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Addressing Skills Mismatch Between STEM Education and Manufacturing Industry Needs: A Literature Review

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Abstract: The issue of skills mismatch among STEM graduates in the manufacturing sector has become a central concern for global academia and policymakers. In recent years, with the rapid development and intelligent upgrading of manufacturing technology, the gap between the knowledge structure, technical ability and practical experience of graduates cultivated by the higher education system and the needs of the industry has become more and more obvious. Through a systematic literature review, this paper deeply explores the underlying factors causing this phenomenon, especially focusing on the unique challenges in the Chinese labor market. The research focuses on the gap between university curriculum design and industrial skill requirements, carefully analyzes the challenges faced by graduates in the job search process, and examines the crucial role of employability in labor market adaptability. Additionally, this paper explores the cooperation models between universities and enterprises in enhancing the professional competitiveness of graduates and evaluates the effectiveness of existing policy measures. By integrating existing research results, this review not only reveals the deficiencies of current research, but also proposes key directions for future research, aiming to provide theoretical and practical guidance for alleviating the skills mismatch problem.

Keywords: Skills Mismatch; STEM Education; Employability; Manufacturing Industry; Curriculum Development; University-Enterprise Cooperation.

1. Introduction

Currently, the global labor market is witnessing an increasingly widening mismatch between the skills of STEM graduates and industry demands, which is particularly evident in the manufacturing field. As a core hub of global manufacturing, China's higher education is facing severe challenges, with a significant disconnect between the talents cultivated by universities and the actual industry needs. STEM graduates, the higher education system, and manufacturing enterprises are the key players in this issue. Against the backdrop of the rapid transformation and upgrading of the manufacturing industry, many graduates lack the practical experience and critical skills required to align with the industry, thus placing them at a disadvantage in the job market. This trend has become more pronounced with the advancement of intelligent manufacturing, automation technologies, and industrial upgrading, especially in the high-end and intelligent manufacturing sectors.

Skills mismatch not only diminishes the employability of graduates but also restricts the long-term development of the manufacturing industry, posing a challenge to the country's industrial competitiveness. In the face of this phenomenon, the cooperation between universities and enterprises is of utmost importance. It is necessary to adjust the curriculum content to meet market demands and establish more practical learning platforms to enhance students' industry adaptability. By systematically reviewing existing research, this paper comprehensively explores the root causes and impacts of skills mismatch from multiple dimensions and analyzes possible solutions, with the aim of bridging the gap between academia and industry and promoting the healthy development of the labor market.

2. Global Trends in Skills Mismatch

Skills mismatch has become a major challenge in the global labor market. In countries such as Saudi Arabia and the United States, studies have found that graduates generally lack soft skills such as teamwork, communication and problem-solving abilities (Bindawas, 2024; McGunagle & Zizka, 2020). Similarly, in East Africa and Malaysia, graduates' deficiencies in analytical thinking and practical problem-solving abilities have affected their employment prospects (Guardia et al., 2021; Nadarajah, 2021).

2.1. Causes of Skills Mismatch

The literature generally agrees that outdated curriculum design, lack of practical training and limited interaction between universities and industries are the main causes of skills mismatch. In China, the mismatch between the regional education system and labor market needs further exacerbates this problem (Zhou, 2023; Zhang, 2023). In the United States, higher education institutions have been criticized for failing to fully provide students with career preparation skills (McGunagle & Zizka, 2020).

2.2. Importance of University-Enterprise Cooperation

Numerous studies suggest strengthening university-enterprise cooperation. University-enterprise cooperation can provide students with practical training, internships and skill development opportunities, which is essential for bridging the skills gap (Aliu & Aigbavboa, 2020; Ngang et al., 2024). In China, this cooperation is regarded as the key to solving the problems of skills level and type mismatch and improving the

employment rate of university graduates (Olo, 2021; Wang, 2024).

3. Specific Challenges in the Chinese STEM Field

In China, the skills mismatch between STEM graduates and industry demands is particularly conspicuous. Although STEM graduates usually possess a solid technical foundation, they often lack the critical soft skills required in a collaborative environment (Durazzi, 2021; Xiang et al., 2023). This issue is not only prevalent in China but also represents a common challenge globally - technical training alone is insufficient to secure desirable employment without problem-solving, adaptability, and communication skills (McGunagle & Zizka, 2020; Wang, 2022).

4. The Role of Higher Education in Enhancing Employability

Higher education institutions play a crucial role in addressing the skills mismatch problem. Many studies suggest adopting a more comprehensive curriculum design method, including work-integrated learning (WIL), soft skills training and closer industry links (Srivastava & Haghi, 2024; Jamir, 2023). In China, STEM courses are mainly theoretical and urgently need more interdisciplinary, practical and hands-on training to meet the changing needs of the manufacturing industry (Ma, 2021; Wang et al., 2022).

4.1. Success Cases

MIT & Stanford (USA): These universities combine engineering education with real problem-solving through extensive industry cooperation and experiential learning.

Tsinghua University (China): Through cooperation with leading technology enterprises, students can participate in practical projects and cultivate their practical abilities.

Huawei and Vocational Training Programs: Huawei cooperates with Chinese universities to implement industry-led training programs to better cultivate graduates suitable for the high-tech manufacturing industry.

5. Research Gaps and Future Directions

Although there has been extensive research on skills mismatch, there is still a research gap in understanding how curriculum content directly affects the employability of graduates in the Chinese manufacturing industry. Key future research directions include:

Regional Studies: Research on skills mismatch in manufacturing-intensive regions such as Nanning is still relatively limited.

Impact of Curriculum Reform: More empirical research is needed to evaluate the actual effect of curriculum reform on enhancing employability.

University-Enterprise Cooperation Models: Further exploration is needed to find the optimal cooperation model and its feasibility for promotion.

Integration of Soft Skills: Research on how to effectively integrate soft skills training into STEM education.

6. Conclusion

The issue of skills mismatch between STEM education and industry demands remains a pressing topic globally, especially in the Chinese manufacturing sector. This review has summarized the key challenges affecting employability and the importance of curriculum reform and university-industry collaboration. Solving this problem requires policy intervention, enhanced practical training, and strengthened cooperation between academia and industry. Future research should focus on regional solutions to ensure the sustainable employment of STEM graduates.

By systematically addressing these issues, policymakers and educators can better align educational outcomes with industry expectations, thereby cultivating a more competitive and adaptable workforce.

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