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# Sustainable Skill Development in Pakistan: Bridging Gaps in Vocational and Technical Education Policy – A Systematic Literature Review

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**ABSTRACT**

*Skill development is pivotal to Pakistan's economic and social transformation, addressing human capital challenges. This systematic literature review synthesizes findings from 38 peer-reviewed studies conducted between 2015 and 2024 to evaluate Pakistan's existing policies and practices. Findings reveal myriad barriers in Pakistan's vocational education ecosystem, including outdated curricula, weak industry-academia collaboration, and governance inefficiencies, disproportionately affecting vulnerable rural populations. Programs like the National Skills Strategy (NSS) and Punjab Skills Development Fund (PSDF) aim to align education with labor market demands, but financial constraints and governance inefficiencies hinder implementation. Due to infrastructural inadequacies, digital literacy and entrepreneurial education programs face implementation challenges. The study advocates for experiential learning modalities and inclusive policies to dismantle socio-cultural barriers. Comparisons with global models such as Germany's dual education system and Singapore's SkillsFuture initiative illustrate opportunities to modernize Pakistan's TVET (Technical and Vocational Education and Training) framework. Policy recommendations emphasize the need for strategic investments in digital infrastructure to modernize curricula, foster industry partnerships, and integrate cutting-edge technologies aligning TVET with Industry 4.0, fostering public-private partnerships, and promoting gender-inclusive strategies to enhance workforce readiness and economic competitiveness. These reforms align with Sustainable Development Goals (SDGs) 4 and 8, offering a pathway for Pakistan to enhance workforce*

*readiness, foster economic competitiveness, and promote equitable socioeconomic development.*

***Keywords:*** *Digital Literacy; Education Policy; Employability; Skill Development; Technical and Vocational Education and Training*

## 1. Introduction

Pakistan faces a critical juncture in its socioeconomic trajectory, with over 60% of its population under the age of 30 and a steadily rising unemployment rate. It is crucial to provide young individuals with the competencies required for success in a globally linked economy (Sheikh et al., 2019). Myriad graduates possess insufficient practical skills, resulting in a disparity between educational outcomes and industrial demands (Shabbir et al., 2018). Constrained resources, antiquated curriculum, and inadequate industry participation impede their successful execution (Iqbal et al., 2023). Digital literacy and entrepreneurial education have emerged as critical priorities in Pakistan's skill development strategy. Programs like DigiSkills.pk aim to bridge the digital divide by equipping youth with e-commerce and freelancing skills. However, these initiatives face significant challenges, particularly in rural areas where inadequate infrastructure exacerbates the gap between urban and rural access to digital resources (Aijaz et al., 2024).

Globally, strong economies have successfully addressed these challenges by emphasizing industry-relevant curricula, flexible training pathways, and robust public-private partnerships (Maclean et al., 2013). Singapore's SkillsFuture movement emphasizes lifelong learning and adaptability to the Fourth Industrial Revolution, leveraging institutional structures, technology transfer, and partnerships for workforce development (Gill et al., 2000). Similarly, South Korea's lifelong learning model integrates equity and democratic participation, addressing globalization challenges through reforms like the Educational Reform Project (Choi & Kim, 2018). However, regional disparities challenge nationwide implementation (Chung & Chung, 2022). Germany's dual education system effectively blends vocational training with formal education, ensuring employability through strong industry collaboration (Yu, 2019). This model has inspired global adaptations, such as in China, to bridge academic and practical skill gaps (Yang & Dong, 2024). Australia's competency-based training system aligns education with economic goals but faces criticism for fragmented knowledge and market-driven focus (Wheelahan, 2016). Despite challenges, these global examples highlight the critical role of VET in fostering economic competitiveness and addressing youth unemployment.

Programs like National Incubation Centers (NICs) encourage self-employment but provide insufficient assistance, and women encounter cultural obstacles, especially when adapting to technological progress and maintaining economic growth. Similarly, entrepreneurial education remains predominantly theoretical, with limited emphasis on practical training and real-world application, hindering its potential to drive self-employment and innovation (Ahmed et al., 2022). To harness this demographic dividend, Pakistan urgently equip its youth with the skills required to thrive in a globally interconnected and technology-driven economy. Despite national policy frameworks such as the National Skills Strategy (NSS) and Vision 2025, Pakistan's education system remains misaligned with labor market demands, with significant gaps in both the quality and relevance of technical and vocational education and training (Yasmeen & Hashaam, 2024).


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Human Capital Theory emphasizes education as a strategic investment in personal productivity and economic development, which is especially relevant in Pakistan's current skill development context. Digital learning, fair educational access, and consistent government investment in human capital development are essential (Aijaz et al., 2024; Minhaj, 2021). Aligning education with industry requirements, cultivating entrepreneurial competencies, and encouraging lifelong learning enable Pakistan's workforce to adapt to rapid technological advancements and contribute to sustainable economic development (Kim & Park, 2020).

This systematic literature review synthesizes empirical insights from 38 peer-reviewed studies. It critically evaluates Pakistan's TVET landscape, identifies systemic barriers, and explores pathways to align TVET policies with the demands of Industry 4.0. Moreover, the paper examines the socioeconomic implications of gender and regional disparities, providing policy recommendations to foster inclusive, sustainable, and market-aligned skill development initiatives. How is skill development via technical and vocational education addressed by Pakistan's existing educational policies? How can industry connections, entrepreneurial education, and digital literacy enhance employability and skill development in Pakistan's technical and vocational education programs?

## 2. Research Methodology

This systematic literature review aims to provide policymakers in Pakistan with information to create an inclusive, flexible education system aligned with industry needs by analyzing the country's current literature on technical and vocational education and training (TVET). Researchers followed the PRISMA standards for reproducibility and openness (Kitchenham et al., 2009; Page et al., 2021). Problem conceptualization, inclusion screening, literature search, data extraction, analysis, and synthesis were the four main steps of the review process (Vom Brocke et al., 2015). The research data was mainly retrieved from Scopus and ScienceDirect, Google Scholar, ERIC, and the Web of Science. The keywords "Skill Development," "Vocational Education," "Technical Education," "Digital Literacy," and "Entrepreneurship Education" were used to narrow down the search results to studies that were relevant to the policy of skill development in Pakistan. Out of the 1,346 studies found, 1,160 were retrieved from Google Scholar, 82 from ERIC, and 104 from WOS.

This systematic literature review (SLR) relies on a thorough screening procedure to guarantee high-quality and relevant articles. At first, 1,310 articles were excluded based on certain criteria after reviewing their summaries. The following were some of the criteria used to exclude articles: (i) 704 duplicates across different search engines; (ii) 246 articles that did not pertain to vocational and technical training; (iii) 195 studies that had nothing to do with education; (iv) 98 papers that did not center on educational policy or skill development; and (v) 65 articles that were either not written in English or did not contain any empirical research. The review's research objectives were closely met by a concentrated selection of 38 studies that addressed skill development, vocational and technical education, and related educational policies in Pakistan. This selection was made possible through a careful filtering process.


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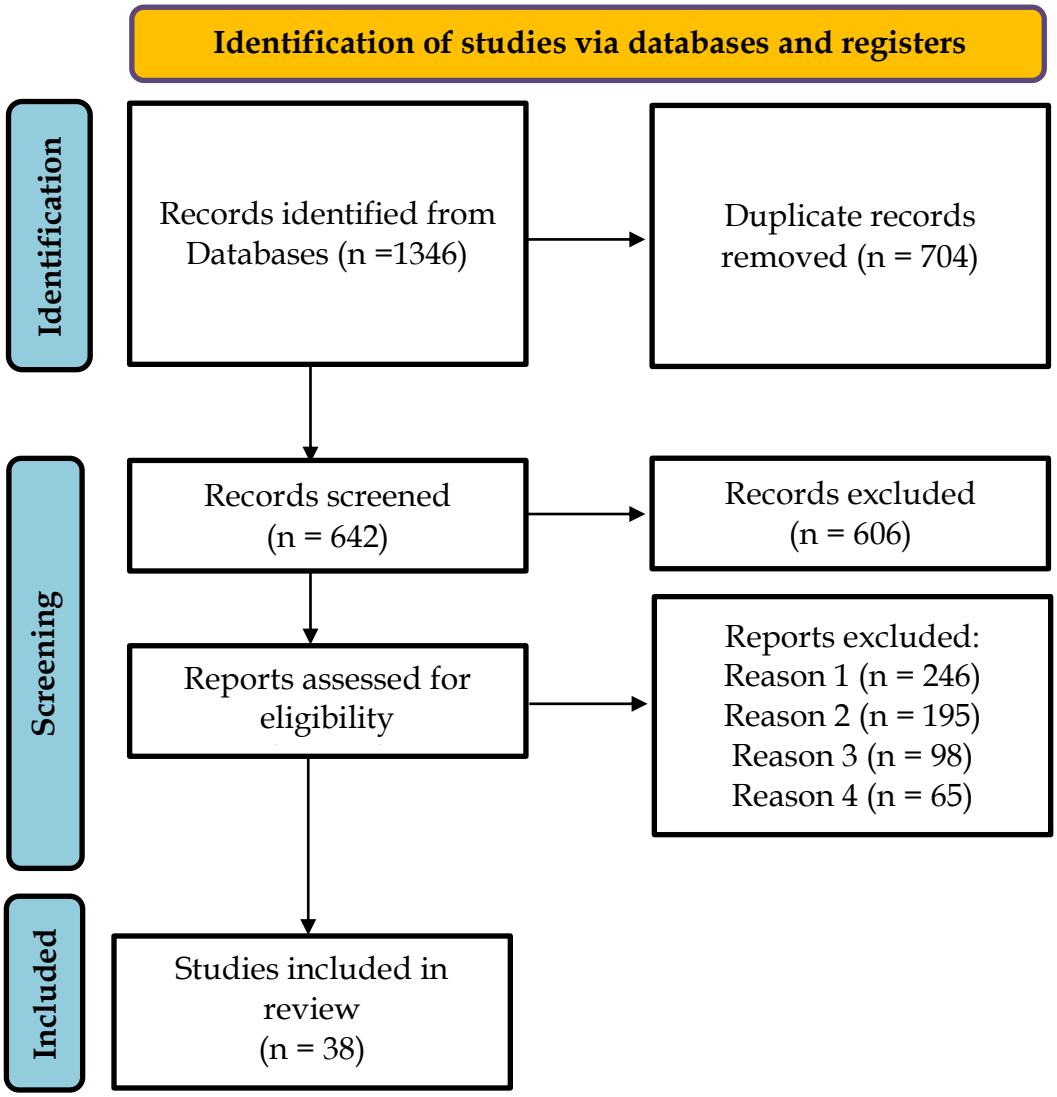


**Figure 1. PRISMA Flow Chart**

The inclusion requirements mandated that research be peer-reviewed and published in English between 2015 and 2024, focusing on Pakistan's skill development and employability strategies. Exclusions included non-journal publications, tertiary sources, and research irrelevant to the focal topics. This guaranteed methodological rigor, emphasizing research of moderate to high quality. Academic sources were augmented with government reports to provide more insights about employability within Pakistan's education system. Data extraction focused on study specifics, procedures, results, and thematic significance, adhering to a framework for monitoring research advancement in intricate domains. Policy efficacy, implementation obstacles, and digital and entrepreneurial education functions are key topics. Flow diagrams and structured reporting under PRISMA 2020 improved the openness of the review process (Kitchenham et al., 2009; Kitchenham & Charters, 2007; Paré et al., 2015).

**Table 1** describes the research used in the systematic literature review, emphasizing skill development, vocational training, policy implementation, digital and entrepreneurial education, and socioeconomic effects. The study has 38 papers presenting varied viewpoints on Pakistan's educational scene. These studies examine essential problems such as regulatory difficulties, deficiencies in digital infrastructure, and the need for alignment between educational institutions and industrial requirements, offering a thorough comprehension of the


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subject. According to study techniques, the table classifies 36 studies on skill development, vocational training, and educational policy in Pakistan. Qualitative research (8) includes interviews, SWOT analysis, and policy evaluations concentrating on obstacles and socioeconomic effects. Quantitative research (6) surveys and structural equation modeling (SEM) to examine the relationship between entrepreneurship education and economic results. Mixed methods research (5) integrates surveys and focus groups to investigate topics such as the digital divide. Literature studies (4) underscore the need for policy change and worldwide trends. Additional techniques (15) include multimodal analyses, policy evaluations, and systematic reviews to tackle infrastructural deficiencies, governance issues, and technology integration.

**Table 1. SLR of TVET and Entrepreneurship Education in Pakistan**

| Author name and Year | Research Methodology | Finding |
|---|---|---|
| (A. Ahmed & Khan, 2018) | SWOT Analysis | Identified strengths (e.g., provincial TEVTAs, ILO/UNESCO partnerships), weaknesses (e.g., lack of collaboration, outdated technology), opportunities (e.g., demand-driven diplomas), and threats (e.g., skill deficiencies in rural areas). |
| (T. Ahmed et al., 2020) | Quantitative | Studied the impact of entrepreneurship education on entrepreneurial intentions; found that learning, inspiration, and resources positively influenced intentions to start new ventures among Pakistani students. |
| (Alam, 2015) | Literature Review | Emphasized the role of TVET in human development; identified skill gaps and recommended urgent reforms to improve workforce productivity. |
| (Altaf, 2023) | Multimodal Analysis | Assessed current TVET policies, highlighting implementation challenges and recommending alignment with industry demands. |
| (Akram & Yang, 2021) | Retrospective Policy Review | Identified barriers to educational policy implementation, including funding shortages and lack of teacher professional development, recommending localized strategies. |
| (Anzak & Sultana, 2020) | Qualitative | Investigated digital literacy among women; and found that digital skills helped empower women socially and economically, especially in entrepreneurship. |
| (Arshad et al., 2018) | Survey and focus groups on entrepreneurship education | Found that entrepreneurship education is largely theoretical. Recommended hands-on entrepreneurial training and better access to financial resources to foster practical skills. |
| (Ashraf et al., 2024) | Historical Analysis | Reviewed historical developments in TVET; highlighted governance, infrastructure, and gender disparities, recommending industry partnerships for |


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| Author name and Year | Research Methodology | Finding |
|---|---|---|
| | | improvements. |
| (Asad et al., 2023) | Quantitative (Survey) | Investigated quality assurance in TVET for IR 4.0; found a positive association between QA and teacher preparedness but identified misalignment with industry needs |
| (Bano et al., 2022) | Qualitative (Descriptive, Exploratory) | Explored TVET in the CPEC context; identified skills gaps, infrastructure issues, and low female participation in the workforce |
| (Batool et al., 2022) | Mixed-methods study | Emphasized the digital divide in Pakistan, especially in rural areas. Suggested improving digital infrastructure to enable equitable access to digital literacy training. |
| (Chamadia & Mubarik, 2021) | Qualitative study | Found that the National Skills Strategy (NSS) and TVET initiatives focus on bridging the skills gap. However, inadequate infrastructure and resource limitations hinder policy effectiveness. |
| (Hassan et al., 2021) | Systematic Literature Review (SLR) | Found low integration of ICT in TVET; recommended inclusion of advanced tech (e.g., AI, IoT) to improve workforce skills and market alignment. |
| (Huda, 2023) | Case Study | Analyzed digital adaptability in education; found that limitations in digital infrastructure restricted students' digital literacy, especially in remote areas. |
| (Haleem et al., 2023) | Comparative Policy Analysis | Reviewed TVET models from Germany, Switzerland, and South Korea; suggested adaptable policy measures for Pakistan to enhance sustainable skill-based education. |
| (Jamil, 2021) | Qualitative | Examined Pakistan's digital divide; attributed limited access to socioeconomic and infrastructural barriers, particularly affecting rural populations |
| (Javed, 2020) | Mixed-methods study with surveys and focus groups | Policies emphasize vocational education for employment, but implementation is weak, particularly in rural areas. Limited resources and outdated facilities reduce effectiveness. |
| (Kanwal & Rehman, 2017) | Quantitative Survey | Studied factors affecting e-learning adoption; identified internet experience and self-efficacy as critical for technology acceptance in higher education. |
| (N. Khan et al., 2024) | Quantitative Survey | Investigated TVET's impact on economic growth; emphasized the role of human resource development as a mediator and the need for market-aligned TVET |
| (S. Khan & Ali, 2024) | Quantitative Regression | Socioeconomic factors affect demand for TVET, with higher-income households showing lower interest in TVET due to a perceived lack of prestige. |
| (Khushik & | Literature Review | Analyzed Pakistani education policies from a |


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| Author name and Year | Research Methodology | Finding |
|---|---|---|
| Diemer, 2018) | | sustainable development perspective, highlighting the importance of integrating sustainable topics into curricula. |
| (F. Khan et al., 2024) | Qualitative study | Found weak collaboration between vocational institutions and industries. Recommended structured internships and apprenticeships to enhance practical skill acquisition. |
| (Kiyani, 2017) | Deductive approach | Entrepreneurship education significantly improves students' attitudes toward entrepreneurial activity, reducing perceived barriers and fostering positive entrepreneurial attitudes. |
| (Majoka & Khan, 2017) | Policy Review | Reviewed educational policies since 1947; identified challenges in policy formulation and implementation across different education levels in Pakistan. |
| (A. Malik & Ameen, 2021) | Qualitative | Explored employment prospects for LIS graduates; noted traditional job market trends but observed emerging roles in information sectors beyond libraries. |
| (M. N. Malik et al., 2019) | Mixed Methods | Investigated sustainability in technology education; found limited awareness and curriculum coverage on sustainability topics, recommending greater integration. |
| (Munawar et al., 2023) | Policy analysis | Emphasized the need for practical applications in entrepreneurship programs. Suggested that theoretical focus limits students' ability to launch businesses. |
| (Nooruddin, 2017) | Policy Analysis | Highlighted the importance of TVET post-18th Amendment; recommended policy reforms to enhance employability and support economic growth. |
| (Pirzada et al., 2022) | Qualitative | Identified assessment challenges in TVET, including issues in course management and competency training implementation; provided recommendations for improvement. |
| (Qureshi & Mian, 2021) | Action Research | Examined best practices for transferring entrepreneurship education; identified program quality and absorptive capacity as key factors for successful knowledge transfer. |
| (Rashid, 2019) | Literature Review | Linked entrepreneurship education with SDGs; advocated for tech-enabled education in fragile regions to overcome resource constraints. |
| (Rizwan et al., 2021) | Mixed Methods | Studied perception gaps between vocational students and employers; recommended better alignment of skills with job market requirements for career sustainability. |
| (Roberts & Mir Zulfiqar, 2019) | Qualitative | Examined socio-cultural and financial barriers to entrepreneurship. Found that a lack of support for women entrepreneurs limits the impact of |


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| Author name and Year | Research Methodology | Finding |
|---|---|---|
| | | entrepreneurship education. |
| (Tanveer et al., 2021) | Policy Review | Examined entrepreneurship policy challenges in universities; highlighted the need for policy support to promote entrepreneurial skills for economic growth. |
| (Tanveer et al., 2020) | Literature Review | Explored AI's potential in education policy; recommended integrating AI for sustainable education and enhanced learning outcomes. |
| (Tunio et al., 2021) | Multi-Methods | Explored factors promoting sustainable entrepreneurship among youth; highlighted the importance of innovative thinking and social support in career choices |
| (Yousaf et al., 2022) | Quantitative (PLS-SEM) | Found entrepreneurial education positively influenced students' attitudes toward entrepreneurship; cultural factors moderated the education-attitude relationship. |
| (Zahid et al., 2023) | Qualitative analysis | Found gaps in Competency-Based Education (CBE) delivery due to COVID-19. Recommended blended teaching approaches for sustainable socioeconomic development in Pakistan. |

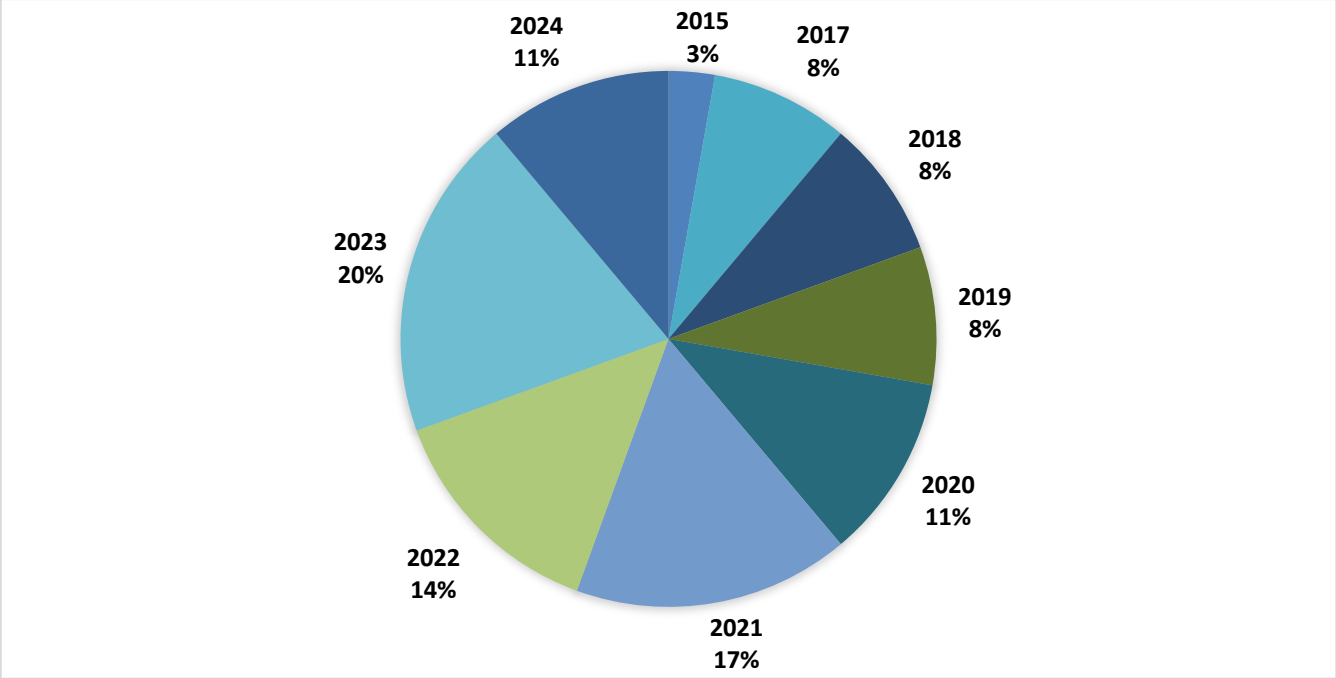


**Figure 2. Distribution of Papers by Publication Year (2015–2024**

**Figure 2** illustrates the increasing research on vocational training and education policy in Pakistan from 2015 to 2024. Minimal activity in 2015 (2.44%) had consistent growth, reaching a zenith in 2021 (17.07%) and sustaining high levels in 2023 and 2024 (14.63%). These


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developments highlight the essential function of vocational education in mitigating unemployment, enhancing digital literacy, and meeting industry demands while stressing the need for ongoing research to tackle growing difficulties and fit with Sustainable Development Goals (SDGs).

The systematic literature review presents several methodological constraints that warrant critical examination. Using platforms like Google Scholar and Scopus, the predominantly digital database search strategy potentially excluded significant research published in non-indexed journals. Language limitations, specifically excluding non-English scholarship, risk marginalizing valuable regional perspectives, particularly those articulated in languages such as Urdu. Methodological boundaries further constrained the study by restricting sources to peer-reviewed journals, thereby omitting potentially insightful grey literature, including conference proceedings and policy documents. The chronological range (2015-2024) inherently limits historical contextualization and longitudinal analysis of educational policy evolution. Future research should consider expanding database diversity, multilingual inclusion, and temporal parameters to generate a more comprehensive understanding of vocational and technical education dynamics in Pakistan.

## 3. Results and Discussion

### 3.1. Education Policies Addressing Skill Development in Pakistan

Educational policies in Pakistan, including the National Skills Strategy (NSS) and Vision 2025, prioritize skill-based education to achieve Sustainable Development Goals (SDGs) to provide demand-oriented skills that correspond with labor market requirements. Nonetheless, myriad execution obstacles remain, such as antiquated infrastructure, insufficient budget, and administrative inefficiencies (Ahmed & Khan, 2018; Rashid, 2019). The decentralization of education after the 18th Amendment has allowed provinces to customize policies according to regional needs (Nooruddin, 2017).

Research indicates that several TVET colleges are deficient in contemporary equipment and current curricula, obstructing their congruence with industry requirements (Ashraf et al., 2024). The deficiencies have constrained the effectiveness of skill development initiatives, especially in rural areas with insufficient training facilities and a lack of skilled teachers (Tanveer et al., 2021). TVET regulations are essential for cultivating a competent workforce that aligns with changing market demands. Previous studies underscores the congruence of skill-based education with the Sustainable Development Goals (Rashid, 2019; Rehman et al., 2015). Implementation challenges, such as resource limitations and antiquated infrastructure, have impeded advancement, especially in impoverished regions (Yousaf et al., 2022). Chamadia and Mubarik advocate aligning skill development programs with industry demands and establishing comprehensive monitoring systems (Chamadia & Mubarik, 2021).

Haleem et al. provide empirical data demonstrating the socioeconomic advantages of skill development, especially for women in Khyber Pakhtunkhwa (Haleem et al., 2023). These programs augment production and income, foster female empowerment, and mitigate unemployment, demonstrating the capacity to tackle gender gaps via focused TVET initiatives. Khan et al. demonstrate that skill enhancement significantly boosts economic production, particularly when aligned with market needs (N. Khan et al., 2024).

### 3.2. TVET Policies

Pakistan's Technical and Vocational Education and Training policies encounter significant implementation obstacles, notwithstanding their capacity to improve employability and


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stimulate economic development. Research identifies financial and bureaucratic limitations (Javed, 2020), inadequate infrastructure, and mismatched curriculum (Haleem et al., 2023). Although programs such as the Punjab Skills Development Fund seek to mitigate the skills gap and combat poverty, infrastructure modernization and alignment with industry requirements are crucial for realizing the National Skills Strategy and Sustainable Development Goals (Chamadia & Mubarik, 2021). Gender disparities and inconsistent instructional quality adversely affect the efficacy of vocational training (Ashraf et al., 2024). Rural regions have financing deficiencies and insufficient facilities, limiting the scope and effectiveness of vocational programs (Bano et al., 2022).

Technical education is essential for developing a proficient workforce in specialized domains such as engineering and applied sciences. Aligning curriculum with technology improvements encounters obstacles, including obsolete curricula and inadequately prepared educators (Bano et al., 2022; Tanveer et al., 2020). Emerging domains such as digital and green technologies are inadequately represented (Kiyani, 2017), and the view of technical education as inferior to academic routes deters enrollment (Majoka & Khan, 2017; Munawar et al., 2023; Pirzada et al., 2022). The quality assurance systems in TVET are inadequate for fulfilling the requirements of Industry 4.0. In the absence of curriculum revisions and enhanced industry connections. These studies together underscore the need for modernization, enhanced governance, and industry partnership to render vocational and technical education more effective and matched with labor market requirements (Asad et al., 2023).

### 3.3. Digital Literacy in Enhancing Employability

Digital literacy is fundamental to skill development in a globalized economy, significantly contributing to improved employability and addressing job disparities in Pakistan. Programs such as DigiSkills.pk seek to empower youngsters with freelancing and e-commerce competencies; nonetheless, considerable obstacles remain, especially in rural areas. Restricted access to digital resources, subpar internet connection, and insufficient infrastructure intensify the digital divide, hindering rural students' engagement in the digital economy (Malik & Ameen, 2021). Previous studies support integrating sophisticated technologies like AI, IoT, and blockchain into vocational training, which are notable deficiencies in Pakistan's educational system (Huda, 2023; Jamil, 2021).

Kanwal and Rehman emphasize the significance of online proficiency and self-efficacy in adopting e-learning, stressing the need for focused interventions to improve digital competence (Kanwal & Rehman, 2017). Munawar et al. assert that digital entrepreneurial education, facilitated via online platforms, promotes innovation and professional development while offering infrastructure and training assistance (Munawar et al., 2023). Jamil emphasizes the need for legislative actions to rectify infrastructural deficiencies, improve teacher training, and include digital competencies in vocational programs to alleviate skill mismatches (Jamil, 2021).

### 3.4. Entrepreneurial Education Fostering Self-Employment

Entrepreneurship education in Pakistan is a crucial method for job creation and economic development, as shown by programs such as the Prime Minister's Kamyab Jawan Program, which seeks to promote youth-led enterprises. These programs sometimes emphasize theoretical knowledge at the expense of practical skill development, resulting in participants being inadequately equipped to confront the problems of starting and maintaining firms (Kiyani, 2017). Socio-cultural hurdles significantly impede women's engagement in entrepreneurship education. Digital platforms and online training provide an alternative,


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empowering women in conservative areas and resource-limited settings (Munawar et al., 2023; Roberts & Mir Zulfiqar, 2019). Practical entrepreneurship training is crucial, especially in rural and under-resourced regions, where experience learning and financial assistance may mitigate startup hindrances (Rashid, 2019). Research highlights the significant influence of entrepreneurship education on students' attitudes and evolving conceptions of company potential (Rizwan et al., 2021).

Rather than confining it to business schools, incorporating entrepreneurial education at vocational institutions may provide wider accessibility and applicability for various student demographics (Qureshi & Mian, 2021). Integrating entrepreneurship and digital skills training may improve employment, professional advancement, and economic resilience, especially for underrepresented groups. Entrepreneurship education may foster innovation, encourage self-employment, and aid in attaining economic growth and sustainable development in Pakistan by emphasizing practical training, gender inclusion, and the incorporation of digital skills (Rashid, 2019).

### 3.5. Industry Linkages to Workforce Preparedness

Collaboration between educational institutions and industries is critical to bridging the skills gap. Weak connections between educational institutions and companies result in considerable skills mismatches, restricting graduates' employability. Chamadia and Mubarik underscore the significance of industry involvement in curriculum development, including advisory boards and frequent revisions to maintain market relevance (Chamadia & Mubarik, 2021). TVET colleges do not include developing technologies such as AI, IoT, and green energy, exacerbating the skills gap. Structured internships and apprenticeships provide vital practical experience, yet they often lack structure, are restricted in scope, and are insufficiently incorporated into TVET courses (Akhtar et al., 2022). The absence of practical experience impedes worker preparedness, especially in rural areas, where industry engagement and institutional support for collaborations are limited (Nooruddin, 2017).

TVET also plays a pivotal role in fostering social mobility. Essential policy frameworks, including the National Skills Strategy (NSS) and initiatives like the Punjab Skills Development Fund, seek to reconcile the disparity between educational outcomes and labor market requirements, thereby advancing Sustainable Development Goals 4 (quality education) and 8 (decent work and economic growth) (Akhtar et al., 2022). The absence of organized and standardized internship and apprenticeship programs diminishes the practical preparedness of graduates (Akhtar et al., 2022). Khan et al. discovered that incorporating industry demands into curricula enhances workforce productivity and pertinence (F. Khan et al., 2024). Previous studies propose linking entrepreneurial education with industrial collaborations to mitigate resource and training deficiencies (Altaf, 2023; Haleem et al., 2023). Integrating new technologies such as ICT, AI, and IoT into TVET curricula is essential for equipping a workforce that meets the requirements of Industry 4.0 (Asad et al., 2023). Strengthening institutional support and promoting digital entrepreneurship will better prepare students to fulfil contemporary job requirements.

### 3.6. Impact on Marginalized Communities

Marginalized communities, such as rural populations and economically disadvantaged groups, have structural obstacles to obtaining education and work. VTE programs provide a framework for these populations to assimilate into the job market, yet considerable obstacles persist. Rural areas often lack enough training facilities and skilled educators, intensifying the


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skills gap (Ashraf et al., 2024; Munawar et al., 2023). Outdated curriculum and little financing further marginalize these populations, hindering their ability to acquire useful skills (Bano et al., 2022). The Punjab Skills Development Fund (PSDF) is a significant project designed to address regional inequities by providing demand-oriented training programs. Nonetheless, its effectiveness is impeded by resource limitations and misalignment with industrial requirements (Chamadia & Mubarik, 2021). Targeted skill programs in locations like Balochistan and Khyber Pakhtunkhwa have shown the capacity to alleviate poverty and empower disadvantaged youth (Haleem et al., 2023; N. Khan et al., 2024).

### 3.7. Social Mobility

Social mobility, defined as the capacity of people to ascend the socioeconomic hierarchy, is intricately connected to access to skill-oriented education. Initiatives such as DigiSkills.pk seek to enhance digital literacy and entrepreneurial competencies, enabling youngsters access to global markets via freelancing and e-commerce (A. Malik & Ameen, 2021). Nonetheless, budget constraints, obsolete technology, and insufficient governance impede the extensive efficacy of these projects (Rehman et al., 2015; Yousaf et al., 2022). Disparities between urban and rural areas persist as a significant issue. Rural locations lack industrial connections and poor infrastructure, which hinders their potential to promote social mobility, while metropolitan centers have better-equipped TVET institutions (Akram & Yang, 2021; Ashraf et al., 2024).

### 3.8. Gender Equity

Gender equality continues to be a significant societal concern in Pakistan. VTE is crucial in mitigating gender gaps by providing women with technical and vocational skills that improve their economic involvement. Skill development initiatives provide women avenues for economic autonomy, particularly in traditional and rural regions. The socioeconomic benefits of VTE in Khyber Pakhtunkhwa are highlighted by Haleem et al., who report that women participating in focused skill development programs saw increased income and a sense of empowerment (Haleem et al., 2023). Notwithstanding its promise, VTE encounters cultural and social obstacles that limit women's involvement. Conventional gender roles and cultural expectations sometimes dissuade women from seeking technical education (S. Khan & Ali, 2024; Nooruddin, 2017).

The findings emphasize the need to modernize Pakistan's vocational and technical education (VTE) by integrating emerging technologies such as AI, IoT, and green energy, aligning with Human Capital Theory and global trends like Industry 4.0. Models such as Germany's dual education system and Singapore's SkillsFuture highlight the importance of industry-academia collaboration and lifelong learning in fostering workforce readiness and adaptability (Field et al., 2010). Addressing gender disparities and regional inequalities requires culturally sensitive strategies inspired by South Korea's equitable lifelong learning model (Chung & Chung, 2022) and the integration of entrepreneurship education to empower marginalized groups, as seen in Australia's competency-based training (CBT) approach (Joyce, 2019).

### 3.9. Practical Implications

Misaligned curricula with technologies like AI, IoT, and green energy impede workforce readiness. Integrating these technologies and fostering industry-academia partnerships through apprenticeships can bridge skills gaps. Programs like DigiSkills.pk need infrastructure investments, including better broadband and teacher training, to close the rural-urban digital


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divide. Addressing gender disparities requires scholarships, mentorship, and community engagement to enhance women's participation. Practical entrepreneurship education for marginalized groups can boost self-employment and innovation. Comprehensive policy reforms, including centralized quality assurance, increased funding, and public-private partnerships, are essential to modernize VTE.

## 4. Conclusion

This research emphasizes how important vocational and technical education is to addressing unemployment and promoting economic development in Pakistan. Despite efforts to match education with market demands via frameworks like the Punjab Skills Development Fund (PSDF) and the National Skills Strategy (NSS), issues including outmoded curriculum, poor infrastructure, and little industry cooperation still exist, especially in rural regions. Some of the main weaknesses are the lack of integration of digital literacy, inadequate hands-on training in entrepreneurship education, and poor alignment with Industry 4.0 technologies such as AI and IoT. These problems result in a skills mismatch and impede workforce preparedness. Improving inclusion and employability requires addressing socioeconomic obstacles, especially those that harm women, and encouraging organized internships and apprenticeships.

Incorporating 21st-century skills like collaboration, digital literacy, and problem-solving into the educational curriculum is essential since these talents are closely linked to employment. Enhancing the connection between business and academics is essential. Policies must promote collaborations via organized apprenticeships, industry-driven training programs, and advisory committees to close the skills gap and improve practical experience. Digital literacy should be promoted, necessitating investments in digital infrastructure and ICT integration to line with global labor norms, especially in disadvantaged rural regions. Moreover, specific incentives like scholarships, transportation, and gender-sensitive training settings are essential to mitigate gender discrepancies and socio-cultural obstacles hindering women's involvement. Disparities in resource allocation due to decentralized government after the 18th Amendment may be alleviated by centralized quality assurance methods, maintaining consistent standards throughout provinces. These initiatives correspond with Sustainable Development Goals (SDGs) 4 (Quality Education) and 8 (Decent Work and Economic Growth), upgrading Technical and Vocational Education and Training (TVET) and equipping Pakistan's workforce for the challenges of the 21st century.

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The authors have declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.


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