational education to produce skilled human resources remained very limited. During the final years of the Qajar dynasty, technical and vocational education expanded gradually across various fields. The creation of Iranian and German Technical Conservatories was followed by the establishment of additional technical institutions.

Between 1956 and 1972, three development plans placed greater emphasis on technical and vocational education. By the end of the third plan, the number of technical and vocational centers had reached 118, with 15,956 students enrolled. This figure grew to 237 centers and 47,451 students by the end of the fourth plan. However, during the decade 1962–1972, less than 3 percent of all secondary school students were enrolled in vocational and art schools, while over 97 percent pursued theoretical education.

The introduction of the new educational system from the 1966–1967 academic year brought a notable shift. The share of technical and vocational education rose to approximately 17 percent in the 1970s. Between 1971 and 1978, the number of students in technical and vocational streams quadrupled, increasing their proportion within total secondary education from 4 percent (1971–1972) to 23.6 percent (1978–1979). One of the primary objectives of the new program was "to strengthen secondary education, especially technical and vocational education, in order to train skilled workers, technicians, engineers, specialists, and qualified managers for the country's development" (Ministry of Education, 1965). The technical and vocational branch was organized into three main sections—industrial education, rural and agricultural vocational education, and service education—each further divided into multiple fields. Admission to the technical and vocational stream remained significantly lower than the theoretical stream, and most students in these programs were those with lower academic averages who had been diverted from theoretical pathways (Naveedy and Khlaghaghi, 2014).

After the 1979 Revolution, the secondary education system underwent another major reform. The new structure was implemented in the 1992–1993 academic year, initially covering 10 percent of first-year secondary students. Within this framework, a formal technical and vocational program known as the "*Kardanesh Branch*" (Work & Knowlegde Branch) was introduced. The stated goal of the Kardanesh branch was "to train semi-skilled, skilled, master-level, and supervisory human resources required by industry, agriculture, and service sectors according to the country's economic, social, and cultural development needs, so that every employed person or job seeker acquires sufficient knowledge and skills for their work" (Ministry of Education, 1994).

The implementation of the Kardanesh branch contributed to substantial quantitative growth in technical and vocational education. With the rising secondary school population, the share of students in technical/vocational and Kardanesh/vocational training streams increased markedly. This share reached 29.07 percent in 2000–2001 and 36.37 percent in 2005 (Naveedy and

Khlaghaghi, 2014). According to official statistics from the Integrated Student Education System (SIDA, 2025), in the 2024–2025 academic year, out of 3,055,788 total secondary school students, 1,316,450 (43.1%) were enrolled in the technical and vocational education and Kardanesh/vocational training branches. Of these, 623,761 students (47.4%) were in the Kardanesh/vocational training branch. The distribution of students across the four main fields—industry, agriculture, services, and art—is presented in Figure 1.

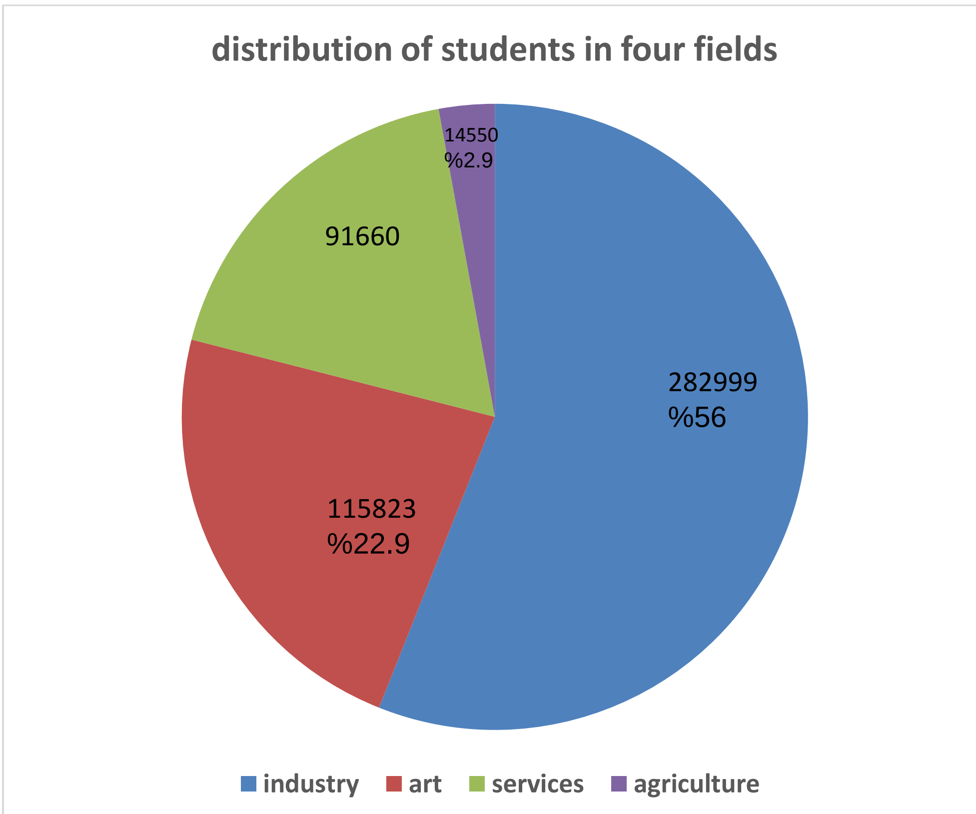

Figure 1: Technical and vocational students divided into four fields

Overall, the historical trajectory reflects a gradual transition from a predominantly theoretical secondary education system toward greater balance with technical and vocational pathways, driven by national development priorities over more than a century. By the 2024–2025 academic year, out of 3,055,788 secondary school students, 1,316,450 (43.1%) were enrolled in technical/vocational or Kardanesh tracks (SIDA, 2025). However, As shown in Table 1, student enrollment is highly concentrated; more than 80% of students in the technical and vocational branch and approximately 65% in the Kardanesh branch are studying in only 10 fields.

Table 1. Distribution of the Most Popular Fields in Technical and Vocational Education and Kardanesh Branches (Percentage of Students)

Rank	Technical & Vocational Branch	Percentage		Kardanesh / Vocational Training Branch	Percentage
1	Computer Networks and Software	18.2%	1	Automobile Repair and Electrical Systems	9.7%
2	Accounting	12.4%	2	Industrial Electricity	8.5%
3	Electrotechnics	8.6%	3	Financial Accounting	7.9%
4	Automobile Mechanics	7.6%	4	Sewing (Evening & Wedding Dresses)	7.4%
5	Fashion Design and Sewing	7.6%	5	Internet Website Production	6.9%
6	Interior Architecture	6.3%	6	Computer Graphics	5.8%
7	Physical Education	5.9%	7	Electronic Content Production	5.7%
8	Graphics	5.6%	8	Computer Illustration and Special Effects	5.1%
9	Construction	3.9%	9	Building Drafting	3.8%
10	Electronics	3.6%	10	Family Affairs Management and Planning	3.7%

Source: Integrated Student Education System (SIDA, 2025)

Despite repeated policy reforms and increased enrollment, extensive research consistently demonstrates serious shortcomings in inputs, processes, and outputs. Graduates frequently face unemployment or employment unrelated to their training, and the system has largely failed to equip students with relevant competencies. A review of the historical development of technical and vocational education in Iran reveals that since 1956, all national development plans have emphasized the importance of expanding technical and vocational education programs. Over the past half-century, the proportion of students enrolled in technical and vocational streams has increased substantially, rising from approximately 3 percent in 1972 to more than 43 percent in 2024.Nevertheless, most informed experts acknowledge that the current state of technical and vocational education remains unsatisfactory. Moreover, existing research evidence points to significant dysfunctions and major deficiencies within the formal technical and vocational education system.

A review of the findings from existing research reports indicates that technical and vocational education programs have failed to achieve their intended objectives. In fact, the inputs, processes, and outputs of Iran's formal technical and vocational education system are unsatisfactory.Shokouhi's study (1990) reveals that in the late 1980s, 89 percent of employed secondary school graduates considered their secondary education to have had no effect or only a minimal impact on performing the duties of their current occupations. In the following decade, Nafisi (2000) showed that 44.4 percent of the 15–19 age group—who were expected to be enrolled in upper secondary education—had dropped out by the end of the period. Of these dropouts, 34.5 percent were employed, yet due to incomplete educational coverage, they lacked the necessary skills to perform their job responsibilities.Thus, we are confronted with the reality that school dropouts and university-rejected graduates possess no relevant skills for employment. Furthermore, the findings of numerous studies (e.g., Golmohammadi, 1998; Kahak, 1998; Hassan Famian, 1998; Mohammadi, 2000; Abdollapour, 2001; Shah Hosseini, 2003; Irani, 2002; Fakhrrahimi, 2000; Hamidi, 2002; Baghchesaraei, 2003; Jafari Herandi, 2007; Drakhshan, 2003; Naveedy and Barzegar, 2003; Saberi, 2004; Moradi, 2005; Shariat Zadeh, 2006; Mirhadi, 2007; Naveedy, 2018; Naveedy, 2021; and Naveedy, 2023) point to major deficiencies in the inputs, processes, and outputs of the formal technical and vocational education system.

B) Emerging Challenges

In the contemporary era, which places strong emphasis on a knowledge-based economy, significant challenges have emerged in the domain of education and training. In this context, the term "challenge" refers to a constellation of conditions, realities, reasons, and evidence that contest the current state of the formal education system, cast doubt upon the efficacy of existing programs, and urge educational authorities to transform the status quo and adapt to emerging conditions. Consequently, it appears essential to introduce fundamental changes in the approaches and operational frameworks of educational systems.Indeed, education systems are confronted with problems whose effective resolution depends upon the exercise of intelligence, critical thinking, and adaptive capacity. It is evident that multiple solutions can be proposed for these systemic issues, solutions that are not necessarily compatible with one another. The credibility of each solution is ultimately evaluated according to its practical utility, although the sustainability and breadth of such utility vary considerably across different interventions.Educational systems established in the twentieth century were originally designed as effective mechanisms for intelligently addressing the challenges posed by the phenomenon of industrialization. However, under present conditions, they no longer demonstrate optimal efficiency and are increasingly being called into question.With the widespread adoption of artificial intelligence and robotics, is it possible that formal technical and vocational education programs will undergo profound transformation?

Technological advancements in the fields of artificial intelligence and automation have led to a decline in the demand for "middle-level skills." At present, the digitalization of financial transactions has resulted in the elimination of thousands of jobs in the financial services sector. In his article, Andrew Scott (as cited in Rezaei, 1397) refers to the existence of a "gap or hollowing out in intermediate occupations," stating that in recent years, a significant hollowing has occurred in the middle segment of the labor market. Individuals positioned in the middle of the employment spectrum have witnessed the reduction or disappearance of their jobs.David H. Autor, Professor of Economics at the Massachusetts Institute of Technology, has categorized occupations into those requiring strong cognitive skills and non-cognitive skills, as well as routine and non-routine jobs. According to him, non-cognitive and routine occupations have fallen victim to automation, which in turn has created a hollowing in middle-level jobs. Individuals who have lost their jobs at this level often lack the specialized skills necessary to transition to higher-level positions on the employment spectrum—namely, occupations that demand high cognitive abilities. Instead, they have been forced to accept jobs that require skills below their existing capabilities.

The expansion of artificial intelligence, robotics, and emerging technologies is likely to extend beyond routine occupations with low cognitive demands. Some routine jobs that require high cognitive skills will also face threats. Moreover, occupations that do not require high cognitive skills but are non-routine in nature will be affected. Artificial intelligence will perform many of the tasks currently carried out by marketers, and restaurants will increasingly utilize robots to reduce their workforce.The gap that has formed in intermediate occupations is widening further, and competition for low-skill jobs at the bottom of the employment spectrum will intensify. Many individuals will witness the disappearance of their jobs and will need to seek entirely different forms of employment. In some cases, they may even be compelled to relocate. The emotional costs of such uncertainty should not be overlooked.No one denies that the labor market will face serious disruption due to artificial intelligence. However, our use of the term "job" must be clear and precise. A job should be understood as a composite of various tasks. Certain aspects of progress in artificial intelligence and robotics are particularly concerning. All occupations are potentially under threat.

Technology is no longer merely a complement to skilled and educated workers; rather, it has become a complete substitute. Chitsaz (2023) has drawn attention to the role of convergence among scientific disciplines in accelerating transformative changes and warns that if policymakers fail to implement timely regulatory measures, severe and irreversible consequences await us. In his view, all occupations are in crisis, and a large number of jobs may disappear. This could lead to the emergence of income gaps, instabilities, and social crises. After this point, competitive advantage will no longer be fixed or stable. The analysis of data, intelligent monitoring, and up-to-date understanding of market dynamics have become essential. Routine and algorithmically amenable occupations are at serious risk. It is estimated that approximately 500,000 to 900,000 jobs related to artificial intelligence will disappear in the next decade. In some cases, business owners may resort to migration due to infrastructural weaknesses. Daniel Susskind, a British economist, argues that the rapid growth of technology—particularly the new generation of artificial intelligence—will lead to widespread unemployment among humans. This phenomenon will bring extensive social and psychological consequences. Demand for middle-income and middle-skill jobs will decline sharply (Susskind, 2020). The polarization of incomes and skills is clearly evident. In the near future, "middle-level skills" will no longer guarantee employment. The future labor market will require two main groups: low-skilled workers and those with high levels of knowledge and expertise.

A historical analysis of labor market transformations suggests that the distribution of occupations once took the shape of a pyramid: specialized professions at the top, semi-specialized occupations in the middle, and unskilled jobs at the base. In the recent past, the number of semi-skilled workers—such as technicians—increased and penetrated the upper levels of the pyramid. As a result, the pyramid transformed into a cylinder. In recent years, the distribution of employment in the labor market has been shifting toward a cylinder resembling a "bitten apple," with a thinned middle section and thicker top and bottom.

Figure 1: Transformation of the Occupational Pyramid Due to Technological Changes

C) Strategies for Confronting Emerging Challenges

Given the current state of formal technical and vocational education and the emerging challenges, the search for strategies aligned with the new conditions appears essential. It should be noted that the development of skills at the level of general education is not merely a national issue pertaining to education in Iran; rather, it is a common global challenge, particularly in developing countries, including the Asia-Pacific region. For this reason, the issues and points raised in the report of the UNESCO Regional Office in Bangkok (UNESCO, 2013) are consistent with the challenges facing secondary education in Iran.The author, through the study of relevant sources, has found that the **vocationalisation** of general education and technology-based education rooted in **STEM** can serve as a compatible policy and an appropriate option.

What is Vocationalisation and Why Vocationalise General Secondary Education?

The rapid transformation of societies in social, political, economic, technological, and educational domains has altered perspectives on the need for, and the nature of, vocational skills. Since the beginning of the twenty-first century, as the world has confronted the phenomena of globalization and rapid technological change, many countries have reoriented their industrial policies—and, consequently, their education systems—toward creativity and entrepreneurship. They have placed strong emphasis on foundational skills education with a holistic approach. This perspective has extended not only to technical and vocational education but also to general and secondary education.Some developing countries, including Singapore, South Korea, China, Malaysia, and Australia, have pursued economic development objectives by implementing fundamental transformations in their education systems and have achieved successful outcomes in this regard.

The primary goal of vocationalisation is to enhance the "*economic relevance of education*" (Laglo, 2005). Vocationalisation of education requires the cultivation of students equipped with the skills, knowledge, and judgment essential for a productive economy. The efforts of Asia-Pacific countries to achieve greater economic development have increasingly highlighted the importance of technical and vocational education and training within their national education agendas. However, the high cost, relatively low social prestige, and, in some cases, limited accessibility of these programs—coupled with students' preference for theoretical education and university pathways—have led many to choose academic routes.Gwang-Jo Kim, Director of the UNESCO Bangkok Office, stated in the foreword to the seventh volume of the UNESCO report (2013, p. 6): "Sustainable economic development in the region depends largely on addressing the weak linkage between school outputs and the labor market." According to UNESCO experts (2013), skills development programs must extend beyond the confines of traditional technical and vocational schools and be implemented within the framework of general education.

How to Vocationalise General Education

The demand for increased productivity and employability through the development of work-oriented competencies has brought vocational education under the umbrella of vocationalisation, alongside general and pre-vocational options in schools. Vocationalised education may be viewed as part of vocational education, with the underlying assumption being the direct transition of students into the labor market upon graduation. Vocationalised secondary education refers to "a curriculum that largely preserves its general or academic character while incorporating vocational subjects and practical work as a small part of the student's timetable throughout the secondary school period." The aim of this approach is to expose a larger number of students to vocational education (Laglo, 2005, p. 3).Nevertheless, other approaches can also be considered as manifestations of the concept of "vocationalisation." For instance, to vocationalise the entire education system, the scope of skills development programs may be expanded to expose a greater number of students to technical and vocational education. On the other hand, integrating vocational subjects into the general education curriculum can be seen as providing a large population of students with opportunities to gain initial understanding and insight into the world of work and career development. Thus, even if not all students in a vocationalised system enter the labor market directly, these programs are considered beneficial in raising students' awareness of the labor market. Consequently, vocationalised education can be regarded as pre-vocational education, the premise of which is not direct entry into the labor market but rather preparing students for intensive vocational training at a later stage.

The functional aspects of this education—those linked to labor market needs (such as technical knowledge, flexibility, and improved productivity)—are far more significant than its purely educational outcomes. This pragmatic approach primarily focuses on general/employability skills within the context of specific occupations. Although the list of employability skills varies from country to country, these skills—conceptualized at different times as generic skills, employability skills, core skills, key skills, or life skills—play a crucial role in ensuring that young people possess the necessary qualities to enter and participate effectively in the workplace.The call for the development of employability skills falls under another trend that emphasizes strengthening convergence between theoretical and vocational education at the secondary level (Pavlova, 2005). Greater emphasis on the comprehensiveness of education, especially in developed countries, has contributed to more effective performance in higher-productivity sectors.

The most cost-effective way to achieve vocationalisation and skills development is to integrate technical and vocational education with general education. However, the major challenge lies in determining *how* this integration should be implemented. Technical and vocational education, as an inseparable component of general education, should begin with a broad foundation of vocational training. It must facilitate horizontal and vertical linkages within the education system and between school and employment, while aiming to eliminate all forms of discrimination. As Binet (1997, cited in Yazdampanah, 2006) noted, curriculum integration is a method of organizing shared learning content or life skills that are essential for all citizens. Shumaker states that integration connects various aspects of the curriculum into a meaningful combination within a broad content domain. In this sense, it is viewed as a general category that reflects real life (1991). Integration activates students' capacities (Barrett, 2001; Birch, 2000; Brewer, 2002; Burton, 2001).Moreover, integration provides students with meaningful learning experiences and promotes the generalization and application of what they have learned in real-life situations.

In the 1960s and 1970s, relatively slow technological changes, combined with an emphasis on skills development, could more or less guarantee job security for life. However, the accelerated pace of technological change—particularly in developed countries—has increased the importance of general education that equips workers to perform effectively in high-productivity sectors. As a result, there has been a visible shift from training for specific occupations (with no real lifetime job security and rapidly expanding labor market needs) toward more flexible education. In this context, the "vocationalisation of general education" has gained greater significance for the economy, and the role of general human capital has been enhanced.The distinction between general and specific education/knowledge is closely related to technology and can be explained in terms of general versus specific human capital. This gap arises from whether individuals can only perform one specific technology (specific human capital) or whether general human capital enables them to perform any type of technology (Kim and Terada-Hagiwara[6], 2010). Depending on their stage of development, countries must strike an appropriate balance between the development of general and specific human capital to ensure the adaptation and diffusion of new technologies. With the increasing importance of returns on investment, demand-driven approaches to vocationalisation must be aligned with the specific stage of economic development, the type of economy, and regional characteristics. Countries that are not at a high level of gross national income can achieve significant gains in competitiveness if they implement reforms to improve human capital (Sabadie and Johansen, 2010).

Approaches to Vocationalisation

With regard to specific approaches to vocationalisation, the UNESCO report (2013) identifies two main models, as follows. These models are not mutually exclusive, and some countries, such as Thailand, employ both.

- *Integrated Curriculum:* Vocational specialization at the secondary level in the Republic of Uzbekistan and Malaysia, and vocational education in Thailand, fall into this category. In this approach, vocational subjects are incorporated into the general secondary curriculum, allowing students to select vocational courses according to their interests and aptitudes. Moreover, the goal is not merely to expand vocational education; students can also choose subjects from other scientific or humanities fields, thereby opening up more career pathways.
- *Concurrent Delivery of General and Vocational Education:* In the Republic of Korea, China, and Thailand, both general and vocational education are offered within the same type of institution (comprehensive schools in Korea and China, and an independent model in Thailand). In these cases, students in the general education stream participate in a specific vocational program (often outside the school) while retaining their status as general education students. The concurrent approach uses separate curriculum planning for the vocational stream and awards vocational certificates to those who successfully complete the courses.

A STEM-based curriculum overlaps with the two aforementioned models. STEM is an interdisciplinary approach to learning in which rigorous academic concepts are combined with real-world lessons. In this approach, students apply science, technology, engineering, and mathematics in contexts that connect school, community, work, and the global economy. This develops STEM literacy and enables competitiveness in the new economy (National Science Foundation of Sri Lanka, 2022). Lee et al (2000) consider the objectives of science education to be the improvement of learners' critical thinking, logical reasoning, and ultimately problem-solving abilities. The future of economic growth depends largely on the availability of a skilled workforce, whose training must begin in school and continue through the active support and implementation of STEM education in schools and universities. Shatunova, et al (2019) reported that the use of the STEM approach improves teaching and learning because students' interaction with one another and with teachers in searching for and exploring problem solutions increases their motivation to learn. Students exposed to this educational approach do not merely learn the subject; they learn *how to learn*, how to ask questions, how to experiment, and how to act.

The meaning of science education has shifted from the mere learning of scientific facts and concepts in an abstract environment to the acquisition of scientific skills or process skills, attitudes, and ethical considerations (Harlen, 2000). It appears that adopting the STEM approach in schools is the only way to cultivate a workforce prepared to face the serious challenges associated with sustainable economic growth. The goal of STEM education is to equip students with the skills and knowledge required for future STEM-related occupations and to foster innovation and critical thinking.However, integrated STEM education often requires substantial materials, resources, and training (such as construction tools, electronic components, etc.) (Coppola et al., 2015; McFadden & Roehrig, 2017; Stohlmann et al., 2012). The lack of knowledge, skills, materials, and resources leads teachers to feel that such a method is unreliable, resulting in reluctance to adopt integrated STEM education, particularly when integrating technology into science, mathematics, and engineering lessons (Coppola et al., 2015; Shernoff et al., 2017; Wang, 2011). Numerous sources (e.g., Margot & Kettler, 2019; Stohlmann et al., 2012; Wang et al., 2011) have pointed to teachers' weaknesses in implementing integrated STEM programs. These weaknesses relate to teachers' self-efficacy, STEM content knowledge, time, skills, curriculum, and assessment. Therefore, to ensure the effectiveness of STEM education, skilled and knowledgeable teachers are needed—especially those capable of linking different disciplines across the curriculum (Karimzadeh et al., 2022).

4. Conclusion

Education systems have been established to cultivate individuals capable of performing effectively in various real-world situations. General education seeks to develop individuals who can function appropriately in social, economic, and psychological domains. The core objective of technical and vocational education is essentially the same. Vocationalisation and the integration of technical and vocational education with general education represent an educational strategy whose usefulness must be judged through empirical validation.Studies conducted in OECD countries indicate a trend in which upper secondary vocational schools attract more students from lower socioeconomic classes than general and academic high schools.

This has led to higher retention rates among students aged 15–19 (Bishop and Ferran, 2005). However, an emphasis on traditional technical and vocational education tends to steer society toward the reproduction of existing socioeconomic structures. Young (2010) argues that a technical-vocational approach to the curriculum directs learners into positions from which they are unlikely to advance to other social positions. Vocational education occupies a lower position in the hierarchy of knowledge and value and is often designed as a pathway for lower-achieving learners (Stevenson, 2005). This negative labeling creates a "vocational habitus" that causes students to settle in their current position and refrain from pursuing higher aspirations (Taylor, 2008).

On the other hand, the relatively slow pace of technological change during the 1960s to 1980s, combined with an emphasis on skills development, could more or less guarantee lifetime job security. However, the accelerated pace of technological change over the past half-century has profoundly affected the education systems of developing countries, including Iran's education system. In recent decades, countries have shifted their focus from social issues to economic priorities. Nations have entered a competitive arena in which international competitiveness tops their political agendas. The World Economic Forum classifies countries into three stages of development: factor-driven economies (Stage 1), efficiency-driven economies (Stage 2), and innovation-driven economies (Stage 3).

At the international level, the concept of human resource development has gained prominence and is increasingly favored over the narrower notion of human capital. In its broad sense, human resource development encompasses health, quality of life, general education, and technical and vocational education. Within this new discourse, the "vocationalisation of general education" is viewed as a tool for human development that can enhance economic competitiveness and improve employability. The idea of vocationalising general education was developed to describe the ultimate goal of increasing the economic relevance of education. Vocationalising the school curriculum means exposing students in general education to vocational and practical subjects, strengthening economic aspects of upbringing, providing work-oriented learning experiences for all students, and promoting universal skills development. In other words, integrating technical and vocational education with general education both enriches general education programs and lays the foundation for vocational training. At the Second International Conference on Technical and Vocational Education held in April 1999 in South Korea, UNESCO recommended the injection of vocational subjects into general education curricula (Colin N. Power, 1999). One of South Korea's educational reforms to address 21st-century challenges was the implementation of a school-to-work transition system beginning in the early years of schooling (Lee Mok, 1999).

The primary goal of technical and vocational education is the successful transition from school to the world of work. Achieving this goal depends on labor market conditions and the level of skills acquired. If students fail to attain the required employability skills and competencies demanded by the labor market, they will be unable to secure employment.In this study, an attempt was made to outline and highlight technological transformations and the inevitable changes in the labor market, while presenting a picture of the existing context and conditions in Iran. Until the early 1980s, a large portion of Iran's population lacked secondary and higher education. Consequently, employment prospects for secondary school graduates, particularly those from technical and vocational programs, were high. With the surge in university entrance candidates in the 1990s, the contextual conditions changed, and interest in technical and vocational education declined. The rationale for reforming Iran's education system in the 1990s was described as "diverting the education system from training human resources familiar with the work environment toward a purely university-oriented approach." The main objective of this systemic change was to integrate work and education, combine practical and theoretical training, and ultimately direct students toward the labor market. However, Iran's education system has not come close to achieving this goal. The deviation of Iran's education system over the past half-century has not only persisted but has become more complex with the emergence of new labor market conditions.

Empirical evidence suggests that the inputs, processes, and outputs of the formal technical and vocational education system are unsatisfactory. Over the past half-century, Iran's education system has undergone repeated changes, with various measures adopted for its improvement. In all reform initiatives, increasing the share of technical and vocational education has been emphasized; yet the expected results have not materialized. Meanwhile, we are living in an era of rapid advancement in artificial intelligence-based technologies, where many knowledge- and skill-based services traditionally provided by technical and vocational graduates (middle-level skills) can now be performed by robots.Under such circumstances, continuing with the traditional approach to technical and vocational education is no longer justifiable. Adopting a policy aligned with current realities has become essential. Given that the economies of developing countries, including Iran, have moved beyond earlier stages and are now oriented toward innovation, the adoption of a policy consistent with cultural context, economic conditions, and emerging labor market needs is inevitable. In light of this necessity, the implementation of the *vocationalisation of general education* and *STEM-based technological education* is recommended for Iran and other developing countries. This policy is compatible with an innovation-driven economy and appears realistic for ensuring the quality of universal education and preventing the unequal distribution of educational opportunities.

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