JOURNAL OF CULTURAL ANALYSIS AND SOCIAL CHANGE

Journal of Cultural Analysis and Social Change,
2025, 10(3), 3181-3188
ISSN: 2589-1316

Designing a Future-Oriented Electronics Teacher Education Curriculum: Integrating AI, IoT, Automation, and Entrepreneurial Competencies for the Digital Workforce

Nattapong Tomun[1*], Buncha Sansoda[2], Rapeeporn Benjapitakdilok[3]

[1] *Associate Professor Dr., Department of Technical Education Program in Electronics and Automation Systems Engineering, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi. Pathumthani, 12110, Thailand. ORCID iD: 0009-0001-7201-1134, nattapong_t@rmutt.ac.th*

[2] *Assistant Professor Dr., Vice Dean for Academic Affairs, Department of Technical Education Program in Electronics and Automation Systems Engineering, Faculty of Technica Education, Rajamangala University of Technology Thanyaburi. Pathumthani, 12110, Thailand. ORCID iD: 0009-0003-8733-0888. buncha_s@rmutt.ac.th*

[3] *Academic and Research Department, Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, Pathum Thani 12110, Thailand, ORCID iD: 00090003-5886-1508, Repeeporn_b@rmutt.ac.th*

*__Corresponding Author:__ nattapong_t@rmutt.ac.th

Citation: Tomun, N., Sansoda, B. & Benjapitakdilok, R. (2025). Designing a Future-Oriented Electronics Teacher Education Curriculum: Integrating AI, IoT, Automation, and Entrepreneurial Competencies for the Digital Workforce, *Journal of Cultural Analysis and Social Change*, 10(3), 3181-3188. https://doi.org/10.64753/jcasc.v10i3.3660

Published: December 25, 2025

ABSTRACT

The rapid digital transformation of the electronics industry has fundamentally reshaped workforce competency requirements, creating new challenges for vocational teacher education. This study investigates labor-market demand for electronics vocational teachers in Bangkok and its metropolitan area, with particular attention to the skills and qualifications required in the digital workforce era. A mixed-methods research design was employed. Quantitative data were collected from 200 respondents representing enterprises and educational institutions and were analyzed using descriptive statistics, one-way ANOVA, and multiple regression. Qualitative data were obtained through in-depth interviews with 17 key informants and analyzed using content analysis. The findings indicate that enterprises place the highest value on competencies in Artificial Intelligence (AI) and the Internet of Things (IoT). In contrast, educational institutions report a critical shortage of teachers with expertise in automation systems. Statistically significant differences were identified between industry and academic perspectives regarding both teacher demand and required competencies ($p < 0.05$). Regression analysis reveals that industrial technology trends, AI and IoT skills, and practical teaching competence are the strongest predictors of electronics teacher qualification requirements. Based on these findings, the study proposes a future-oriented curriculum framework for electronics teacher education that integrates automation, AI, IoT, embedded systems, work-integrated learning, and entrepreneurial skill development. The study provides empirical evidence supporting curriculum reform in vocational teacher education. It provides practical guidance on aligning educational provision with the evolving needs of Thailand's electronics industry within the digital economy.

Keywords: Electronics Teacher Education; Digital Workforce; AI and IoT Skills; Automation Systems; Vocational Curriculum Development

INTRODUCTION

The electronics labor market is undergoing profound transformation as a result of rapid technological advancement, particularly in artificial intelligence (AI), the Internet of Things (IoT), automation, and data-driven production systems. These developments have reshaped not only the nature of electronics occupations but also the competencies required of educators responsible for preparing future technicians. Contemporary electronics professionals are increasingly expected to integrate digital technologies, analyze data from interconnected systems, and adapt to continuous technological change. Failure to respond to these shifts risks widening the gap between workforce capabilities and industry requirements, potentially undermining productivity and economic competitiveness.

In Thailand, the electronics sector plays a strategic role in driving industrial upgrading and the national digital economy agenda. Bangkok and its surrounding metropolitan areas function as major hubs for electronics manufacturing, automation, and technological innovation, while simultaneously hosting a large concentration of vocational and higher-education institutions. Within this context, electronics vocational teachers occupy a critical position as mediators between rapidly evolving industry practices and formal education systems. Their qualifications, skills, and professional readiness directly influence the quality of human capital entering the electronics workforce. Despite the growing importance of advanced digital competencies, vocational teacher education in electronics continues to face structural challenges. Curricula in faculties of industrial education are often constrained by slow revision cycles, limited access to advanced industrial technologies, and insufficient collaboration with industry partners. As a result, many electronics teachers are inadequately prepared to teach emerging technologies such as AI-enabled control systems, IoT-based automation, and smart manufacturing platforms. This misalignment is particularly problematic in a labor market increasingly shaped by Industry 4.0 and digital transformation policies.

Existing research on workforce development in Thailand has largely focused on general labor demand, graduate employability, or technician-level skills. While these studies provide valuable insights into industry needs, they pay limited attention to the specific competencies required of electronics vocational teachers, who must combine advanced technical expertise with pedagogical and industry-based skills. Moreover, empirical evidence comparing the perspectives of enterprises and educational institutions regarding electronics teacher qualifications remains scarce. Addressing this gap is essential for informing curriculum reform in electronics teacher education. A systematic understanding of labor-market demand, competency requirements, and stakeholder expectations can support the development of future-oriented curricula that produce electronics teachers who are both pedagogically effective and technologically relevant. This study therefore examines employer and institutional needs in Bangkok and its metropolitan area, identifies key skills required of electronics vocational teachers in the digital era, and proposes evidence-based guidelines for curriculum development aligned with industry transformation.

Although prior studies have examined labor-market trends and skill requirements in the electronics and industrial sectors, several critical research gaps remain. First, most existing research emphasizes technician-level competencies or graduate employability, rather than focusing on the qualifications and professional readiness of electronics vocational teachers who play a pivotal role in workforce preparation. Second, limited empirical research has systematically compared the perspectives of enterprises and educational institutions regarding the demand for electronics teachers and the competencies required in the digital economy. As a result, curriculum development in faculties of industrial education often relies on fragmented or outdated assumptions about industry needs.

Third, while emerging technologies such as AI, IoT, automation, and embedded systems are widely recognized as central to Industry 4.0, there is insufficient empirical evidence on how these technologies should be integrated into electronics teacher education curricula in a structured and pedagogically meaningful manner. Existing curriculum models frequently emphasize theoretical knowledge or isolated technical skills, with limited attention to practical teaching competence, work-integrated learning, and the development of entrepreneurial capabilities.

Finally, in the Thai context, research that provides an evidence-based curriculum framework linking labor-market demand, digital technology trends, and vocational teacher education remains notably limited, particularly in metropolitan regions where industrial transformation is most pronounced. This study addresses these gaps by empirically examining stakeholder demand, identifying key predictors of electronics teacher qualifications, and proposing a future-oriented curriculum framework that aligns vocational teacher education with the evolving requirements of the digital electronics industry.

Research Objectives

1. **To examine labor-market demand for electronics vocational teachers** in Bangkok and its metropolitan area in relation to digital transformation within the electronics industry.
2. **To identify and compare the key competencies required of electronics vocational teachers** from the perspectives of enterprises and educational institutions, with emphasis on digital technologies, practical teaching skills, and industry relevance.
3. **To propose a future-oriented electronics teacher education curriculum framework** that aligns vocational education with evolving industry demands and supports sustainable workforce development in the digital economy.

RESEARCH METHODOLOGY

Research Design

This study employed a mixed-methods research design to comprehensively examine labor-market demand for electronics vocational teachers and the competencies required in the digital workforce era. The mixed-methods approach was selected to enable triangulation between quantitative evidence derived from large-scale surveys and qualitative insights obtained from industry and institutional stakeholders. Such integration enhances the robustness and credibility of findings related to workforce demand, skill requirements, and curriculum implications.

The research was conducted in Bangkok and its metropolitan area, a region characterized by high concentrations of electronics industries and vocational education institutions, making it particularly suitable for examining alignment between education supply and labor-market demand.

Population and Sample

Quantitative Phase

The quantitative population comprised employers from electronics-related industries and personnel from educational institutions involved in electronics vocational education. As the total population size was unknown, the required sample size was calculated using Cochran's (1953) formula with a 95% confidence level and a margin of error of ±5%. The calculated minimum sample size was 400 respondents. Data were collected using simple random sampling, ensuring representation across enterprises and educational institutions.

Qualitative Phase

The qualitative sample consisted of 17 key informants, selected through purposive sampling. Inclusion criteria were:

1. At least three years of managerial or supervisory experience in electronics-related enterprises or government agencies;
2. Direct involvement in workforce development, recruitment, or policy implementation; and
3. Willingness to participate in in-depth interviews.

The sample size aligns with recommendations by Hennink and Kaiser (2021), who suggest that data saturation in relatively homogeneous groups typically occurs between 9 and 17 interviews.

Research Instruments

Two primary instruments were used:

1. ***Structured Questionnaire***

   The questionnaire was developed based on an extensive literature review and covered five dimensions:
   - labor demand in the electronics sector,
   - required knowledge and competencies of electronics technicians,
   - personal characteristics valued by employers,
   - skills required in the digital workforce, and
   - qualifications required of electronics vocational teachers.

Responses were measured using a five-point Likert scale ranging from 1 (lowest) to 5 (highest). Content validity was assessed by experts using the Content Validity Index (CVI), and reliability analysis yielded acceptable Cronbach's alpha coefficients (> 0.70).

2. ***Semi-Structured Interview Guide***

The interview guide focused on emerging technology trends, expectations toward electronics teachers, curriculum limitations, and recommendations for teacher education reform. Questions were open-ended to allow participants to elaborate on industry and educational perspectives.

Data Analysis

Quantitative data were analyzed using descriptive statistics (frequency, percentage, mean, standard deviation) and inferential statistics (one-way ANOVA, independent-samples t-tests, and multiple regression analysis) to examine differences between stakeholder groups and to identify predictors of teacher qualification requirements. Qualitative data were analyzed using content analysis, involving coding, categorization, and thematic interpretation. Trustworthiness was enhanced through methodological triangulation and cross-verification between qualitative and quantitative findings.

Ethical Considerations

All participants provided informed consent before data collection. Confidentiality and anonymity were strictly maintained, and data handling complied with Thailand's Personal Data Protection Act (PDPA) B.E. 2562.

RESULTS

Labor-Market Demand for Electronics Technicians

Table 1 presents the level of labor-market demand for electronics technicians.

Table 1. Labor Demand in the Electronics Technician Profession

Factors	Mean	S.D.	Interpretation
Current employment rate in the electronics job market	4.32	0.76	Highest
Future labor demand according to technological trends	4.15	0.82	High
Importance of basic electricity and electronics knowledge	4.10	0.79	High
Importance of digital technologies (AI, IoT, automation)	4.05	0.85	High
Importance of specialized knowledge (microcontrollers, smart systems)	4.25	0.70	Highest
Overall	**4.17**	**0.77**	**High**

Table 1 presents the level of labor-market demand for electronics technicians amid ongoing technological transformation. Overall, the findings indicate a consistently high level of demand across all examined factors (Overall Mean = 4.17, SD = 0.77), reflecting strong and sustained requirements for skilled electronics personnel in the contemporary labor market.

Among the assessed factors, the current employment rate in the electronics job market received the highest rating (Mean = 4.32, SD = 0.76), indicating that the sector is actively absorbing electronics technicians at present. This result suggests that electronics-related occupations remain critical to industrial operations and continue to experience stable employment opportunities, particularly in regions characterized by industrial concentration and technological development.

Similarly, the importance of specialized knowledge, such as microcontroller systems and innovative electronic technologies, was rated highest (Mean = 4.25, SD = 0.70). This finding underscores a structural shift in labor demand toward advanced, application-oriented competencies that support intelligent systems, automation, and digitally integrated production environments. The relatively low standard deviation further suggests a strong consensus among respondents regarding the necessity of such specialized expertise.

The future labor demand aligned with technological trends was also evaluated at a high level (Mean = 4.15, SD = 0.82), indicating expectations of continued or increasing demand for electronics technicians as digital technologies, automation, and intelligent systems become more deeply embedded in industrial processes. This result reflects employer anticipation of long-term workforce needs driven by Industry 4.0 and digital transformation initiatives.

In terms of foundational competencies, the importance of basic electricity and electronics knowledge was rated highly (Mean = 4.10, SD = 0.79), reaffirming that fundamental technical knowledge remains the core professional foundation for electronics technicians. While advanced digital skills are increasingly emphasized, these findings indicate that foundational knowledge remains relevant and serves as a prerequisite for the practical application of higher-level technologies.

Finally, the importance of digital technologies, including AI, IoT, and automation systems, was rated high (Mean = 4.05, SD = 0.85). Although slightly lower than specialized knowledge ratings, this result highlights the growing expectation that electronics technicians possess sufficient digital literacy and system-level understanding to operate, integrate, and adapt to emerging technologies in smart manufacturing and automated environments.

Taken together, the results demonstrate that a dual emphasis on strong foundational knowledge and advanced, specialized digital competencies characterizes labor-market demand for electronics technicians. This pattern suggests that workforce competitiveness in the electronics sector increasingly depends on integrating basic technical proficiency with application-specific expertise in innovative and automated systems, with important implications for curriculum design and vocational teacher preparation in the digital era.

Knowledge and Competency Requirements of Electronics Technicians

Table 2. Knowledge and Competency Requirements

Dimension	Mean	S.D.	Interpretation
Knowledge	4.15	0.75	High
Competency	4.47	0.77	Highest

Both knowledge and competency dimensions were rated at high to highest levels. In particular, competency-based attributes were emphasized more strongly than theoretical knowledge, reflecting industry preference for applied and performance-oriented skills.

Further analysis revealed that communication and collaboration skills (Mean = 4.64) and problem-solving skills (Mean = 4.55) were the most highly valued competencies, indicating that technical expertise alone is insufficient without strong interpersonal and analytical abilities.

Employer-Preferred Personal Characteristics

Table 3. Personal Characteristics Required by Employers

Factors	Mean	S.D.	Interpretation
Honesty and ethics	4.30	0.68	Highest
Commitment to self-development	4.22	0.72	High
Creativity and open-mindedness	4.18	0.74	High
Flexibility and adaptability	4.10	0.76	High
Overall	**4.20**	**0.73**	**High**

Employers placed the greatest emphasis on honesty and ethical behavior, followed by continuous self-development. These findings suggest that ethical responsibility and lifelong learning are considered foundational attributes for sustainable performance in the electronics industry.

Skills and Characteristics Required in the Digital Workforce

Table 4. Digital Workforce Skills and Readiness

Factors	Mean	S.D.	Interpretation
Technical and digital technology skills	4.50	0.65	Highest
Communication and collaboration skills	4.42	0.70	Highest
Ability to learn new technologies quickly	4.20	0.85	High
Data literacy and IT utilization	4.30	0.82	Highest
Workforce readiness for digital labor market	3.21	0.88	Moderate

The results indicate that digital technical skills and collaborative competencies are essential for electronics professionals in the digital era. However, the moderate rating of workforce readiness (Mean = 3.21) suggests a persistent skills gap that must be addressed through education and training reform.

Comparison of Stakeholder Perspectives (ANOVA Results)

Table 5. One-Way ANOVA Results

Variables	F-value	p-value	Interpretation
Demand for electronics teachers	5.21	0.002	Significant difference
Skills required for electronics teachers	4.75	0.008	Significant difference

Table 5 reports the results of the one-way analysis of variance (ANOVA) conducted to examine differences in perceptions between enterprises and educational institutions regarding the demand for electronics vocational teachers and the skills required for effective performance in the digital era.

The analysis reveals a statistically significant difference in perceptions of demand for electronics teachers between the two stakeholder groups ($F = 5.21$, $p = 0.002$). This finding indicates that enterprises and educational institutions do not share a uniform assessment of teacher demand. Enterprises operating in rapidly evolving technological environments tend to evaluate demand in relation to immediate workforce needs, technological adoption, and productivity requirements. In contrast, educational institutions often assess demand through the lens of institutional capacity, teaching workloads, and long-term academic planning. The divergence suggests that teacher demand is interpreted differently depending on whether the primary focus is on industrial performance or educational provision.

Similarly, a statistically significant difference was observed in perceptions of the skills required for electronics teachers ($F = 4.75$, $p = 0.008$). This result confirms that the two groups prioritize distinct competency profiles. Educational institutions place greater emphasis on pedagogical competence, including instructional design, classroom management, and student development, reflecting their responsibility for curriculum delivery and learning outcomes. Conversely, enterprises emphasize technical expertise and innovation-oriented skills, particularly competencies related to advanced digital technologies, automation, and system integration, which are essential for responding to industry transformation and maintaining competitiveness.

The presence of significant differences between the two variables underscores a structural misalignment between educational and industry expectations. While pedagogical skills remain essential for effective teaching, the strong industry preference for technical and innovation-related competencies suggests that current teacher preparation models may inadequately reflect labor-market realities. Without deliberate mechanisms to integrate industrial perspectives into curriculum design and teacher development, this divergence may contribute to skills mismatches and limit the effectiveness of vocational education in preparing industry-ready graduates.

Overall, the ANOVA results provide empirical support for strengthening collaboration between enterprises and educational institutions to define qualification standards for electronics vocational teachers. Aligning pedagogical competence with up-to-date technical expertise is critical for bridging stakeholder expectations and ensuring that electronics teacher education responds effectively to the demands of the digital workforce.

Factors Influencing Electronics Teacher Qualifications (Regression Analysis)

Table 6. Multiple Regression Analysis

Independent Variables	β	t-value	p-value	Interpretation
Industry technology trends	0.45	6.12	0.001	Significant
AI and IoT skills	0.42	5.95	0.002	Significant
Practical teaching skills	0.38	5.47	0.003	Significant

Table 6 presents the results of the multiple regression analysis conducted to identify the key factors influencing the qualification requirements of electronics vocational teachers in the context of digital transformation. The study reveals that all three independent variables, industry technology trends, AI and IoT skills, and practical teaching skills, exert statistically significant influences on electronics teacher qualifications ($p < 0.05$), indicating that a combination of technological, professional, and pedagogical factors shapes teacher competency requirements.

Among the predictors, industry technology trends have the most substantial effect on electronics teachers' qualifications ($\beta = 0.45$, $t = 6.12$, $p = 0.001$). This finding suggests that the pace and direction of technological change within the electronics industry play a decisive role in defining the competencies expected of vocational teachers. As production systems increasingly incorporate automation, smart devices, and data-driven processes, teachers are expected to possess up-to-date industry knowledge to translate evolving technological practices into relevant instructional content. The magnitude of this effect underscores the need for continuous curriculum updating and ongoing professional development to ensure that teachers' competencies remain aligned with industrial innovation.

The second strongest predictor is AI and IoT skills ($\beta = 0.42$, $t = 5.95$, $p = 0.002$), underscoring the centrality of advanced digital competencies in electronics teacher qualification frameworks. This result reflects growing expectations that vocational teachers not only understand emerging technologies conceptually but also can apply AI- and IoT-based systems in instructional and practical contexts. The strong effect of this variable indicates that proficiency in AI and IoT has transitioned from a supplementary skill to a core professional requirement for electronics teachers in the digital workforce era.

Practical teaching skills also have a significant positive influence on electronics teachers' qualifications ($\beta = 0.38$, $t = 5.47$, $p = 0.003$). This finding confirms that, despite the increasing emphasis on advanced technology, pedagogical competence remains an essential component of teacher qualification. Effective practical teaching skills, such as designing hands-on learning activities, facilitating problem-based learning, and integrating real-world industrial scenarios, enable teachers to translate complex technological knowledge into meaningful learning experiences for students.

Taken together, the regression results demonstrate that electronics teacher qualifications are shaped by an integrated competency profile, in which responsiveness to industry technology trends, mastery of advanced digital skills, and strong practical teaching capabilities are mutually reinforcing. The findings suggest that vocational teacher education programs should move beyond traditional content-based training models toward competency-oriented frameworks that systematically combine technological expertise with pedagogical effectiveness. Such integration is critical to ensuring that electronics teachers are able to prepare students for rapidly changing industrial environments and to sustain workforce relevance in the digital economy.

DISCUSSION

This study provides empirical evidence on the evolving competency requirements for electronics vocational teachers amid rapid digital transformation. The findings confirm that labor-market demand is no longer driven solely by foundational electronics knowledge but increasingly shaped by advanced digital technologies, particularly Artificial Intelligence (AI), the Internet of Things (IoT), and automation systems. This shift reflects broader structural changes associated with Industry 4.0 and supports labor market theories emphasizing skill-biased technological change (Autor et al., 2003; Manyika et al., 2017).

First, the strong emphasis enterprises place on AI, IoT, and automation skills underscores the growing importance of technology-integrated human capital, consistent with Human Capital Theory (Becker, 1964; Schultz, 1971). Employers prioritize competencies that enable teachers to transfer up-to-date industrial knowledge to students, ensuring that graduates can function effectively in digitally integrated production environments. This finding aligns with reports from the OECD (2019) and the World Economic Forum (2020), which identify digital and analytical skills as core capabilities in future labor markets.

Second, the statistically significant differences between enterprise and educational institution perspectives reinforce the relevance of Dual Labor Market Theory (Doeringer & Piore, 1971; Reich et al., 1973). Educational institutions tend to emphasize pedagogical competence and student development, whereas enterprises prioritize technical expertise and innovation capacity. This divergence suggests a structural misalignment between education supply and industry demand, particularly in vocational teacher preparation. Without systematic collaboration mechanisms, electronics teacher education risks reinforcing skill segmentation rather than facilitating labor mobility across primary and secondary labor markets.

Third, regression analysis demonstrates that industry technology trends, AI/IoT competencies, and practical teaching skills are the strongest predictors of electronics teacher qualification requirements. These results support Competency-Based Theory (Boyatzis, 1982; McClelland, 1973), which emphasizes integrated performance outcomes rather than isolated knowledge acquisition. Importantly, practical teaching competence remains a significant predictor, indicating that advanced technical skills alone are insufficient unless teachers can translate them into practical learning experiences through project-based and work-integrated pedagogies.

Qualitative findings further extend these insights by identifying three essential competency domains for electronics teachers: technical-industry skills, pedagogical-digital skills, and industry-based experiential skills. This triangulated evidence reinforces the applicability of the TPACK framework (Mishra & Koehler, 2006), which argues that effective teaching in digital contexts requires the integration of technological, pedagogical, and content knowledge.

Overall, the findings suggest that electronics teacher education must transition from a discipline-centered model toward a future-oriented, industry-aligned curriculum that integrates advanced technologies, experiential learning, and the development of entrepreneurial capabilities. Such transformation is critical for sustaining workforce relevance and national competitiveness in Thailand's digital economy.

CONCLUSION

This study examined labor-market demand and competency requirements for electronics vocational teachers in Bangkok and its metropolitan area amid rapid digital transformation. Using a mixed-methods approach, the study identified clear shifts in employer expectations toward advanced digital technologies, particularly AI, IoT, and automation, while also highlighting persistent gaps in teacher readiness and curriculum alignment.

The findings demonstrate that enterprises and educational institutions hold significantly different expectations regarding electronics teacher qualifications. While educational institutions prioritize pedagogical competence, enterprises emphasize advanced technical and innovation-related skills. Multiple regression analysis confirms that industry technology trends, AI/IoT competencies, and practical teaching skills are the most influential factors shaping teacher qualification requirements.

Based on these results, the study proposes a future-oriented framework for electronics teacher education that integrates modern digital technologies, work-integrated learning, and entrepreneurial competencies. This framework provides a strategic pathway to align vocational teacher education with evolving labor-market needs and to support sustainable workforce development in the digital era.

IMPLICATIONS

1. Implications for Policy

National education and labor policies should prioritize systematic alignment between vocational teacher education and industry transformation. Policy instruments should support curriculum flexibility, investment in digital infrastructure, and the implementation of certified upskilling programs in AI, IoT, and automation for vocational teachers.

2. Implications for Educational Institutions

The faculties of industrial and vocational education should redesign electronics teacher education curricula to emphasize:

- AI, IoT, automation, and embedded systems
- project-based and problem-based learning
- work-integrated learning through industry partnerships
- entrepreneurial and innovation-oriented competencies

Regular curriculum revision mechanisms and co-design with industry stakeholders are essential to ensure relevance.

3. Implications for Industry

Enterprises should actively engage in vocational teacher development through internships, joint curriculum design, guest lecturing, and collaborative applied research projects. Industry participation is critical for ensuring that teaching content reflects current and emerging technological practices.

4. Implications for Future Research

Future studies should expand the geographic scope beyond metropolitan regions, employ longitudinal designs to assess the outcomes of curriculum reform, and conduct comparative analyses across ASEAN countries to strengthen regional workforce development strategies.

REFERENCES

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics, 118*(4), 1279–1333. https://doi.org/10.1162/003355303322552801

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Boyatzis, R. E. (1982). *The competent manager: A model for effective performance*. Wiley.

Doeringer, P. B., & Piore, M. J. (1971). *Internal labor markets and manpower analysis*. M.E. Sharpe.

Hennink, M., & Kaiser, B. N. (2021). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine, 292*, 114523. https://doi.org/10.1016/j.socscimed.2021.114523

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). *A future that works: AI, automation, employment, and productivity*. McKinsey Global Institute.

McClelland, D. C. (1973). Testing for competence rather than for intelligence. *American Psychologist, 28*(1), 1–14. https://doi.org/10.1037/h0034092

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.

OECD. (2019). *Education at a glance 2019: OECD indicators*. OECD Publishing. https://doi.org/10.1787/f8d7880d-en

Reich, M., Gordon, D. M., & Edwards, R. C. (1973). A theory of labor market segmentation. *The American Economic Review, 63*(2), 359–365.

Schultz, T. W. (1971). *Investment in human capital: The role of education and of research*. Free Press.

World Economic Forum. (2020). *The future of jobs report 2020*. World Economic Forum.

