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DEVELOPING A FUTURE-ORIENTED ELECTRONICS CURRICULUM: INTEGRATING AI, IOT, AUTOMATION, AND ENTREPRENEURIAL SKILLS FOR THE DIGITAL WORKFORCE

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Abstract

This study examines demand for electronics vocational teachers in Bangkok and surrounding metropolitan areas and identifies qualifications required in the digital workforce era. A mixed-methods design was employed. Quantitative data were collected via structured questionnaires from 200 respondents across enterprises and educational institutions; analyses included descriptive statistics (mean, SD), one-way ANOVA, and multiple regression. Qualitative data were gathered through in-depth interviews with 17 purposively selected informants and analyzed using content analysis. Results show enterprises most value skills in Artificial Intelligence (AI) and the Internet of Things (IoT) (Mean = 4.30, SD = 0.82), while institutions report shortages in automation-system expertise (Mean = 4.10, SD = 0.78). Perspectives significantly differ between enterprises and institutions (ANOVA, $p < 0.05$). Regression indicates industrial technology trends ($\beta = 0.45$, $p = 0.001$), AI/IoT skills ($\beta = 0.42$, $p = 0.002$), and practical teaching ability ($\beta = 0.38$, $p = 0.003$) as the strongest predictors of required qualifications. The study recommends reforming electronics curricula to integrate automation, AI, IoT, and embedded systems; emphasizing project-based and work-integrated learning; and strengthening entrepreneurial competencies. Certified teacher upskilling and sustained industry collaboration are essential to ensure relevance. The research offers an actionable framework to align vocational education with industry needs and develop future-ready electronics teachers in Thailand.

Keywords: Electronics Vocational Teachers, Workforce Demand, Digital Skills, AI and IoT, Curriculum Reform

Introduction

The labor market for electronics technicians is undergoing significant transformation in response to rapid technological advancement. As modern technologies evolve, technicians are increasingly expected to possess advanced skills related to digital tools and data interpretation from interconnected systems (Autor, 2003; Manyika et al., 2017). A failure to adapt to these shifts may result in a mismatch between workforce capabilities and industry needs, potentially leading to higher unemployment and reduced productivity (Council of Economic Advisers,
2016).

In Thailand, the electronics sector is a key driver of the digital economy. However, a persistent gap exists between graduate qualifications and labor market demands. This is particularly

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critical for electronics vocational educators, who play a pivotal role in preparing skilled technicians. Faculties of industrial education are tasked with training future instructors but often face difficulties in updating curricula to reflect technological trends. Research by Niran Jullasub et al. (2018) highlights regional labor market needs in fields like electrical engineering, emphasizing the necessity for closer alignment between education and employment sectors.

Despite growing attention to workforce development, limited research has focused on the direct connection between employer expectations and the competencies required of electronics teachers—particularly in Bangkok and its surrounding areas, which are hubs for both industry and education. Most studies emphasize general labor trends without addressing the specific skills needed in teaching roles affected by emerging technologies. Therefore, comprehensive research is needed to guide curriculum design and ensure a responsive supply of qualified electronics educators aligned with market demands.

Research Objectives

1. To analyze the current needs of employers and educational institutions in Bangkok and its metropolitan area regarding electronics teachers.
2. To identify the essential skills and knowledge required for electronics teachers to align with labor market demands and technological advancements.
3. To propose guidelines for curriculum development in faculties of industrial education aimed at producing electronics teachers who meet the needs of both industry and educational sectors.

Labor Market Theories: A Comparative Perspective

Labor market theories provide essential frameworks for understanding how employment, wages, and workforce skills interact in dynamic economies. Four key perspectives—Labor Supply and Demand Theory, Human Capital Theory, Dual Labor Market Theory, and Competency-Based Theory—offer complementary insights into labor market behavior and workforce development.

Labor Supply and Demand Theory emphasizes the equilibrium between employers' demand for labor and workers' willingness to supply it at varying wage levels. Wages serve as the key determinant of this balance: higher wages encourage labor participation but may reduce employer demand due to increased costs (Borjas, 2020). Labor demand is shaped by production needs, technological innovation, and economic growth, while labor supply reflects education, skills, and workforce motivation (Blundell et al., 2016). Equilibrium shifts occur through technological change, labor policies, and macroeconomic fluctuations (Katz & Krueger, 2019), making this theory vital for workforce planning in technology-intensive industries.

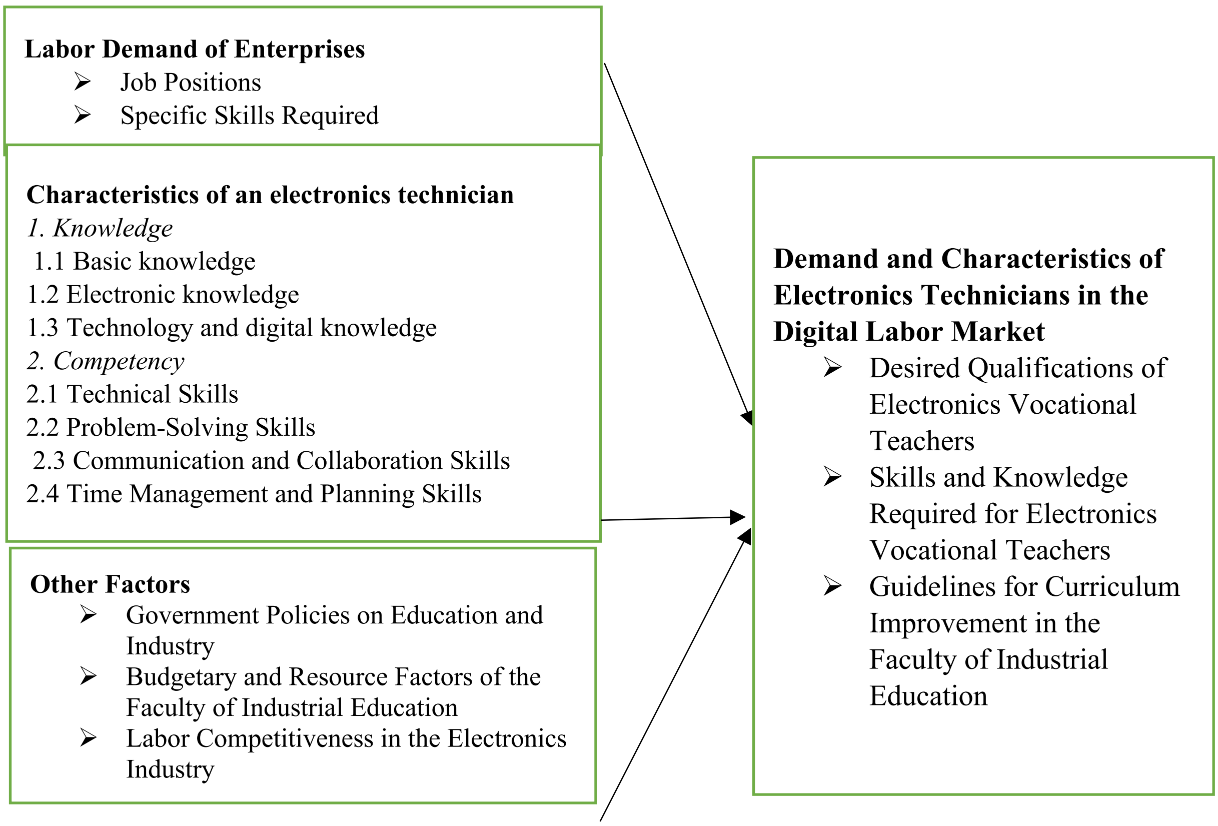
Human Capital Theory expands this discussion by positioning education, skills, health, and personal attributes as investments that increase individual productivity and national competitiveness. Introduced by Becker (1964) and Schultz (1971), the theory underscores that knowledge, competencies, and health contribute to economic value creation. Skills development and lifelong learning enhance adaptability, while health and ethical traits such as responsibility and perseverance sustain productivity (Bowles & Gintis, 2011). Human capital is thus a strategic asset, reinforcing the need for continual investment in training and capacity building, especially in economies transitioning toward digital and knowledge-driven growth.

Dual Labor Market Theory shifts focus to structural segmentation in employment. Reich et al. (1973) and Gordon et al. (1982) identified a "primary labor market" of secure, well-paid jobs with advancement opportunities and a "secondary labor market" of low-paid, unstable employment with limited mobility. This framework highlights that disparities are not solely based on individual merit but also institutional and organizational practices. For developing economies such as Thailand, this segmentation presents challenges in workforce equality, as many workers remain trapped in secondary labor markets without access to structured training or career progression. Addressing this divide requires targeted interventions to upgrade skills and provide equitable opportunities across all sectors.

Competency-Based Theory provides a more applied perspective, focusing on the integration of knowledge, skills, attributes, and behaviors that enable effective job performance (Boyatzis, 1982; McClelland, 1973). Competency frameworks emphasize not only technical expertise but also personal qualities such as adaptability, collaboration, and ethical conduct. Organizations increasingly adopt competency-based approaches to ensure workforce readiness and alignment with evolving industry needs. This approach also supports the design of education and training programs that directly prepare individuals for specific roles, strengthening organizational competitiveness in fast-changing markets.

Together, these theories illustrate both the structural and individual dimensions of labor markets. Labor Supply and Demand Theory explains market mechanisms, Human Capital Theory underscores the value of education and skills, Dual Labor Market Theory reveals systemic inequalities, and Competency-Based Theory links workforce capabilities with organizational needs. Integrating these perspectives provides policymakers, educators, and employers with a comprehensive framework for aligning labor market development with the demands of the digital economy, ensuring both economic growth and workforce resilience.

Conceptual Framework



Research Methodology

This study employs a mixed-methods design to examine labor-market demand for electronics technicians and employer-required attributes in Bangkok and its metropolitan area. The qualitative phase targets employers, business owners hiring electronics technicians, and relevant government officials. Guided by Hennink and Kaiser (2021), who note data saturation commonly occurs with 9–17 interviews in relatively homogeneous groups, 17 key informants were selected via purposive sampling. Inclusion criteria were: (1) at least three years in managerial roles within electronics-related enterprises or government agencies; (2) demonstrable experience and sector knowledge in the study region; and (3) willingness to participate. All participants provided informed consent, and procedures conformed to Thailand's Personal Data Protection Act (PDPA) B.E. 2562.

The quantitative phase focuses on employers in electronics-related industries. Because the population size is unknown, Cochran's (1953) formula was applied at a 95% confidence level with a ±5% margin of error, yielding a required sample of 400 respondents, selected through simple random sampling.

Data collection instruments comprised semi-structured interview guides (qualitative) and a structured questionnaire (quantitative), both derived from a focused literature review and aligned to the study framework. Quantitative data were analyzed using descriptive statistics (frequency, percentage, mean, standard deviation) and inferential tests (one-way ANOVA and multiple regression) to assess group differences and predictors of employer requirements. Qualitative data were subjected to content analysis, with credibility reinforced through triangulation across sources and methods. Ethical safeguards included anonymity, informed consent, and secure data handling consistent with PDPA provisions. This design provides robust, convergent evidence to inform workforce and curriculum alignment in the digital era.

Results

Analysis of Labor Demand in the Electronics Technician Profession

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
Basic knowledge of electricity and electronics is important for electronics technicians.	4.10	0.79	High
Knowledge of technology and digital technologies such as IoT, AI and automation systems are important for electronics technicians.	4.05	0.85	High
Specialized knowledge such as microcontroller systems or smart electronics systems are important	4.25	0.70	High
Overall	**4.17**	**0.77**	**Highest**

Table 1 indicates consistently strong demand for electronics technicians, with all surveyed factors rated at high to highest levels—signaling an industry-wide need for skilled, up-to-date labor. The current employment rate scored the highest (Mean = 4.32, SD = 0.76; highest), confirming that the present labor market actively seeks electronics technicians. Future demand aligned with technological trends was also robust (Mean = 4.15, SD = 0.82; high), suggesting continuing needs amid rapid technological change. Foundational capabilities remain critical: basic electricity and electronics knowledge received a high rating (Mean = 4.10, SD = 0.79), underscoring its role as the profession's bedrock. Digital-era competencies further elevate employability: technology and digital knowledge—including IoT, AI, and automation—was rated high (Mean = 4.05, SD = 0.85), reflecting intensified demand as operations digitize. Notably, specialized expertise (e.g., microcontrollers and smart electronic systems) achieved a highest rating (Mean = 4.25, SD = 0.70), highlighting the premium placed on advanced, application-specific skills. Overall, the total mean across factors was 4.17 (SD = 0.77; high), indicating sustained, elevated demand for talent combining strong fundamentals with digital and specialized competencies—key drivers of worker competitiveness in today's electronics labor market.

Analysis of Knowledge, Competence and Skills Required of Electronic Technicians

Table 2: Knowledge, competence and skills required of electronic technicians

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

Table 2 shows that required knowledge and competencies were rated from high to highest across all factors, underscoring the centrality of strong fundamentals and applied skills in the electronics sector. For knowledge, foundational understanding—basic professional principles and science/technology—was rated highest (Mean = 4.25, SD = 0.70), confirming its role as the career's bedrock. Specialized knowledge (e.g., industrial electronic systems) was also evaluated at highest (Mean = 4.08, SD = 0.75), signaling the need for domain-specific expertise. Technology and digital knowledge (software use, automation systems) reached highest as well (Mean = 4.12, SD = 0.80), reflecting the premium on digital fluency for efficiency and innovation. Overall knowledge achieved a highest interpretation (Mean = 4.15, SD = 0.75), indicating expectations for a comprehensive, current knowledge base.

For competency, technical skills (installation and maintenance) were rated highest (Mean = 4.35, SD = 0.78), highlighting hands-on proficiency. Problem-solving (fault analysis and solutions) scored highest (Mean = 4.55, SD = 0.85), emphasizing diagnostic capability. Communication and collaboration earned the top mean (Mean = 4.64, SD = 0.71; highest), affirming the importance of teamwork. Time management and planning were likewise highest (Mean = 4.33, SD = 0.73). Overall performance competencies were highest (Mean = 4.47, SD = 0.77), confirming that integrated, practice-oriented skills remain decisive for workplace effectiveness.

From the data analysis, it was found that both knowledge and competence were evaluated at a high level, especially communication and collaboration skills (4.64) and problem-solving skills (4.55), which are the most important factors that the industry sector places the most importance on. In terms of knowledge, basic knowledge (4.25) and specialized knowledge (4.08) are still highly necessary, but the trend of the electronics industry is giving more importance to knowledge of digital technology (4.12). In summary, the development of skills and abilities of electronic technicians should focus on technical skills, problem-solving abilities, and collaboration skills, along with enhancing knowledge of technology and digital technology to meet the needs of the labor market in the digital age.

Analysis of Characteristics Required by Entrepreneurs

Table 3: Characteristics required entrepreneurs

Factors	**Mean**	**S.D**	**Interpretation**
Honesty and Ethics: Work ethics and morals, such as responsibility, honesty, and confidentiality of the organization.	4.30	0.68	Highest
Commitment to self-development: The willingness to learn and develop new skills to keep up with change.	4.22	0.72	High
Creativity and open-mindedness: Having new ideas and being open to change.	4.18	0.74	High
Flexibility and adaptability: The ability to adapt to new situations and challenges.	4.10	0.76	High
Overall	**4.20**	**0.73**	**High**

From Table 3, it was found that the characteristics that entrepreneurs prioritized were evaluated at the "very" to "most" level in all factors, reflecting that entrepreneurs prioritized ethical characteristics, self-development, creativity, and adaptability of workers in the electronics industry. In terms of honesty and ethics, the mean score was 4.30, standard deviation = 0.68. The interpretation is that it was evaluated at the "most" level, reflecting that entrepreneurs prioritized honesty, responsibility, and keeping the organization's secrets as the first basic factors that help build credibility and stability of the business. In terms of commitment to self-development, the mean score was 4.22, standard deviation = 0.72. The interpretation is that it was evaluated at the "very" level, reflecting the need for workers to be proactive in learning and developing new skills in order to adapt to changes in technology and industry. In terms of creativity and open-mindedness, the mean score was 4.18, standard deviation = 0.74. The interpretation is that it was evaluated at the "very" level, indicating that entrepreneurs prioritized workers who were innovative, could invent new ways of working, and were ready to accept opinions and changes in the organization. In terms of flexibility and adaptability, the mean score was = 4.10, standard deviation = 0.76. The interpretation is that it is evaluated at the "high" level, indicating that workers who can adapt to new situations and face challenges effectively are in demand in the electronics industry.

The total mean of all factors = 4.20, standard deviation = 0.73. The interpretation is that it is evaluated at the "high" level, indicating that entrepreneurs need workers with ethical characteristics, self-development, creativity, and adaptability to work effectively and be ready to cope with changes in the industry. From the analysis, relevant agencies should promote the development of these characteristics in workers through training on ethical behavior in organizations, promote lifelong learning, and encourage workers to be creative in solving problems, including supporting the development of training programs that help workers better adapt to new technologies.

Analysis of the Needs and Characteristics of Electronic technicians in The Digital Age

Table 4: Demands and characteristics of electronic technicians in the digital age

Factors	Mean	S.D	Interpretation
The most important skills and abilities for the digital workforce			
Technical and digital technology skills	4.50	0.65	Highest
Communication and collaboration skills	4.42	0.70	Highest
Technical and digital technology skills	4.38	0.72	Highest
Communication and collaboration skills	4.30	0.75	Highest
Qualities that digital workers should have in order to effectively adapt to technological changes			
Ability to learn new technologies quickly	4.20	0.85	High
Ability to work flexibly and adapt	4.10	0.78	High
Creativity and innovation	4.15	0.80	High
Skills in understanding data and using information technology	4.30	0.82	Highest
What level of digital technology expertise should digital workers have?			
Basic (can use basic software)	4.28	0.71	Highest
Moderate (can use and adapt to new technologies)	4.33	0.74	Highest
High (can develop programs or automation systems)	4.36	0.79	Highest
Expert (can design and develop new technologies)	4.16	0.81	High
How well do you think the current readiness of the	3.21	0.88	Partial, need

workforce matches the needs of the digital labor market?			more development
Which factors most affect the development of the workforce to meet the needs of the digital labor market?			
Education system and curriculum	4.37	0.72	Highest
Training and skills development by the company	4.88	0.75	Highest
Government support and labor policies	4.29	0.69	Highest
The ability of workers to learn and develop themselves	4.41	0.73	Highest

Survey results underscore that technical skills and digital technology are the top priority for electronics workers in the digital era (Mean = 4.50, SD = 0.65; highest), confirming the need for strong technological expertise to keep pace with industry change. Communication and collaboration rank next (Mean = 4.42, SD = 0.70; highest), indicating that teamwork and cross-functional coordination are essential in digitally integrated workplaces.

Adaptability attributes are also critical. The ability to learn new technologies quickly (Mean = 4.20, SD = 0.85; highest) highlights the value of lifelong learning. Data literacy and IT use (Mean = 4.30, SD = 0.82; highest) further signal that workers must analyze and apply data effectively to improve quality, productivity, and decision-making. Regarding depth of digital expertise, expectations span basic to high: the high level—ability to develop programs or automation systems—earned a Mean = 4.36 (SD = 0.79; highest), while basic proficiency—use of standard software—scored Mean = 4.28 (SD = 0.71; highest). This suggests a baseline of digital fluency with pathways for advancement.

Despite these expectations, the current workforce readiness is only moderate (Mean = 3.21, SD = 0.88), interpreted as “has some skills but needs further development.” To close this gap, workplace training and skill development emerged as the most influential lever (Mean = 4.88, SD = 0.75; highest), followed by the education system and curriculum (Mean = 4.37, SD = 0.72; highest), which must realign to fast-evolving technologies. Overall, the findings call for expanded, hands-on upskilling in firms and agile curriculum reform to build a digitally competent, industry-ready electronics workforce.

One-way analysis of variance (One-way ANOVA) to compare the opinions of the sample groups

Variables	F-Value	p-value (Sig.)	Interpretation
Demand for Electronics Teachers between Businesses and Educational Institutions	5.21	0.002	There is a significant difference.
Skills Required for Electronics Teachers	4.75	0.008	There is a significant difference.

This table shows the results of a one-way ANOVA to examine whether there is a difference between the opinions of business and educational institutions on the key issues. The p values < 0.05 for both variables indicate that there is a significant difference between the opinions of business and educational institutions on teacher demand and required skills. This result supports Hypothesis 2 that the needs of business and educational institutions are different, with educational institutions prioritizing teaching skills and businesses prioritizing technical skills.

Multiple Regression Analysis to Analyze Factors Affecting The Qualifications of Electronic Teachers

Independent Variables	(Beta)	t-value	p-value (Sig.)	Interpretation
Technology Trends in	0.45	6.12	0.001	Significantly influences

Independent Variables	(Beta)	t-value	p-value (Sig.)	Interpretation
Electronics Industry				teacher qualifications
Practical Teaching Skills	0.38	5.47	0.003	Significantly influences teacher qualifications
AI and IoT Skills	0.42	5.95	0.002	Significantly influences teacher qualifications

The analysis results showed that the factors affecting the qualifications of electronics teachers were industry technology trends, practical teaching skills, and AI and IoT skills, which were statistically significant ($p < 0.05$). This table shows the results of the analysis of the factors affecting the qualifications of electronics teachers. The industry technology trend factor (Beta = 0.45) had the highest influence on the qualifications of electronics teachers, which supported Hypothesis 3 that developing a curriculum that is in line with technology will enhance teachers' potential. AI and IoT skills (Beta = 0.42) and practical teaching skills (Beta = 0.38) also had significant influences, indicating that the curriculum should increase technology training and practical teaching.

Skills and knowledge required for electronics teachers to keep up with the changing labor market and technology

The results of the interview data analysis found that the skills required for electronics teachers can be divided into 3 main areas: Technical skills include expertise in new devices and technologies such as microcontrollers, IoT, AI, and automation systems, the ability to design and analyze electronic circuits, and an understanding of industry standards such as IPC (for electronics) and IEC (international electrical standards). Pedagogical skills include the development of course content that is in line with industry standards, the use of digital teaching media and online learning technologies, the design of Active Learning and Problem-Based Learning (PBL) learning. Industry-Based Skills include real work experience in the electronics industry, the ability to transfer knowledge in quality management such as Lean Manufacturing and Six Sigma, and industrial networking to take students on internships and develop projects with the business sector.

Hypothesis Test Results

Hypothesis 1: Establishments and educational institutions in Bangkok and its vicinity have a need for electronic teachers with modern technology skills and practical teaching more than theoretical skills.

Variables	Mean	S.D	F-Value	P-value (Sig.)	Interpretation
Theoretical skills	3.85	0.90	4.52	0.003	There is a significant difference
Modern technology skills	4.25	0.82	5.21	0.002	There is a significant difference
Practical teaching skills	4.30	0.78	4.89	0.004	There is a significant difference

Summary of Hypothesis 1: Accept the hypothesis. The ANOVA analysis results show that the establishments and educational institutions have a statistically significant need for modern technology skills and practical teaching more than theoretical skills ($p < 0.05$).

Hypothesis 2: Skills and knowledge required for electronics teachers are different between the needs of educational institutions (focusing on teaching skills and student development) and establishments (focusing on technical skills and electronic innovation)

Teachers	Teaching skills (Mean)	Technical andInnovative Skills (Mean)	t-value	p-value (Sig.)	Interpretation
Educational institutions	4.40	3.90	5.14	0.001	There is a significant difference.
Business establishments	3.85	4.50	5.47	0.002	There is a significant difference.

Summary of Hypothesis 2: Accept the hypothesis. The t-test results show that educational institutions tend to give more importance to teaching skills than technical and innovative skills, while business establishments give more importance to technical and innovative skills than teaching skills, with statistical significance ($p < 0.05$).

Hypothesis 3: The development of the curriculum of the Faculty of Industrial Education that is consistent with the needs of the labor market will increase the employment opportunities and efficiency of electronic teachers in the future.

Independent Variables	(Beta)	t-value	p-value (Sig.)	Interpretation
Adjusting the curriculum to be in line with the labor market	0.52	6.35	0.001	Significantly influence employment opportunities
Adding new technology content to the curriculum	0.45	5.89	0.002	Significantly influence teacher performance
Developing soft skills in the curriculum	0.40	5.32	0.004	Significantly influence employment opportunities

Summary of the results of the test of hypothesis 3: Accept the hypothesis. The results of the multiple regression analysis found that adjusting the curriculum to be in line with the labor market, adding new technology content, and developing soft skills have a statistically significant influence on the employment opportunities and performance of electronic teachers ($p < 0.05$).

Summary of hypothesis testing

Hypotheses	Results	Results
H1: The demand for modern technology skills and practical teaching is higher than theoretical skills.	Significant difference ($p < 0.05$)	Accept
H2: The required skills differ between educational institutions and workplaces.	Significant difference ($p < 0.05$)	Accept
H3: Developing a curriculum that is in line with the labor market increases employment opportunities and teacher efficiency.	Significant influence on employment opportunity ($p < 0.05$)	Accept

Guidelines for developing labor to meet the needs of the labor market in the digital age

From the analysis of data on the needs of the labor market in the digital age, it was found that electronic technicians need to have technical skills and digital technology, including communication and collaboration skills at a high level. However, the current readiness of the labor force is still insufficient, making it necessary to develop labor to be able to respond to the needs of the industry effectively.

1. Improve the education system and curriculum to be in line with changing technology. One factor that has a significant impact on labor development is the education system and the teaching curriculum, which has an average score of 4.37 (the highest level), indicating that the curriculum needs to be improved to be in line with digital technology trends. Approaches that should be implemented include increasing the content of digital technology, such as the Internet of Things (IoT), artificial intelligence (AI), programming, and automation systems; integrating project-based learning by giving students the opportunity to work on real projects with the industrial sector; and promoting lifelong learning through short-term courses or new skills training so that laborers can continuously update their knowledge.

2. Develop digital skills and the use of technology for laborers. The survey found that laborers should have at least a medium to high level of expertise in digital technology, especially in the development of programs or automation systems, which received an average score of 4.36 (the highest level). Therefore, skills in this area should be systematically developed through the following approaches: Provide training in digital technology and automation systems so that workers can use and adapt to new technologies effectively. Encourage workers to practice using specialized software, such as electronic circuit design programs or software used in industry. Encourage workers to develop data literacy skills to support working in environments that use Big Data.

3. Enhance learning skills and adaptability. The survey found that the ability to learn new technologies quickly had an average score of 4.20 (high level), which means that workers must be able to continuously learn and develop their skills. Development approaches include promoting active learning, such as using online learning systems, workshops, or hackathons, so that workers can practice real skills, encouraging workers to have creative thinking and problem-solving skills through simulations or case studies, and training in soft skills, such as the ability to work as a team and communicate effectively, which are important skills for working in the digital age.

4. Develop cooperation between the government sector, businesses, and educational institutions. Training and skills development by businesses received the highest average score of 4.88 (highest level), which shows that the industrial sector plays an important role in labor development. Approaches that should be implemented include creating cooperation between universities and the industrial sector through internship programs, dual education, or on-site training, and designing curricula jointly with businesses. To ensure that the content matches the skills that the labor market needs, workers have access to training opportunities in workplaces, especially courses related to Industry 4.0.

5. Support labor development through government policies. The support from the government and labor policies has an average score of 4.29 (highest level), which means that the government should play an important role in promoting labor development. Approaches that should be implemented include establishing policies to support digital training and skills development, such as providing training funds, developing courses for workers at all levels, creating a government online learning platform that allows workers to access modern learning resources, and providing incentives for businesses that invest in labor development, such as tax breaks for companies that provide skills training for employees.

6. Encourage workers to have an open attitude towards learning and self-development. In addition to training and support from the government, workers' ability to learn and develop themselves is also an important factor in adapting to the digital labor market, with an average score of 4.41 (highest level). Approaches that should be implemented include promoting a lifelong learning culture, encouraging workers to develop themselves through online channels, such as free or low-cost courses on e-Learning platforms, and involving workers in professional communities and innovation networks to exchange knowledge and develop skills together. Labor development to be in line with the digital labor market requires implementation in many dimensions, including:

1. Improving the education system and curriculum to be up-to-date and meet the needs of the industry.
2. Developing digital technology skills and the use of information technology.
3. Promoting learning and adaptability of the workforce.
4. Creating cooperation between the industrial sector, educational institutions, and the government sector.
5. Supporting the workforce through government policies, such as providing training funds and promoting lifelong learning.
6. Encouraging the workforce to have an open attitude towards development and lifelong learning.

These approaches will help the workforce effectively adapt to changes in the digital industry and promote the country's economic development and innovation in the long term.

Discussion

1. The need for modern technology skills and practical teaching

The research results are consistent with the work of Tondeur et al. (2017) who found that technical and engineering teachers in the 21st century must be able to use digital technology in teaching, not only providing theoretical knowledge but also designing practical learning activities to develop students' practical skills. Similarly, Mishra & Koehler (2006) proposed the TPACK Model (Technological Pedagogical Content Knowledge) that teachers must have knowledge of both technology, teaching methods, and academic content in order to be able to teach effectively in the digital age.

2. Differences in skills required between educational institutions and workplaces

The research results support the work of Darling-Hammond et al. (2019) who found that educational institutions tend to focus more on developing teachers' teaching skills than technical skills, while the industry needs personnel who can use technology and innovation to develop products and production processes. Kim et al. (2020) studied the needs of the industrial sector for engineering graduates and found that workplaces want graduates to be able to analyze and solve problems through the design thinking process and develop solutions using modern technology, which is consistent with the research results that found that Employers prioritize technical and innovation skills over teaching skills.

3. Developing a curriculum that is in line with the labor market. The research supports the work of the OECD (2019), which emphasized that higher education curricula should be continuously improved to meet the needs of the industry, especially in developing essential skills in the digital age, such as coding, artificial intelligence, and data analytics. Henderson et al. (2021) studied the impact of curricula that are in line with the needs of the labor market in engineering and found that adding modern technology content and developing soft skills, such as teamwork and creative thinking, increased the employment opportunities and competitiveness of graduates. This is consistent with the research results that found that adjusting the curriculum to the labor market has a positive influence on the employment opportunities and performance of electronics teachers.

New Knowledge

From the research results, it was found that the business has a high demand for teachers with AI and IoT skills, and educational institutions have a shortage of teachers with automation skills. New knowledge that should be developed into an electronics technician vocational course should have the following characteristics:

1. Integrating modern technology in the curriculum

1.1 Automation and IoT (Internet of Things) Basic programming to control IoT devices Design and install automation systems in industrial plants Analysis of data from IoT devices for maintenance

1.2 Artificial intelligence (AI) and data analysis Basic AI and Machine Learning related to electronics work Use of AI in intelligent control systems Analysis of data from sensors to increase efficiency of industrial systems

1.3 Embedded systems and microcontrollers Use of Arduino and Raspberry Pi to control automation systems Design and develop intelligent electronic devices

2. Emphasis on practical skills and integrated learning

2.1 Project-based learning (PBL) Developing prototype products using AI and IoT in industry Simulating smart home systems or smart factories

2.2 Internships with businesses (Work-integrated Learning - WIL) Educational institutions should sign MOUs with businesses to provide students with hands-on experience. Train teachers to teach and apply technology in real life

3. Digital skills and entrepreneurship development

3.1 Electronics programming skills, Python and C++ coding for embedded systems, Web interface development for controlling IoT devices

3.2 Electronics technology entrepreneurship, business model development for smart electronic products, presentation of work and fundraising for startups

4. Teacher development and curriculum infrastructure. Train teachers to be experts in AI and IoT through certified training courses, provide modern learning equipment such as automatic robotic arms, IoT experimental kits, and 3D printers, and collaborate with the industry sector to keep up with changes in technology.

Future electronics technician career curricula should focus on integrating modern technologies such as AI, IoT, automation, and embedded systems, along with emphasizing practical skills training through projects and internships in workplaces. In addition, entrepreneurship skills should be developed so that students are not only technicians but also able to develop and create their own innovations.

Recommendations

1. For the Faculty of Industrial Education

The Faculty of Industrial Education should improve the curriculum to be in line with the needs of educational institutions and businesses. It should add subjects related to new technologies such as AI, IoT, and automation systems. It should also develop a more intensive practical training curriculum to meet the needs of the labor market.

2. For educational institutions and businesses

Educational institutions and businesses should cooperate in curriculum development and teacher training. It should support the Cooperative Education project to give students the opportunity to learn from real businesses. It should also provide Upskilling and Reskilling training for electronics teachers to keep up with changes in technology.

3. For the government sector

The government sector should support the budget for developing vocational and industrial curricula. It should also establish a labor demand data center so that educational institutions and students can adapt to industry trends.

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