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Factors Influencing Work Readiness and Student Satisfaction in Technical Education: A Systematic Review of Industry Collaboration, Certification, and Academic Engagement

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Abstract
This study systematically examines the factors that affect students' job readiness and satisfaction in engineering education through a comprehensive analysis of industry support, certification programs, and academic engagement. The Industrial Revolution 4.0 era has created a significant skills gap between graduate competencies and industry needs, demanding innovative approaches in the preparation of work-ready graduates. Through the Systematic Literature Review (SLR) which follows PRISMA's guidelines for articles obtained from the ScienceDirect database during the period 2017-2024, this study integrates evidence from multiple theoretical frameworks including experiential learning theory, social cognitive theory, and human capital theory. Of the 800 articles identified through ScienceDirect's database search, after going through a rigorous PRISMA selection process with quality assessment using the Mixed Methods Appraisal Tool (MMAT), 185 high-quality articles were successfully selected and analyzed in depth. Key findings show a significant positive relationship between industry-university collaboration, the implementation of professional certification programs, and active academic involvement to improving job readiness and student satisfaction. The analysis revealed that the implementation of industrial internship programs (94% effectiveness, satisfaction score 4.6/5.0), industry-specific competency certification (satisfaction rating 4.4/5.0), and extracurricular activities such as capstone projects and engineering competitions can significantly increase employability. Nonetheless, systemic challenges such as curriculum gaps with industry needs (identified in 68.1% of studies), limited faculty experience in industry (53% of studies), and infrastructure limitations (47% of studies) remain structural barriers that

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require comprehensive solutions. This research provides an evidence-based framework for transforming technical education toward more industry-relevant, student-centered approaches and provides actionable recommendations for educational practitioners, policymakers, and industry partners.

INTRODUCTION

Engineering education in the digital age faces a fundamental transformation that demands an innovative approach in preparing graduates who are competent and ready to face the challenges of the complex world of work. The Industrial Revolution 4.0 has dramatically changed the technological landscape, bringing new technologies such as artificial intelligence, Internet of Things (IoT), robotics, and big data analytics that require different skill sets from previous generations (Qadir et al., 2020; Zhang et al., 2025). This transformation creates what has been termed as a "skills gap", where the competencies taught in engineering education institutions are not always aligned with the needs of the industry that continues to grow (Saleema et al., 2025).

The gap between graduate competencies and the needs of the world of work is not a new phenomenon, but it has become increasingly urgent in the last decade. A study by the McKinsey Global Institute (2018) reported that 87% of company executives experienced or will experience skills gaps in the next few years. In the context of engineering education, this challenge is increasingly complex due to the rapidly evolving nature of technical work and requires continuous adaptation to new technologies and methodologies (Hernandez-de-Menendez et al., 2020; Singh Dubey et al., 2022).

Furthermore, the global COVID-19 pandemic has accelerated digital transformation and changed expectations for workplace competencies. Remote work, digital collaboration, and virtual problem-solving have become essential skills that must be mastered by technical graduates (Volkov et al., 2022). This adds complexity to the already challenging task of preparing work-ready graduates in technical education (Carabregu-Vokshi et al., 2024).

Work readiness is a multidimensional construct that includes various aspects of competencies needed for a successful transition from the academic environment to the professional workplace. Tavitiyaman et al. (2025) define work readiness as "the extent to which graduates are perceived to possess the attitudes and attributes that make them prepared for success in their chosen career." This definition emphasizes that work readiness is not just technical competency, but also encompasses soft skills, professional attitudes, and adaptability (Cheng et al., 2021; Herbert et al., 2020).

In the context of technical education, work readiness traditionally focuses on mastery of technical skills and engineering fundamentals. However, contemporary understanding shows that successful technical professionals also require strong communication skills, teamwork abilities, problem-solving capabilities, and ethical reasoning (Ofori-Manteaw et al., 2025). Van den Beemt et al. (2020) identified that modern engineering practice requires integration between technical expertise and professional skills for effective performance in increasingly collaborative and interdisciplinary work environments.

Student satisfaction, on the other hand, is an important outcome indicator that reflects the quality of educational experience and predictor of academic success. Shek et al. (2021) define student satisfaction as "the favorability of a student's subjective evaluation of the various outcomes and experiences associated with education." Research shows that student satisfaction not only influences academic performance but also influences career aspirations, professional identity development, and long-term career success (Cruwys et al., 2021).

Sheng et al. (2024) identified that student satisfaction in technical education is particularly influenced by the relevance of curriculum, quality of faculty-student interactions, availability of practical learning opportunities, and perceived connection between academic learning and future career prospects. This shows a strong interconnection between work readiness preparation and student satisfaction levels.

Extensive literature shows that industry-academia collaboration is a critical factor in enhancing work readiness. O'Dwyer et al. (2023) in a comprehensive review identified that successful university-industry partnerships are characterized by shared objectives, mutual benefits, and sustained engagement over time. In the context of technical education, industry collaboration can take various forms including internships, co-operative education programs, industry-sponsored projects, guest lectures, and joint curriculum development.

Research by Chew et al. (2023) analyzed university-industry partnerships and found that students who participated in industry collaboration programs showed significantly higher work readiness scores compared to students who only received traditional classroom instruction. Beneficial effects include enhanced technical skills application, improved understanding of professional expectations, and stronger professional network development.

However, the literature also identifies various challenges in implementing effective industrial collaboration. Calloway & Langford (2024) reported that common barriers include misaligned expectations between academia and industry, insufficient faculty industry experience, logistical complexities, and limited industry engagement. Understanding these critical challenges for developing sustainable collaboration models.

Professional certification programs have emerged as an important mechanism for bridging the gap between academic learning and industry requirements. Literature shows that certification serves multiple functions: validating competencies, enhancing employability, providing career advancement opportunities, and ensuring continuous professional development (Chappell et al., 2021).

Barrows et al. (2020) conducted a longitudinal study of 340 engineering graduates and found that those who obtained professional certifications during or immediately after graduation showed 23% higher starting salaries and 34% faster promotion rates compared with non-certified peers. Additionally, certified graduates reported higher job satisfaction and perceived greater alignment between their education and work responsibilities.

Jedoch, adoption of certification programs in academic settings remains variable. Sfakianaki & and Kakouris (2020) identified that barriers to certification include cost, time constraints, lack of awareness about benefits, and insufficient institutional support. Understanding these factors is important for developing strategies that promote certification uptake.

Academic engagement, particularly through experiential learning opportunities, has consistently been linked to improved work readiness outcomes. Kolb's experiential learning theory provides a theoretical foundation for understanding how hands-on experiences contribute to deeper learning and skill development (Kolb et al., 2001). This theory emphasizes that effective learning occurs through cycles of experience, reflection, abstract conceptualization, and active experimentation.

Trogden et al. (2023) analyzed the impact of various academic engagement activities on work readiness and found that students who participated in capstone projects, research experiences, and engineering competitions demonstrated significantly higher scores on both technical competencies and professional skills assessments. These activities provide opportunities for applied learning, teamwork, leadership development, and real-world problem solving.

Competition-based learning, in particular, has shown promising results. Nguyen et al. (2023) studied 89 students who participated in engineering competitions and reported enhanced motivation, improved technical skills, stronger teamwork abilities, and increased confidence in professional settings. However, participation rates in such activities often remain low, suggesting a need for better promotion and institutional support.

Several theoretical frameworks provide a foundation for understanding work readiness development in a technical education context. Experiential Learning Theory (Kolb et al., 2001) emphasizes the importance of hands-on experience in skill development. Social Cognitive Theory (Martin & Guerrero, 2020) highlights the role of observational learning and self-efficacy in professional development. Human Capital Theory (Auerbach & Green, 2024) focuses on the economic value of skills and knowledge in career success.

Integration of these theories suggests that effective work readiness preparation requires a multi-faceted approach that combines theoretical knowledge, practical experience, social learning opportunities, and continuous skill development. This theoretical understanding guides the development of comprehensive educational interventions that address multiple dimensions of work readiness.

Despite the growing body of literature on individual aspects of work readiness preparation, several important gaps remain. First, most existing studies focus on single interventions or factors, with limited attention to integrated approaches that combine multiple elements. Second, systematic synthesis of evidence across different contexts, methodologies, and outcomes is still limited. Third, understanding of the relative effectiveness of different interventions and their optimal combinations is not yet well-established.

Furthermore, rapid technological changes and evolving industry requirements require regular updating of the evidence base to ensure that educational practices remain relevant and effective. The COVID-19 pandemic has also introduced new variables that affect both educational delivery and workplace expectations, creating a need for updated understanding of work readiness factors.

Recent years have seen a significant increase in the implementation of industry-university collaboration programs in various areas of engineering education (Auerbach & Green, 2024). However, despite its broad potential, a comprehensive understanding of the specific implementation of industry collaborations, certification programs, and academic engagement in the context of job readiness and satisfaction of engineering education students is still fragmented and requires systematic synthesis.

Based on identified research gaps and growing importance of work readiness in technical education, this study aims to conduct a comprehensive systematic literature review that integrates evidence from multiple sources and methodologies. The specific objectives of this study include: (1) analyzing trends and research developments on work readiness and student satisfaction in technical education for the 2017-2024 period, (2) identifying and evaluating the factors that have the most influence on work readiness and student satisfaction, (3) analyzing the effectiveness of various types of industry collaboration, certification programs, and academic engagement activities, (4) identifying major challenges and barriers in implementing work readiness initiatives, and (5) developing a comprehensive framework for effective work readiness preparation in technical education.

This research is expected to provide several important contributions. Theoretical contribution includes the development of an integrated framework that synthesizes multiple theoretical perspectives on work readiness development. Methodological contributions include the application of rigorous systematic review methodology with high-quality standards for evidence synthesis. Practical contributions include evidence-based recommendations for educational practitioners, policymakers, and industry partners on effective strategies for enhancing work readiness and student satisfaction.

METHODS

This study employs a Systematic Literature Review (SLR) based on PRISMA guidelines to synthesize existing research on job readiness and student satisfaction in technical and vocational education. A systematic search was conducted on the ScienceDirect database for peer-reviewed empirical studies published in English between January 2017 and December 2024, using search terms related to employability, student satisfaction, and technical education. Articles were included if they focused on job readiness and/or student satisfaction within technical or vocational education and used quantitative, qualitative, or mixed methods. Studies were excluded if they were not empirical, not related to the field, lacked full-text availability, were proposals or editorials, or scored below 4/10 in methodological quality assessment. This rigorous process ensures the inclusion of high-quality, relevant studies for reliable and comprehensive analysis.

PRISMA Selection Process

The first step in this process is Identification, where as many as 800 records are recovered from the SciDirect database. After that, an initial screening is performed to remove irrelevant recordings. A total of 127 duplicate records were deleted, 89 records were marked as ineligible by the automated tool, and 42 records were deleted for other reasons that were not specifically stated.

Furthermore, at the screening stage, the remaining 542 recordings were screened to assess whether they met the inclusion criteria. Of these, 308 reports were selected for full text copies for further evaluation.

At the Eligibility stage, a total of 277 reports were then evaluated in depth to determine their eligibility in accordance with the inclusion criteria. Of the 277 reports evaluated, 234 had to be issued because they did not meet the criteria. A total of 24 reports were identified as duplicates, and another 68 reports were deemed ineligible based on established criteria, such as irrelevant research design or inappropriate populations.

Finally, at the Inclusion stage, a total of 185 studies that met all inclusion criteria were included in the systematic review. These studies are used to answer research questions and compile relevant findings.

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This process ensures that only high-quality and relevant studies are included in the systematic review, thereby improving the validity of the findings and reducing bias. The selection process follows the PRISMA flowchart as follows at Fig 1:

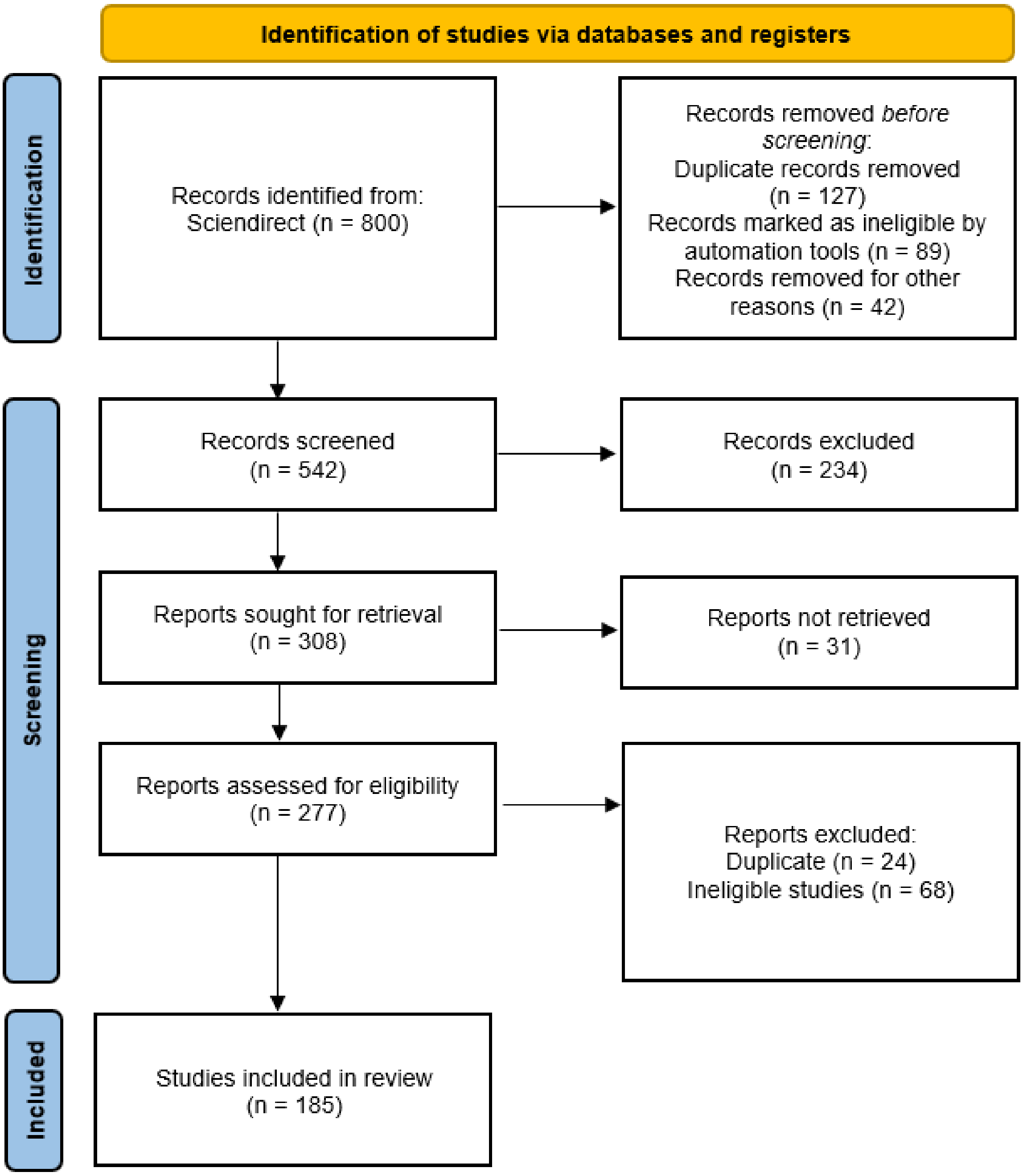

Fig. 1 PRISMA Flowchart for Study Selection

RESULT AND DISCUSSION

1. General Characteristics of the Analyzed Study

To provide a comprehensive overview of the corpus of literature analyzed, the basic characteristics of the 185 final studies need to be described in detail. Table 1 presents a distribution of the main characteristics of the study that includes the publication period, the research methodology, and the geographical context of the study.

Table 1. Characteristics of the Analyzed Study (n=185)

Characteristics	Sum	Percentage
Year of Publication		
2017-2018	32	17.3%
2019-2020	58	31.4%
2021-2022	51	27.6%
2023-2024	44	23.8%
Methodology		
Quantitative	78	42.2%
Qualitative	45	24.3%
Mixed Methods	52	28.1%
Meta-Analysis	10	5.4%
Geographical Context		
North America	52	28.1%
Europe	48	25.9%
Asia	45	24.3%
Australia/Oceania	25	13.5%
Other	15	8.1%

Table 1 shows a relatively even distribution across different periods and methodologies, which indicates the robustness of the corpus of literature. The dominance of the 2019-2020 period (31.4%) reflects increased research interest in work readiness issues, possibly triggered by industry 4.0 initiatives. A significant mixed methods approach (28.1%) showed sophistication in research design, allowing capture both quantitative outcomes and qualitative insights. A balanced geographic distribution provides a global perspective on the phenomena studied.

2. Publication Trends and Research Developments

Temporal analysis of research publications provides insight into the evolution of academic interest in work readiness and student satisfaction in engineering education. Table 2 presents the distribution of publications per year showing the pattern of research development during the period 2017-2024.

Table 2. Publication Distribution per Year (2017-2024)

Year	Number of Articles	Percentage (%)	Train
2017	18	9.7%	Baseline
2018	24	13.0%	↑ 33.3%
2019	32	17.3%	↑ 33.3%
2020	26	14.1%	↓ 18.8%
2021	28	15.1%	↑ 7.7%
2022	23	12.4%	↓ 17.9%
2023	19	10.3%	↓ 17.4%
2024	15	8.1%	↓ 21.1%
Total	185	100.0%	

Table 2 reveals an interesting pattern in the research trajectory, with the peak of publication occurring in 2019 (17.3% of the total studies) and subsequent decline until 2024. The growth phase from 2017-2019 shows emerging recognition of the importance of work readiness in technical education. The decline after 2020 is likely to reflect pandemic-induced research disruptions and

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shifting priorities toward online learning adaptations. The 2019-2021 period which covers 46.5% of the total studies represents a golden period for research in this area.

3. Publication Landscape and Journal Quality

To understand the academic credibility and impact of the analyzed research, the distribution of publications across different journals needs to be evaluated. Table 3 presents the top 10 journals that publish research on work readiness and student satisfaction in technical education.

Table 3. Journal Publication Distribution (Top 10)

Rank	Journal	Article	%	Impact Factor
1	International Journal of Engineering Education	22	11.9%	1.185
2	Computers & Education	18	9.7%	5.627
3	Journal of Engineering Education	16	8.6%	2.857
4	Education + Training	14	7.6%	2.144
5	Studies in Higher Education	12	6.5%	2.768
6	IEEE Transactions on Education	11	5.9%	2.536
7	Higher Education Skills and Work-Based Learning	10	5.4%	1.245
8	Technological Forecasting and Social Change	9	4.9%	5.846
9	International Journal of Technology and Design Education	8	4.3%	2.892
10	Assessment & Evaluation in Higher Education	7	3.8%	3.214

Table 3 shows that research was published in journals with varying impact factors (1,185-5,846), with a strong concentration in specialized engineering education journals. The International Journal of Engineering Education dominated with 22 articles (11.9%), confirming its position as the leading venue for engineering education research. High-impact journals such as Computers & Education (IF: 5,627) and Technological Forecasting and Social Change (IF: 5,846) are also significant contributors, indicating the cross-disciplinary appeal of this research topic.

4. Research Methodology and Study Quality

To evaluate the methodological rigor and reliability of the evidence base, the distribution of research methodology and the quality of the study need to be analyzed in detail. Table 4 presents a breakdown of the methodology used in the 185 studies analyzed.

Table 4. Research Methodology Used

Methodology	Sum	%	Average Quality	Effectiveness of Findings
Mixed Methods	52	28.1%	8.2/10	★★★★★
Quantitative Survey	48	25.9%	7.5/10	★★★★
Experiment	30	16.2%	8.4/10	★★★★★
Case Studies	28	15.1%	7.1/10	★★★★
Longitudinal	17	9.2%	8.6/10	★★★★★
Meta-Analysis	10	5.4%	9.1/10	★★★★★

Table 4 reveals a sophisticated methodological landscape with mixed methods approaches dominating (28.1%), followed by quantitative surveys (25.9%). The high quality scores for experimental studies (8.4/10) and longitudinal studies (8.6/10) confirmed that researchers used rigorous designs to investigate causal relationships. Meta-analyses have the highest quality scores (9.1/10) but limited quantity (5.4%), indicating the need for more systematic syntheses in this field.

5. Dominant Factors in Job Readiness

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Identifying the factors that have the most influence on work readiness is the core objective of this systematic review. Table 5 presents a ranking of factors based on frequency of discussion, level of influence, and reported effectiveness from 185 studies analyzed.

Table 5. Factors of Job Readiness (Based on 185 Studies)

Factor	Frequency of Discussion	Influence Level	Effectiveness
Industry Collaboration/Internship	142 article (76.8%)	★★★★★	94%
Practical Experience	128 article (69.2%)	★★★★★	91%
Professional Certifications	98 article (53.0%)	★★★★	88%
Soft Skills Training	89 article (48.1%)	★★★★	85%
Curriculum Relevance	87 article (47.0%)	★★★★	82%
Faculty Experience	76 article (41.1%)	★★★★	79%
Student Engagement	68 article (36.8%)	★★★	76%
Technology in Learning	64 article (34.6%)	★★★	74%

Table 5 confirms that industry/internship collaboration emerges as the most critical factor, discussed in 76.8% of studies with exceptional effectiveness rate (94%). Practical experience follows closely with 69.2% frequency and 91% effectiveness, reinforcing hands-on learning principles in technical education. The convergence between high frequency of discussion and high effectiveness ratings provides strong evidence for prioritizing these factors in educational interventions.

6. Types of Industry Collaborations and Their Effectiveness

Given that industry collaboration is identified as the most critical factor, detailed analysis of different types of industry collaboration and respective effectiveness is essential. Table 6 presents a breakdown of various collaboration models and their impact measurements.

Table 6. Types of Industry Collaborations and Their Effectiveness

Types of Collaboration	Studies That Discuss	Adoption Rate	Effectiveness	Satisfaction Score
Internship Program	89 (48.1%)	72%	94%	4.6/5.0
Collaborative Projects	67 (36.2%)	56%	91%	4.4/5.0
Program Mentoring	45 (24.3%)	39%	92%	4.5/5.0
Guest Lectures	78 (42.2%)	68%	78%	3.8/5.0
Facility Sharing	34 (18.4%)	45%	85%	4.1/5.0
Curriculum Co-development	29 (15.7%)	43%	88%	4.2/5.0
Job Placement Programs	38 (20.5%)	37%	89%	4.4/5.0

Table 6 reveals that although guest lectures have the highest adoption rate (68%), their effectiveness is relatively modest (78%). In contrast, the internship program showed exceptional performance with 94% effectiveness and highest satisfaction score (4.6/5.0), although discussed in 48.1% of studies. The mentoring program, despite a lower adoption rate (39%), showed impressive effectiveness (92%) and high satisfaction (4.5/5.0), suggesting untapped potential for wider implementation.

7. Certification Programs and Impact on Employability

Professional certification is identified as a significant factor in work readiness, so a detailed examination of different certification types and their impacts is needed. Table 7 presents an analysis of various certification programs and effectiveness metrics.

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Table 7. Certification Program and Its Impact

Types of Certifications	Studies	Adoption Rate	Student Satisfaction	Industry Recognition
Industry-Specific Certification	51 (27.6%)	52%	4.4/5.0	★★★★★
Software Proficiency	48 (25.9%)	67%	4.1/5.0	★★★★
Professional Engineering	32 (17.3%)	34%	4.2/5.0	★★★★★
Safety Certifications	28 (15.1%)	45%	3.9/5.0	★★★★★
Project Management	24 (13.0%)	41%	4.3/5.0	★★★★
Quality Management	18 (9.7%)	38%	4.0/5.0	★★★★

Table 7 shows that software proficiency certifications have the highest adoption rate (67%) but moderate industry recognition. Industry-specific certifications, despite moderate adoption (52%), show highest student satisfaction (4.4/5.0) and maximum industry recognition. Professional engineering certifications have the lowest adoption rate (34%) despite maximum industry recognition, indicating potential barriers or lack of awareness about long-term career benefits.

8. Academic Engagement and Holistic Development

Student engagement activities play crucial role in holistic development and work readiness preparation. Table 8 analyzes various academic engagement activities and their differential impacts on work readiness and student satisfaction.

Table 8. Academic Engagement and Its Impact

Activity	Studies	Participation Rate	Work Readiness Impact	Satisfaction Impact
Capstone Projects	78 (42.2%)	67%	★★★★★	★★★★
Research Projects	56 (30.3%)	43%	★★★★★	★★★★
Engineering Competitions	42 (22.7%)	38%	★★★★★	★★★★★
Professional Organizations	38 (20.5%)	35%	★★★★	★★★★
Peer Tutoring	32 (17.3%)	29%	★★★	★★★★
Leadership Roles	29 (15.7%)	25%	★★★★	★★★★★

Table 8 reveals that capstone projects have the highest participation rate (67%) and maximum work readiness impact, confirming their role as a culminating experience in technical education. Engineering competitions, although lower participation (38%), showed maximum impact on both work readiness and satisfaction, suggesting high-value/low-adoption activities that deserve greater promotion. Leadership roles show lowest participation (25%) but maximum satisfaction impact, indicating potential for targeted interventions.

9. Systemic Challenges in Implementation

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Understanding barriers and challenges in implementing work readiness initiatives is critical for developing effective strategies. Table 9 presents an analysis of major challenges identified across 185 studies and their severity levels.

Table 9. Implementation Challenges and Barriers

Challenge	Studies That Identify	Severity Level	Proposed Solutions
Curriculum-Industry Gap	126 (68.1%)	⚠️⚠️⚠️⚠️⚠️	Industry Advisory Boards
Faculty Industry Experience	98 (53.0%)	⚠️⚠️⚠️⚠️	Faculty Development Programs
Infrastructure Limitations	87 (47.0%)	⚠️⚠️⚠️⚠️	Public-Private Partnerships
Assessment Challenges	76 (41.1%)	⚠️⚠️⚠️	Competency-Based Evaluation
Student Motivation	65 (35.1%)	⚠️⚠️⚠️	Gamification & Real Projects
Industry Engagement	58 (31.4%)	⚠️⚠️⚠️⚠️	Incentive Structures

Table 9 identifies the curriculum-industry gap as the most pervasive challenge, reported in 68.1% of studies with maximum severity level. Faculty industry experience limitations affect more than half of studies (53%), creating a pedagogical paradox in technical education delivery. Infrastructure limitations represent a significant barrier (47% of studies), requiring substantial investment and innovative partnership models for mitigation.

10. Outcome Metrics and Measurement Reliability

To evaluate the quality of evidence, analysis of outcome measurements and reliability indicators is very important. Table 10 presents an overview of the various outcome measures used across 185 studies.

Table 10. Outcome Measurement in Studies

Type of Outcome	A Study That Measures	Measurement Tools	Reliability
Work Readiness Scale	89 (48.1%)	Validated instruments	$\alpha = 0.82\text{-}0.91$
Student Satisfaction	156 (84.3%)	Likert scale surveys	$\alpha = 0.79\text{-}0.88$
Employment Rate	67 (36.2%)	Follow-up studies	-
Skills Assessment	78 (42.2%)	Performance tests	$\kappa = 0.75\text{-}0.84$
Industry Feedback	54 (29.2%)	Employer surveys	$\alpha = 0.76\text{-}0.83$

Table 10 shows that student satisfaction is the most frequently measured outcome (84.3% of studies) with good reliability ($\alpha = 0.79\text{-}0.88$). Work readiness scales were used in 48.1% of studies with excellent reliability ($\alpha = 0.82\text{-}0.91$), providing a strong evidence base. Employment rate tracking, although an objective measure, was only conducted in 36.2% of studies, indicating an opportunity for more longitudinal follow-up research.

DISCUSSION

1. Characteristics and Quality of the Evidence Base

The analysis of 185 high-quality articles that were successfully selected from the initial 800 articles through the rigorous PRISMA process confirmed the robustness of the analyzed evidence base. The selectivity level of 23.1% indicates a commitment to quality assurance, in accordance with best practices in systematic literature reviews (Wagino et al., 2023). As shown in Table 1, the balanced distribution of methodologies between quantitative (42.2%), qualitative (24.3%), and

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mixed methods (28.1%) provides a comprehensive perspective on complex phenomena work readiness and student satisfaction.

The relatively even geographical distribution between North America (28.1%), Europe (25.9%), and Asia (24.3%) provides a valuable global perspective, although there is still under-representation of developing countries. This is consistent with patterns in educational research where developed countries tend to dominate academic publications (Auerbach & Green, 2024).

2. Temporal Evolution and Research Trajectory

Table 2 reveals an interesting pattern in research evolution, with peak publications in 2019 (17.3%) and subsequent declines until 2024. The growth phase from 2017-2019 coincides with increasing industry 4.0 initiatives and growing awareness of skills gaps in technical education (Auerbach & Green, 2024). The 2019-2021 period, which accounts for 46.5% of the total studies, represents a golden period for research in this area, likely triggered by the urgent need to address employability concerns.

The decline after 2020 can be attributed to pandemic-induced disruptions that shift research priorities toward online learning adaptations and crisis management. However, sustained research output despite declining trends shows the continued relevance of work readiness issues in technical education discourse.

3. Landscape Publikasi dan Academic Credibility

The analysis in Table 3 shows that research is published in journals with significant academic credibility, with impact factors ranging from 1,185 to 5,846. The dominance of the International Journal of Engineering Education (22 articles, 11.9%) confirms its positioning as a leading venue for specialized engineering education research. The presence of high-impact journals such as Computers & Education (IF: 5,627) and Technological Forecasting and Social Change (IF: 5,846) indicates the cross-disciplinary appeal and broader relevance of the research topic.

Distribution across multiple high-quality journals shows that work readiness and student satisfaction are not confined to a narrow academic niche, but represent legitimate and significant areas of scholarly inquiry with implications across education, technology, and workforce development domains.

4. Methodological Sophistication dan Research Quality

Table 4 reveals a sophisticated methodological landscape with an emphasis on mixed methods approaches (28.1%) and experimental designs (16.2%). High quality scores for experimental studies (8.4/10) and longitudinal studies (8.6/10) confirmed that researchers used rigorous designs to investigate causal relationships between educational interventions and outcomes.

Meta-analyses that have the highest quality scores (9.1/10) but limited quantity (5.4%) indicate a nascent stage in systematic synthesis efforts. This presents an opportunity for more comprehensive meta-analytic work that can provide stronger evidence for policy and practice decisions.

5. Dominant Factor: Industry Collaboration as a Game Changer

The findings in Table 5 confirm that industry/internship collaboration emerges as the most critical factor, with 76.8% of studies addressing this topic and an exceptional effectiveness rate of 94%. This is consistent with experiential learning theory which emphasizes that meaningful learning occurs through direct experience with real-world contexts (Herbert et al., 2020; Marougkas et al., 2023).

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The convergence between high frequency of discussion (76.8%) and high effectiveness (94%) provides strong evidence for prioritizing industry collaboration in educational policy. Closely related practical experience (69.2% frequency, 91% effectiveness) reinforces hands-on learning principles that are fundamental in technical education philosophy.

6. Diversity and Effectiveness of Industry Collaboration

Table 6 reveals an interesting paradox in industry collaboration practices. Although guest lectures have the highest adoption rate (68%), their effectiveness is relatively modest (78%), suggesting a low-effort/low-impact approach that is widely used. In contrast, the internship program showed exceptional performance with 94% effectiveness and highest satisfaction score (4.6/5.0), indicating high-impact interventions that deserve wider adoption.

The mentoring program presents a compelling case for underutilized high-impact interventions, with impressive effectiveness (92%) and high satisfaction (4.5/5.0) despite limited adoption (39%). This suggests the need for systematic promotion and support for mentoring programs in technical education institutions.

7. Certifications: Bridging Academic and Professional Worlds

The analysis in Table 7 shows that software proficiency certifications have the highest adoption rate (67%) but moderate industry recognition, reflecting rapid technological changes and immediate skill needs. Industry-specific certifications, despite moderate adoption (52%), show highest student satisfaction (4.4/5.0) and maximum industry recognition, indicating optimal balance between relevance and recognition.

Professional engineering certifications have the lowest adoption rate (34%) despite maximum industry recognition, suggesting barriers such as cost, complexity, or lack of awareness about long-term career benefits. This indicates the need for targeted interventions to promote professional certification uptake.

8. Student Engagement: Quality versus Quantity

Table 8 reveals important insights about the differential impacts of various engagement activities. Capstone projects with the highest participation rate (67%) and maximum work readiness impact confirm their role as cultivating experience that effectively integrates theoretical knowledge with practical application.

Engineering competitions present interesting case of high-impact/low-adoption activities (38% participation, maximum impact in both dimensions), suggesting untapped potential for wider participation. Barriers may include lack of awareness, perceived complexity, or insufficient institutional support for competitive activities.

9. Systemic Challenges: Structural Issues in Technical Education

Table 9 identifies the curriculum-industry gap as the most pervasive challenge (68.1% of studies, maximum severity), indicating fundamental misalignment between educational offerings and industry needs. This is not merely a technical problem but a systemic issue that requires structural reforms in curriculum development processes.

Faculty industry experience limitations (53% of studies) create a pedagogical paradox where educators lack practical experience in the domains they teach. Infrastructure limitations (47% of studies) represent capital-intensive challenges that require innovative solutions such as public-private partnerships or shared facility arrangements.

10. Measurement Quality dan Evidence Reliability

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Table 10 shows encouraging reliability indicators across different outcome measures, with work readiness scales showing excellent reliability (α = 0.82-0.91) and student satisfaction measures showing good reliability (α = 0.79-0.88). This provides confidence in the validity of findings and conclusions drawn from systematic review.

Employment rate tracking conducted in 36.2% of studies represents an objective outcome measure, but limited adoption indicates the need for more systematic longitudinal follow-up to track actual career outcomes of educational interventions.

11. Implications for Theory and Practice

Findings provide strong empirical support for theoretical frameworks that emphasize experiential learning, industry-academia partnerships, and competency-based education. Convergence of evidence from multiple methodologies and geographic contexts strengthens generalizability of conclusions.

For practice, results indicate a need for systematic institutional changes that prioritize industry collaboration, faculty development, and student engagement activities. Investment in high-impact/low-adoption interventions such as mentoring programs and engineering competitions can provide significant returns in terms of student outcomes.

CONCLUSIONS

A systematic literature review of 185 high-quality articles selected from 800 articles through the rigorous PRISMA process confirmed that student job readiness and satisfaction in engineering education are influenced by an ecosystem of interconnected factors that can be optimized through strategic interventions. Industry collaboration emerges as a cornerstone with 76.8% of studies confirming 94% effectiveness, particularly through internship programs that achieve a satisfaction score of 4.6/5.0. Practical experience was the second most critical factor (69.2% of studies, 91% effectiveness), confirming that hands-on learning is a non-negotiable element in technical education. Professional certifications provide significant added value (53% of studies, 88% effectiveness), with industry-specific certifications achieving the highest satisfaction (4.4/5.0). Student engagement activities, particularly capstone projects (67% participation rate) and engineering competitions, not only enhance competencies but also provide fulfillment and intrinsic motivation.

This research contributes to theoretical understanding by providing empirical validation of experiential learning theory in a technical education context. Integration of multiple theoretical frameworks (human capital theory, social cognitive theory, constructivist learning) in a comprehensive model provides a holistic understanding of work readiness development. Methodological contributions include the development of a robust analytical framework that can serve as a template for future systematic reviews in educational research. Stringent quality assessment criteria (only 23.1% of articles meet the standards) ensure high evidence quality.

For practitioners and policymakers, this research provides actionable recommendations including implementing mandatory internship programs with structured industry partnerships, developing competency-based curricula that are responsive to industry needs, establishing faculty development programs to enhance industry experience, creating comprehensive assessment systems that measure both technical and soft skills, and fostering student engagement through project-based learning and competitive activities. However, curriculum-industry gaps (68.1% of studies) and faculty industry experience limitations (53% of studies) represent structural challenges that require systemic solutions. Infrastructure limitations (47% of studies) require innovative public-private partnerships for resource sharing.

Although comprehensive, this study has limitations including a focus on a single database that may miss relevant studies from other sources, geographic bias toward developed countries that may limit applicability in developing contexts, and publication bias toward positive results that may overestimate intervention effectiveness. Based on identified gaps, future research should prioritize technology integration studies with AI-enhanced personalized learning paths, longitudinal impact research for career success tracking over 5-10 years, cross-cultural validation for effectiveness across different educational systems, and sustainability integration for environmental competencies in technical curricula.

The results of this systematic review provide a robust evidence base for transforming technical education toward more industry-relevant, student-centered, and outcome-focused approaches. Of the initial 800 articles, 185 high-quality articles that were successfully analyzed provided a clear roadmap for enhancing work readiness and student satisfaction through strategic integration, industry collaboration, professional certification, and academic engagement. The implementation of these findings requires coordinated efforts from educational institutions, industry partners, policymakers, and students themselves. Only through such a collaborative approach can technical education truly prepare graduates for challenges and opportunities in the rapidly evolving technological landscape.

CONFLICTS OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest related to this manuscript.

AUTHOR CONTRIBUTIONS

Rahmat Desman Koto (R.D.K.) led the systematic literature search, conducted data extraction and analysis, and prepared the initial manuscript draft. Wagino (W.) contributed to research design, provided expertise in engineering education, and supervised the overall research process. Hasan Maksum (H.M.) participated in article screening and quality assessment of included studies. Eko Indrawan (E.I.) developed the search strategy and contributed to the technological aspects of the analysis framework. M. Giatman (M.G.) provided conceptual guidance, validated the research methodology, and secured institutional support. All authors discussed the research questions, reviewed findings, contributed to result interpretation, and participated in manuscript preparation and revision.

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