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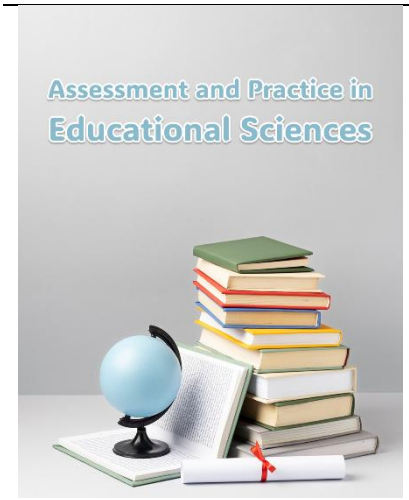

Design and Validation of a Localized Development Model for Technical and Vocational Training Based on the Industrial Capacities of Bandar Abbas

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ABSTRACT

This study aimed to design and validate a localized development model for technical and vocational education aligned with the industrial capacities of Bandar Abbas. The research employed a sequential exploratory mixed-methods approach. In the qualitative phase, data were collected through 20 semi-structured interviews with experts in technical education and industry, analyzed using thematic analysis with open, axial, and selective coding. In the quantitative phase, a researcher-made questionnaire based on the identified qualitative components was distributed among 374 participants, including industrial personnel and technical education professionals. The reliability and validity of the model were assessed through Cronbach's alpha, AVE, CR, and Fornell-Larcker discriminant validity. Model fit was tested using structural equation modeling (SEM) in LISREL. Paired-sample t-tests revealed statistically significant differences ($p < 0.01$) between the current and desired states in 8 out of 9 key components, indicating major gaps in areas such as goal setting, training, and infrastructure. Convergent validity was confirmed with AVE values above 0.5, and reliability was supported by Cronbach's alpha values exceeding 0.7 for all constructs. Fornell-Larcker matrix confirmed discriminant validity. The SEM results showed good model fit indices (e.g., RMSEA = 0.05, CFI = 0.98, GFI = 0.93), validating the structural integrity of the proposed model. The validated development model demonstrates strong empirical and theoretical grounding for improving technical and vocational education tailored to regional industrial needs. Its adoption could significantly enhance alignment between education outputs and labor market demands in Bandar Abbas and similar industrial contexts.

Keywords: Technical and vocational education; model development; structural equation modeling; industrial alignment; educational planning; Bandar Abbas.

Introduction

In the contemporary era marked by rapid technological advancements and ever-evolving labor market demands, the alignment of technical and vocational education with industrial capacities has become not only a strategic imperative but also a developmental necessity. Technical and vocational education and training (TVET) systems serve as essential mechanisms for preparing a competent workforce, enhancing employability, and stimulating economic growth, especially in regional contexts

like Bandar Abbas, which possesses unique industrial and logistical advantages. However, the disconnection between educational programs and the real demands of industry continues to be a persistent issue in Iran's educational policy discourse (1, 2).

The evolution of TVET systems in Iran has historically mirrored broader socio-economic priorities. Recent efforts have aimed to transform TVET into a pillar of national development by embedding elements of entrepreneurship, innovation, and practical competence (3, 4). Nevertheless, the system continues to grapple with significant challenges such as inadequate curriculum relevance, fragmented policy implementation, and insufficient engagement with industrial stakeholders (5, 6). In response to these challenges, the need for a localized, dynamic, and contextually grounded development model has been increasingly emphasized by researchers and policymakers alike (7, 8).

In this vein, numerous studies have been conducted to assess the status, limitations, and reform strategies of TVET institutions in Iran. For instance, Didehvar et al. (2024) highlight structural and curricular discrepancies in Iranian vocational education compared to international standards, noting gaps in master's programs and practical competencies when compared with systems in countries like Germany and Malaysia (9). This view is corroborated by Magdeberg (2023), who outlines the robust integration of industry-based learning in international TVET models, reinforcing the importance of aligning educational outputs with market realities (10). Furthermore, Shari'ati et al. (2019) argue that TVET systems must cater to the needs of a knowledge-based economy, calling for quality assurance mechanisms and future-oriented skills training (11).

In Bandar Abbas—a port city of strategic economic significance—the mismatch between the outputs of technical and vocational education and the demands of the local industrial sector is especially pronounced. Despite the region's rich industrial base, many graduates remain underemployed due to outdated curricula and poor coordination between educational institutions and industrial employers (12, 13). The situation underscores the urgency of designing a model that is not only educationally sound but also tailored to the real-world needs of the local economy.

The theoretical underpinnings of such a model draw from grounded theory, systems theory, and human capital development frameworks. For example, Kamarei et al. (2021) underscore the importance of professional development for TVET managers through emergent data-driven strategies, suggesting that leadership quality and institutional vision are pivotal for systemic improvement (14). Similarly, Chekani Azaran et al. (2021) propose a model for enhancing managerial competencies based on grounded theory, emphasizing the alignment between internal administrative capacity and external performance outcomes (15). These insights form a foundation for conceptualizing how organizational effectiveness in TVET institutions can be operationalized through strategic planning and leadership development.

Alongside leadership and planning, curriculum relevance remains a central concern. Momeni Mohammadi et al. (2021) explore the existence of "superfluous curricula"—content that does not serve the functional needs of either students or industries—in technical education programs, arguing for the elimination of curricular waste and the streamlining of course offerings (16). A complementary study by Torakhan et al. (2017) similarly offers a model for reducing curriculum inefficiency and increasing the applicability of technical content (17). These findings collectively advocate for an education model that is needs-based, flexible, and continually revised in accordance with industrial trends and technological change.

In tandem with curricular reform, the incorporation of new technologies such as artificial intelligence (AI) is reshaping vocational education worldwide. Amirkhaninia et al. (2024) investigate the transformative impact of AI on the scientific development of TVET students, noting that the integration of smart technologies can enhance both learning outcomes and operational efficiency (18). Such innovations necessitate an adaptive infrastructure and skilled educators capable of navigating and integrating these tools into instruction.

The human resource dimension is another critical axis in the development of TVET systems. Studies such as Ghaderi Sheykhi Abadi et al. (2023) introduce synergistic leadership as a key factor in optimizing managerial performance within technical institutions, promoting team cohesion and strategic clarity (19). Complementarily, Kamarei et al. (2021) propose a professional development framework that enhances the competencies of TVET managers by focusing on participatory decision-making, reflective practices, and goal-oriented training (20). These approaches underscore the pivotal role of human capital in institutional transformation.

Meanwhile, several works have turned attention to the cultural and economic barriers that constrain the performance of TVET systems in Iran. Hosseinpour (2023) identifies prevailing challenges such as social stigma, limited industry collaboration, and budgetary constraints as key obstacles to the optimal functioning of vocational colleges (6). Likewise, Amouri and Khorram Abadi (2020) examine the pedagogical failures in Arabic language instruction in TVET schools, using it as a microcosm to discuss broader systemic inefficiencies (21).

Moreover, the entrepreneurial potential of vocational education is an area of growing focus. Arabi et al. (2022) propose an entrepreneurial education model designed specifically for Iran's TVET context, emphasizing the importance of cultivating skills that enable students to establish their own ventures rather than rely solely on formal employment channels (3). This perspective is echoed by Iri et al. (2024), who explore the ambivalence of entrepreneurship in the TVET sector, calling for clearer institutional frameworks and supportive ecosystems (4).

At a practical level, the effectiveness of technical and vocational education programs can be measured through outcomes such as job creation and community development. Jafari et al. (2023), in their study of home-based businesses for rural women in Damghan County, found that targeted vocational training not only empowered individuals but also contributed to regional socio-economic resilience (12). This case study highlights the importance of context-aware program design that integrates social, economic, and gender-sensitive dimensions into vocational curricula.

The discourse on evaluation and policy reform is further enriched by Nasirian Tamrin et al. (2019), who developed a mixed-method evaluation model to assess educational quality in TVET universities. Their approach combined qualitative insights with quantitative performance metrics to create a comprehensive assessment framework (22). In a broader national context, Barani (2020) evaluates the place of technical and vocational education in Iran's Comprehensive Scientific Map, suggesting that TVET should be repositioned as a central strategy in the national development agenda (23).

Institutionally, the Faculty of Educational Sciences (University, 2022) provides an approved master's curriculum for TVET, which serves as a foundational reference for this study's model development efforts (24). However, given the rapidly changing economic and technological landscape of Bandar Abbas, especially in relation to its industrial ports and energy sectors, there is a pressing need to localize and adapt these general models into frameworks that directly address regional realities.

In sum, the convergence of empirical studies, theoretical developments, and policy evaluations indicates the necessity of designing a localized model for the development of technical and vocational education that is specifically tailored to the industrial ecosystem of Bandar Abbas. Such a model must integrate strategic leadership, curriculum alignment, technological innovation, cultural adaptation, and entrepreneurial empowerment. By synthesizing the insights from the comprehensive body of existing literature, this study aims to contribute a validated and context-sensitive framework capable of bridging the gap between education and industry—thus enhancing employability, economic sustainability, and regional development.

Methods and Materials

Study Design and Participants

This study adopted an applied research approach in terms of its purpose, as the primary aim was to design a localized developmental model for technical and vocational education aligned with the industrial capacities of Bandar Abbas. In terms of methodology, the research followed a sequential exploratory mixed-methods design, incorporating both qualitative and quantitative phases. The initial qualitative phase served as the foundation for theorizing and model construction through thematic analysis, while the subsequent quantitative phase focused on model validation.

In the qualitative phase, the research employed a thematic analysis approach to explore expert perspectives and uncover the dimensions underlying the developmental needs of technical and vocational education in relation to industrial demands. The target population in this phase included experts in education, managers and instructors from technical and vocational training institutions, as well as industrial sector specialists in Bandar Abbas. A purposive sampling strategy was utilized to identify participants with extensive knowledge in the relevant domains. Data were gathered through 20 semi-structured interviews. The number of interviews was not predetermined but continued until theoretical saturation was achieved, meaning that new interviews no longer yielded novel insights. After each interview, transcripts were coded and analyzed to guide subsequent interviews in a more focused direction based on emerging dimensions and components.

The quantitative phase was designed based on the model developed in the qualitative stage. It aimed to validate the proposed model by assessing its alignment with perceptions of industry stakeholders in Bandar Abbas. The statistical population in this phase consisted of 8,953 industry employees including managers, deputies, and staff, as well as 19 administrators and faculty members of technical and vocational institutions in the region. Using Cochran's formula, a minimum sample size of 374 individuals was calculated. A stratified random sampling method was employed to ensure proportional representation of each subgroup, particularly due to the heterogeneous structure of the broader industrial population.

Data Collection

In the qualitative phase, data were collected using semi-structured interviews. These interviews were conducted in person after coordinating with selected experts. Each session began with a brief explanation of the research objective, followed by open-ended questions. All interviews were audio-recorded with participant consent and continued until no new categories emerged, indicating data saturation. The recorded interviews were transcribed and then subjected to a rigorous thematic analysis. The process included three stages of coding: open coding (labeling all significant statements), axial coding (grouping similar codes into higher-order categories based on Strauss and Corbin's paradigm model), and selective coding (integrating and refining categories to form core themes). Manual techniques, qualitative data analysis software, and expert feedback were used to enhance the credibility and reliability of the coding process.

To assess the reliability of the coding process, the study employed the test-retest method. A few interviews were re-coded after a two-week interval, and the degree of agreement between the two coding rounds was used as an indicator of reliability. High consistency between repeated coding sessions validated the trustworthiness of the thematic findings.

In the quantitative phase, a researcher-developed questionnaire was used to collect data. The questionnaire was constructed based on the themes and indicators identified in the qualitative phase. It consisted of 56 items covering 18 components, each representing a specific factor affecting the development of technical and vocational training aligned with industrial needs. A five-point Likert scale (ranging from "very low" to "very high") was used to gauge the perceived importance of each factor. The questionnaire was distributed among the selected participants from both industry and technical education institutions.

Data Analysis

The qualitative data analysis was carried out through thematic analysis using the frequency and structure of open, axial, and selective codes. After transcription, interview content was segmented into meaningful units, labeled, and systematically grouped to extract overarching themes. The Strauss and Corbin coding paradigm served as the structural guide to establish

causal relationships among categories and to construct a grounded theoretical model that reflected the underlying logic of technical and vocational development in the industrial context of Bandar Abbas.

For the quantitative phase, both descriptive and inferential statistics were utilized. Descriptive analysis included calculating means and standard deviations to summarize responses. For inferential analysis, the normality of data distribution was assessed using the Kolmogorov–Smirnov test. Upon confirmation of normality, a one-sample t-test was employed to evaluate the current state of each component in the proposed model. Additionally, structural equation modeling (SEM) was conducted using LISREL software to assess the overall model fit and the relationships among constructs. This allowed for validation of the proposed model by testing whether the data supported the theorized relationships between the identified dimensions of technical and vocational education development.

Through this two-phase methodology, the study ensured both theoretical depth and empirical rigor, aligning qualitative insights with quantitative validation to generate a contextually relevant and scientifically sound development model for technical and vocational training in Bandar Abbas.

Findings and Results

The findings from the qualitative phase of this study were derived through thematic analysis of semi-structured interviews with 20 experts in the fields of technical and vocational education and local industry. Following systematic coding and categorization, 18 core components were identified that encapsulate the critical factors necessary for the development of technical and vocational training aligned with the industrial capacities of Bandar Abbas. These components emerged from clustering similar conceptual themes under broader, meaningful categories and serve as the foundational elements of the proposed localized model. The following table presents the identified core components and the specific concepts that define each.

Table 1. Core Components Identified for the Development of Technical and Vocational Training Aligned with Industrial Capacities

Identified Concepts	Core Components
Collecting data from the target market, gathering demographic and employment history and insurance records	Data Collection
Planning for training sales networks, motivating personnel, staff training	Personnel Planning
Evaluating industrial performance, reviewing contracts, decision-making regarding collaboration, analyzing human capital needs	Evaluation
Structuring and documenting data, segmenting the market, goal setting	Data Categorization
Operational staff awareness and skill levels, organizational maturity in management training	Experience
Infrastructure assessments, industrial expansion plans, attention to modern technology and economic positioning	Development and Infrastructure
Effectiveness of educational programs, trainer competency	Educational Capability and Quality
Technical control, financial auditing, inspection of sales offices and stakeholder documents	Supervision and Control
Customer needs assessment, encouraging service uptake, reaching agreements	Persuasion and Agreement
Market penetration strategies, sales network expansion, customer retention, stakeholder cooperation	Market Attraction and Expansion
Continuous skills enhancement, industry-education interaction, future-oriented job policy planning	Development Planning
Behavioral and technical competencies, graduate skills, academic proficiency	Competency
Demographic, cultural, and equipment analysis of regional capacity	Capacity
Designing human capital attraction and training plans tailored to industry needs	Regulatory Framework
Admission criteria, academic and technical prerequisites	Capability
Establishing occupational study centers, identifying industry training needs	Educational Needs
Specializations required by industries, skill diversity analysis, feasibility of supplying skilled labor	Specialization
Defining negotiation methods, selecting negotiation teams, finalizing agreements	Negotiation

The thematic analysis revealed a structured framework of 18 core components that encapsulate the multifaceted nature of developing effective technical and vocational training programs in alignment with the industrial context of Bandar Abbas.

These components span strategic areas such as data-driven planning, organizational capacity, skill development, regulatory considerations, stakeholder engagement, and future-oriented policy. The “Data Collection” component underscores the importance of demographic and workforce intelligence, while “Personnel Planning” and “Evaluation” highlight the critical need for structured staff development and performance assessment mechanisms. Components like “Development and Infrastructure” and “Educational Capability and Quality” focus on systemic readiness and instructional excellence. Additionally, operational dimensions such as “Supervision and Control,” “Persuasion and Agreement,” and “Negotiation” emphasize the necessity for coordination between industries and training institutions. Lastly, components like “Competency,” “Specialization,” and “Capacity” reflect the need for tailoring education programs to actual industrial skill demands. Collectively, these findings offer a comprehensive roadmap for building a localized, responsive, and future-ready technical and vocational education model.

Table 2. Paired t-test Results Comparing the Current and Desired Status of Components in the Development Model of Technical and Vocational Education Aligned with Industrial Capacities

Component	Status	Mean	Std. Deviation	t	df	Sig.
Market Analysis	Current	13.06	4.73	-22.86	373	.001
	Desired	19.10	1.97			
Customer Attraction	Current	17.92	3.93	-26.34	373	.001
	Desired	24.19	2.39			
Goal Setting and Planning	Current	13.38	3.59	-39.18	373	.001
	Desired	22.82	2.97			
Evaluation and Control	Current	31.13	6.34	-14.20	373	.001
	Desired	36.40	3.35			
Experience and Expertise	Current	10.80	2.84	-27.21	373	.001
	Desired	15.83	2.16			
Training	Current	9.82	3.96	-7.58	373	.001
	Desired	11.49	1.58			
Capacity, Development & Infrastructure	Current	12.63	1.55	-21.46	373	.001
	Desired	15.69	2.28			
Legal Framework and Planning	Current	20.84	10.57	-0.57	373	.570
	Desired	21.16	2.33			
Skilled Human Resources	Current	11.93	2.45	-19.69	373	.001
	Desired	15.52	2.54			

The paired t-test results presented in Table 2 compare the current and desired status of nine key components within the proposed development model for technical and vocational education aligned with the industrial needs of Bandar Abbas. The findings demonstrate statistically significant differences ($p < .01$) between the current and desired means across eight out of nine components, indicating a noticeable gap in practice. For example, the component of *Market Analysis* showed a significant mean difference ($t = -22.86$), with the desired mean (19.10) considerably higher than the current mean (13.06). Similarly, significant disparities were observed in *Customer Attraction* ($t = -26.34$), *Goal Setting and Planning* ($t = -39.18$), and *Evaluation and Control* ($t = -14.20$), emphasizing the inadequacy of current strategic and operational measures. The component *Experience and Expertise* revealed a strong gap ($t = -27.21$), reinforcing the lack of alignment between current workforce capabilities and industrial expectations. Other areas such as *Training*, *Capacity and Infrastructure*, and *Skilled Human Resources* also displayed significant deficits. However, the *Legal Framework and Planning* component did not show a statistically significant difference ($t = -0.57$, $p = .570$), indicating relative parity between its current and desired states. Overall, these results highlight that the current implementation status of most components in the proposed model is substantially lower than their expected or optimal levels, underlining the urgent need for targeted interventions and structural improvements in technical and vocational training systems tailored to industrial demands.

Table 3. Reliability and Convergent Validity Analysis of Factors in the Development Model of Technical and Vocational Education Aligned with Industrial Capacities

Variable	Subcomponent	Items	Item Reliability	Item–Total Correlation	Cronbach's Alpha	AVE	CR
Market Analysis	Data Collection	Market data gathering, demographic/work/insurance info	0.70–0.73	0.54–0.58	0.73	0.50	0.85
	Data Categorization	Data documentation, segmentation, goal setting	0.68–0.70	0.57			
Customer Attraction	Negotiation	Negotiation type, techniques, team, finalizing agreements	0.71–0.75	0.50–0.56	0.70	0.54	0.89
	Persuasion and Agreement	Needs assessment, encouraging customers, reaching agreements	0.70–0.78	0.50–0.58			
Goal Setting and Planning	Personnel Planning	Training sales network, motivation, staff training	0.73–0.75	0.54–0.57	0.86	0.54	0.89
	Attraction and Expansion	Market attraction, expanding network, customer retention, stakeholders	0.73–0.74	0.52–0.58			
Evaluation and Control	Evaluation	Industrial performance, contracts, human capital assessment	0.73–0.75	0.54–0.58	0.75	0.55	0.93
	Control	Technical and financial control, documentation inspections	0.73–0.75	0.50–0.58			
Experience and Expertise	Specialization	Industry-specific skills, diversity, feasibility with universities	0.78–0.79	0.50–0.59	0.80	0.61	0.89
	Experience	Operational staff skills, organizational maturity	0.77–0.78	0.51–0.54			
Training	Educational Needs	Occupational studies, identified training needs	0.79–0.80	0.53–0.57	0.70	0.63	0.87
	Training Quality	Program effectiveness, trainer competence	0.78–0.79	0.50–0.53			
Capacity & Infrastructure	Capacity	Demographic and cultural analysis, equipment	0.77–0.78	0.50–0.59	0.78	0.61	0.88
	Development & Infra	Infrastructure, industrial growth, technology, economy	0.78–0.79	0.51–0.58			
Policy & Planning	Regulatory Framework	Human capital plans, updated training programs	0.78–0.80	0.56	0.82	0.60	0.90
	Development Planning	Lifelong skill enhancement, dual oversight, job foresight	0.75–0.78	0.51–0.56			
Skilled Human Resources	Capability	Admission criteria, scientific capacity	0.71–0.77	0.51–0.54	0.75	0.50	0.83
	Competency	Behavioral/technical fit, graduate skills, personal quality	0.66–0.71	0.52–0.59			

The reliability and convergent validity analysis presented in Table 3 confirms the robustness of the designed development model's constructs. The Cronbach's alpha values for all components exceeded the 0.70 threshold, indicating strong internal consistency across the identified subscales. For example, the "Goal Setting and Planning" component achieved an alpha of 0.86, while "Policy and Planning" and "Evaluation and Control" showed similarly high reliability at 0.82 and 0.75, respectively. Convergent validity was supported by Average Variance Extracted (AVE) values ranging from 0.50 to 0.63 and Composite Reliability (CR) values between 0.83 and 0.93, exceeding standard benchmarks (AVE > 0.5, CR > 0.7). Notably, "Training," "Experience and Expertise," and "Capacity and Infrastructure" components showed particularly strong convergent validity with AVE values above 0.60. Furthermore, item reliability across all dimensions ranged from 0.66 to 0.80, and item-total correlations surpassed the 0.50 threshold, reinforcing the validity of each indicator in measuring its respective construct. These results confirm that the model's measurement scales are both psychometrically sound and theoretically coherent, providing a validated foundation for evaluating and implementing technical and vocational training strategies tailored to the industrial landscape of Bandar Abbas.

Table 4. Fornell-Larcker Matrix for the Development Model of Technical and Vocational Education Aligned with Industrial Capacities

Variable	Market Analysis	Customer Attraction	Goal Setting & Planning	Evaluation & Control	Experience & Expertise	Training	Capacity & Infrastructure	Policy & Planning	Skilled HR
Market Analysis	1.44								
Customer Attraction	0.88	1.31							
Goal Setting & Planning	0.70	0.74	1.29						
Evaluation & Control	0.68	0.73	0.75	1.17					
Experience & Expertise	0.64	0.66	0.72	0.66	1.08				
Training	0.61	0.60	0.67	0.69	0.63	0.88			
Capacity & Infrastructure	0.56	0.60	0.56	0.61	0.58	0.16	0.75		
Policy & Planning	0.54	0.52	0.59	0.55	0.56	0.56	0.57	0.72	
Skilled HR	0.50	0.51	0.50	0.58	0.54	0.51	0.54	0.55	0.68

The Fornell-Larcker matrix shown in Table 4 assesses the discriminant validity among the constructs of the proposed development model for technical and vocational education. According to the Fornell-Larcker criterion, discriminant validity is confirmed when the square root of the Average Variance Extracted (AVE) for each construct (diagonal values in bold) is greater than its correlations with other constructs (off-diagonal values in the same row and column). In this study, all diagonal values (ranging from 0.68 to 1.44) exceed the corresponding inter-construct correlation coefficients. For example, the square root of AVE for "Market Analysis" is 1.44, which is higher than its highest correlation with another construct, namely "Customer Attraction" at 0.88. Similarly, "Evaluation & Control" shows a discriminant validity value of 1.17, surpassing all its shared variances with other factors such as "Goal Setting & Planning" (0.75) and "Customer Attraction" (0.73). These results collectively indicate strong discriminant validity across all model dimensions, ensuring that each construct is empirically distinct and measures a unique aspect of the broader framework. This confirms the structural soundness of the model and its capacity to validly distinguish between key factors influencing the development of vocational education aligned with the industrial capacities of Bandar Abbas.

Table 5. Model Fit Indices for the Structural Equation Model of the Development Model of Technical and Vocational Education Aligned with Industrial Capacities

Model Fit Criteria	Index	Obtained Value	Acceptable Threshold	Result
Chi-square to degrees of freedom ratio	K2/df	1.52	Less than 3	Good fit
Root Mean Square Error of Approximation	RMSEA	0.05	Less than 0.1	Good fit
Root Mean Square Residual	RMR	0.020	Close to 0	Good fit
Normed Fit Index	NFI	0.94	Greater than 0.90	Good fit
Non-Normed Fit Index	NNFI	0.97	Greater than 0.90	Good fit
Comparative Fit Index	CFI	0.98	Greater than 0.90	Good fit
Incremental Fit Index	IFI	0.98	Greater than 0.90	Good fit
Relative Fit Index	RFI	0.93	Greater than 0.90	Good fit
Goodness-of-Fit Index	GFI	0.93	Greater than 0.90	Good fit
Adjusted Goodness-of-Fit Index	AGFI	0.92	Greater than 0.90	Good fit

As illustrated in Table 5, the results of the structural equation modeling (SEM) indicate a highly acceptable model fit across all evaluated indices. The chi-square to degrees of freedom ratio (K2/df) was 1.52, which is well below the threshold of 3, suggesting an excellent fit. The RMSEA value of 0.05 further supports model adequacy by falling within the acceptable error

range, indicating that the model approximates the data well. The RMR index, at 0.020, is also close to zero, reflecting minimal residuals. All incremental and comparative fit indices—including NFI (0.94), NNFI (0.97), CFI (0.98), IFI (0.98), and RFI (0.93)—surpassed the 0.90 threshold, confirming a strong comparative alignment between the proposed and null models. Additionally, absolute fit indices such as GFI (0.93) and AGFI (0.92) exceeded minimum standards, confirming the overall goodness of fit. Collectively, these values affirm that the structural model developed for the localized technical and vocational education framework in Bandar Abbas is statistically valid, robust, and reliable. The fit indices support the theoretical structure of the model, suggesting that the proposed relationships among latent variables are consistent with the empirical data, and the instruments used to measure the constructs demonstrate a strong and coherent alignment with the conceptual model.

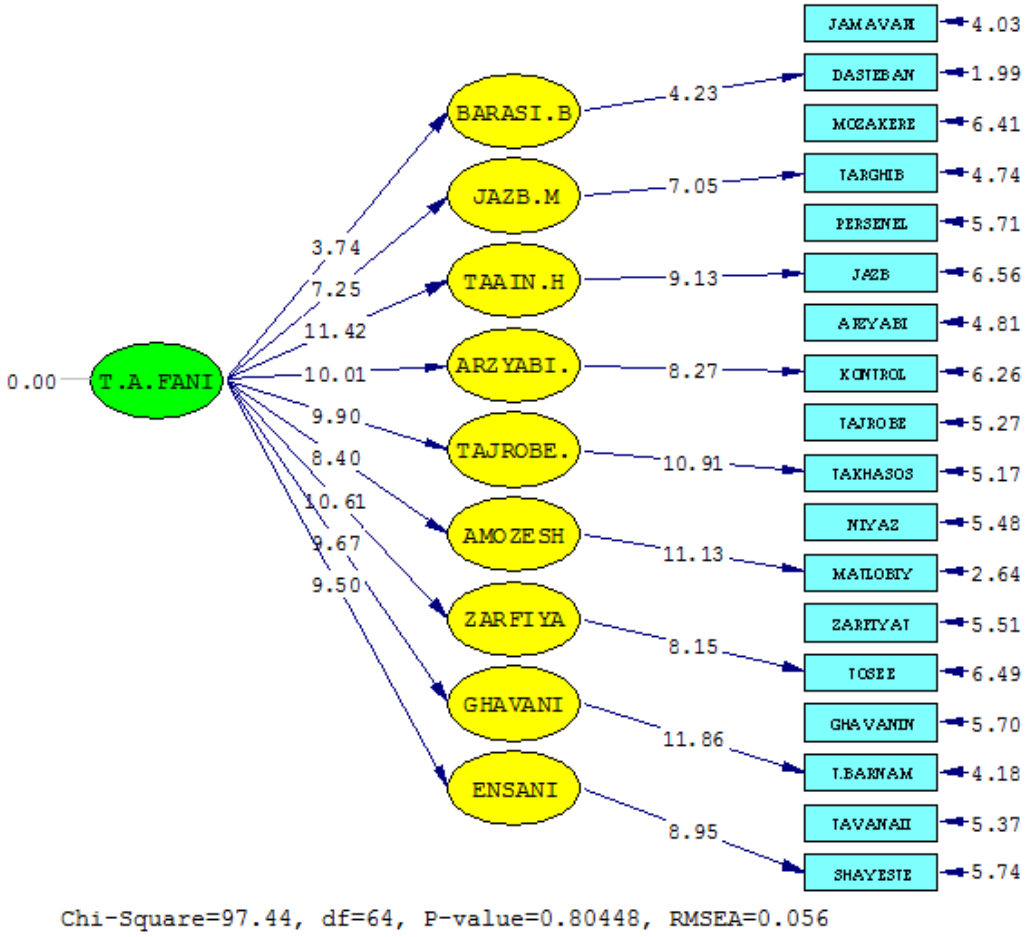

Figure 1. Model with T-Values

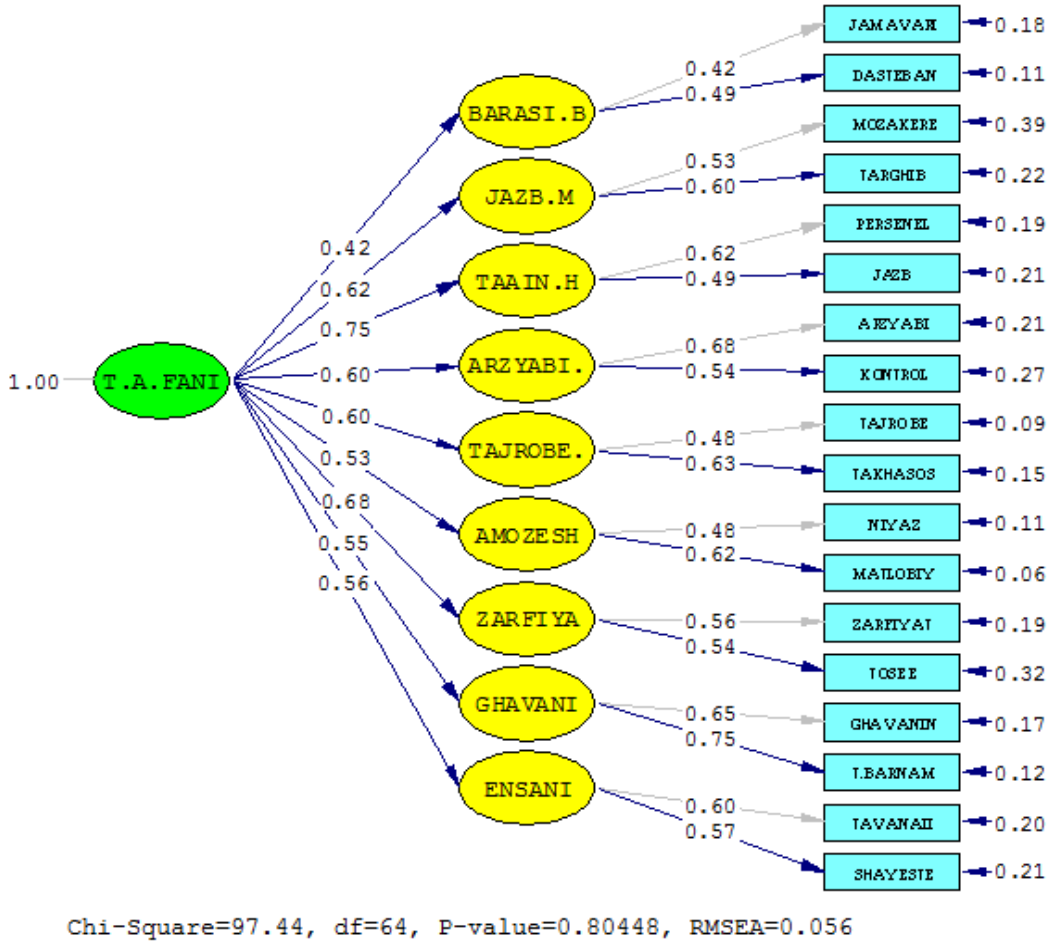

Figure 2. Model with Beta Coefficients

Discussion and Conclusion

The results of this study, which aimed to design and validate a localized development model for technical and vocational education (TVE) aligned with the industrial capacities of Bandar Abbas, confirmed the effectiveness and relevance of the proposed model through a rigorous mixed-methods approach. In the qualitative phase, thematic analysis of expert interviews led to the extraction of 18 core components reflecting key educational and managerial requirements for TVE institutions in the regional industrial context. These components included essential elements such as market analysis, customer attraction, goal setting and planning, evaluation and control, training, experience and expertise, capacity and infrastructure, legal and regulatory planning, and the availability of skilled human capital. The findings from the quantitative phase, including paired-sample t-tests, convergent and discriminant validity analysis, and structural model fit indices, validated the significance and practical value of these components in the current educational landscape of Bandar Abbas.

The comparison between current and ideal states of each component revealed significant gaps in eight of the nine core dimensions. These findings suggest a considerable disconnect between what is currently practiced in TVE institutions and what is ideally needed to meet industrial demands. The component with the highest discrepancy was "goal setting and planning," followed by "market analysis" and "customer attraction." This echoes the concerns raised by Shakari et al. (2019), who emphasized the absence of structured engagement between TVE institutions and local industries as a major barrier to curriculum

effectiveness and student employability (13). Additionally, the relatively poor performance in the "training" and "experience and expertise" dimensions supports the findings of Nazari (2021), who noted that technical schools often fail to equip learners with up-to-date practical skills aligned with the real needs of the labor market (2).

The convergent validity and reliability of the model's components were confirmed through strong Cronbach's alpha, AVE, and CR values, all of which exceeded the minimum thresholds for statistical acceptability. This reinforces the internal coherence of the components and the robustness of the designed framework. The reliability of key constructs like "evaluation and control," "policy and planning," and "goal setting" aligns well with the frameworks proposed by Kamarei et al. (2021), who emphasized the strategic role of managerial planning and assessment systems in improving educational quality and institutional responsiveness in the technical and vocational sector (14, 20). Similarly, Chekani Azaran et al. (2021) emphasized the importance of professional competence among TVE managers as a core enabler for quality education, which further validates the attention given to organizational planning and managerial development in the present model (15).

Structural equation modeling further confirmed the acceptability of the proposed model. With strong fit indices (e.g., RMSEA = 0.05, CFI = 0.98, GFI = 0.93), the data provided strong empirical support for the hypothesized relationships among constructs. These outcomes indicate that the designed model is not only theoretically comprehensive but also statistically validated. Such validation is significant when compared to earlier attempts in the literature to integrate regional industry needs into vocational training, many of which lacked empirical grounding (7, 23). The fit of this model underlines the methodological strength of using a sequential exploratory mixed-methods design, as recommended by Nasirian Tamrin et al. (2019), who used a similar approach to develop an evaluation model for educational quality in TVE universities (22).

One of the key insights from this study was the prominent role of industry-informed planning. As also noted by Arabi et al. (2022), integrating entrepreneurial principles into the TVE curriculum is essential for equipping students with the ability to either adapt to employment or generate their own opportunities (3). This emphasis on entrepreneurial alignment is particularly critical in a city like Bandar Abbas, where industrial growth provides a unique ecosystem for practical training. The validation of this component in the model aligns with the recommendations made by Iri et al. (2024), who analyzed the ambivalence in entrepreneurship education within the TVE system and proposed clearer policy structures to encourage innovation (4). Additionally, the study by Ariana and Daneshfard (2020) underscored the importance of viewing technical universities through the lens of entrepreneurial transformation, arguing that without this perspective, TVE systems may fail to remain relevant in today's economy (8).

The weak performance of the "training" component in the current state assessment also reflects broader cultural and systemic challenges in Iranian vocational education. Hosseinpour (2023) highlighted deep-rooted barriers such as low social prestige for vocational paths, insufficient budget allocation, and limited private sector involvement as critical limitations (6). The identified training inadequacies in this study are a clear manifestation of these macro-level issues. Additionally, the curricular inefficiencies reported align with the findings of Momeni Mohammadi et al. (2021), who explored the problem of "superfluous curricula" that dilute the effectiveness of technical education by including irrelevant or outdated content (16).

Another compelling aspect of the model is its focus on the professional development of educators and managers. The importance of professional capacity-building, as discussed by Ghaderi Sheykhi Abadi et al. (2023), who introduced a synergistic leadership questionnaire tailored for TVE contexts, complements the current model's attention to leadership training and quality control structures (19). These leadership dynamics are critical, especially in localized education settings where centralized policies may not always reflect the diverse industrial realities of regions like Bandar Abbas.

Furthermore, this study contributes to the discussion around educational evaluation frameworks. The model supports a structured performance assessment mechanism that includes both formative and summative evaluation elements, thereby

aligning with the performance evaluation indicators proposed by Ghanbari et al. (2020) for the Iranian Technical and Vocational Training Organization (5). Such integrative evaluation tools can help institutions monitor progress, detect deficiencies, and adjust strategies accordingly—an approach strongly recommended by Shari'ati et al. (2019) for maintaining quality in a knowledge-based economy (11).

This study also confirms the importance of technology integration in modern TVE settings. As shown in the research by Amirkhaninia et al. (2024), the incorporation of artificial intelligence into teaching methods can drastically improve student engagement and learning outcomes (18). The current model indirectly supports such innovation by including infrastructure development and trainer competency as core components, both of which are prerequisites for technology adoption.

The model also pays attention to legal and regulatory components—areas often neglected in TVE planning. The results show that although this component did not differ significantly between current and desired states, its role remains critical. It provides the policy scaffolding upon which all other dimensions rest. This finding aligns with the structural reform strategies proposed by the Parliament Research Center of Iran (2022), which identified legal ambiguity and policy fragmentation as key inhibitors of vocational education performance (1).

While the findings of this study offer valuable insights into the design and validation of a context-specific development model for technical and vocational education, some limitations must be acknowledged. First, the research was conducted within the geographic and industrial context of Bandar Abbas, which, despite its strategic significance, may limit the generalizability of results to other regions with different economic profiles. Second, the study primarily relied on self-reported perceptions of experts, which, although rich in depth, may introduce biases related to personal experience and institutional affiliation. Third, the cross-sectional nature of the quantitative phase limits the ability to observe long-term impacts of the model's implementation.

Future studies should consider longitudinal research designs to evaluate the impact of implementing this model over time in various industrial contexts. Comparative studies between different provinces or between public and private TVE institutions could reveal important structural and cultural differences that affect model effectiveness. Additionally, expanding the model to include digital literacy, green skills, and international benchmarking could further enhance its relevance in the globalized economy. Incorporating student and employer perspectives in greater depth could also provide a more holistic understanding of training outcomes and labor market alignment.

To enhance the effectiveness of TVE in Bandar Abbas and similar industrial hubs, it is recommended that institutions adopt the validated model presented in this study as a framework for curriculum design, staff training, and industry collaboration. Policymakers should prioritize investment in infrastructure, especially in digital technologies, and create incentives for private sector participation. TVE managers are encouraged to focus on professional development, performance evaluation systems, and dynamic planning processes to ensure that training programs remain responsive to industry trends and labor market shifts.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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