EDUTECH

Jurnal Teknologi Pendidikan

Journal homepage https://ejournal.upi.edu/index.php/edutech

Bridging the Skills Gap: A Systematic Review of Upskilling and Reskilling Models Linking Instructor Competence to Industry-Relevant Graduate Skills

Yussi Anggraini[1*], Putu Sudira[2], Nuryake Fajaryati[3], Pipit Utami[4], Rangga Bayu Rinawan[5], Rizqi Aji Surya Putra[6]

[1,2,3,4,5,6]Department of Electronic and Informatics Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

*Correspondence: e-mail: yussianggraini@uny.ac.id

ABSTRACT

The skills gap between Technical and Vocational Education and Training (TVET) graduates and rapidly evolving industry requirements remains a persistent challenge, particularly as digitalization and Industry 4.0/5.0 reshape occupational standards. This study systematically reviews upskilling and reskilling approaches that link instructor competence to industry-relevant graduate skills. A Systematic Literature Review (SLR) was conducted in accordance with PRISMA 2020, using literature retrieved from the Scopus database and analyzed through narrative thematic synthesis. The search identified 571 records. Following screening, eligibility assessment, and methodological quality appraisal, 127 studies met the predefined inclusion and quality criteria and were included in the final synthesis. Four recurring themes emerged: (1) institutional upskilling-reskilling approaches, including continuous professional development, competency-based education and training, industry-linked learning, digital and personalized upskilling, and immersive technology-based learning; (2) the central role of instructors' pedagogical, technical, digital, and industry-engagement competencies; (3) the importance of technical, digital, communication, problem-solving, collaboration, adaptability, and employability skills among graduates; and (4) the need for a continuous feedback relationship among industry, institutions, instructors, and learners. The synthesis supports the Industry-Driven Reflective Upskilling-Reskilling (IRUR) framework, in which industry needs inform instructor competence reflection, adaptive competence development, competence transfer to learners, and industry feedback. The review highlights the need for

ARTICLE INFO

Article History:
Submitted/Received 28 Sept 2026
First Revised 18 Oct 2026
Accepted 25 Oct 2026
First Available online 31 Oct 2026
Publication Date 31 Oct 2026

Keyword:
Industry relevance,
Instructor competence,
Reskilling,
TVET,
Upskilling.

longitudinal evaluation and stronger empirical evidence linking instructor professional development, instructional practice, and graduate employment outcomes.
© 2025 Teknologi Pendidikan UPI

1. INTRODUCTION

The skills gap between Technical and Vocational Education and Training (TVET) graduates and industry needs remains a major challenge across many countries. This gap becomes evident when the skills developed through vocational education and training do not fully align with the technical, digital, and interpersonal competencies required in the workplace. In the Malaysian context, the employability requirements of TVET graduates demonstrate the importance of a combination of workplace skills that extends beyond technical mastery alone (Halik Bassah & Mohd Noor, 2023). Therefore, the relevance of TVET learning outcomes should be understood as the alignment among graduate capabilities, technological change, and the actual needs of the labor market.

Digital transformation has intensified this urgency. Advances in artificial intelligence, the Internet of Things, robotics, data analytics, and immersive technologies are changing both the types of jobs available and the ways in which competencies are developed. The implications of Industry 4.0 for skills development require training systems that can respond rapidly to change(McKee & Gauch, 2020) . In TVET, the integration of AI and product design skills through job-analysis-based approaches has also begun to be positioned as a strategy for maintaining curriculum relevance to industry needs (RABIU, 2025). Under these conditions, upskilling and reskilling are no longer merely supplementary activities but rather integral components of a continuous competency renewal mechanism.

Instructors occupy a central position in this mechanism. The effectiveness of vocational education is determined not only by mastery of technical subject matter but also by instructors' pedagogical and digital capabilities and their understanding of authentic workplace contexts. Studies on developing work-ready TVET graduates indicate that instructor competence is associated with the ability to design learning experiences that are relevant to industry demands (Dzia-Uddin et al., 2025) At the same time, the implementation of innovative pedagogy for the Industry 4.0 TVET workforce requires instructors to continually update both their teaching approaches and technological capabilities (Festus et al., 2025).

Instructor competence development should therefore be situated within the relationship between educational institutions and industry. Industry-institution partnerships can promote curriculum alignment, training design, and the updating of competency standards (Halik Bassah & Mohd Noor, 2023; Vinayan et al., 2020), Continuous Professional Development (CPD), Competency-Based Education and Training (CBET), industry-linked learning, digital and personalized upskilling, and immersive technology-based learning are among the approaches identified in the literature as responses to changing skill requirements.

Nevertheless, existing studies still frequently address instructor development, training models, and graduate competencies as separate themes. The relationship between strengthening instructor capacity, transferring competence through the learning process, and graduate outcomes has not always been mapped in an integrated manner. This interconnection is important because upskilling-reskilling programs have strategic value only when renewed instructor competencies are translated into relevant learning practices and subsequently evaluated through industry feedback.

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

Based on this gap, this study aims to: (1) synthesize the characteristics of upskilling-reskilling models and approaches implemented in TVET contexts; (2) identify the instructor competencies most relevant to improving graduate employability and the industry relevance of graduate competencies; and (3) formulate a conceptual framework linking industry needs, instructor competence enhancement, learning innovation, graduate competencies, and industry feedback. The research questions are as follows:

RQ1. What are the characteristics of upskilling and reskilling models implemented in TVET institutions?

RQ2. What competencies do instructors require to support graduates whose skills are relevant to industry needs?

RQ3. How are instructor upskilling-reskilling models related to the industry-relevant competencies required by TVET graduates?

2. METHODS

This study employed a Systematic Literature Review (SLR) conducted in accordance with the PRISMA 2020 guidelines to ensure transparency in the identification, screening, eligibility assessment, and inclusion of studies(Page et al., 2021). An SLR was selected because it enables evidence on upskilling-reskilling models, instructor competence, and industry-relevant graduate skills to be systematically identified, evaluated, and synthesized. The review process consisted of four main stages: identification of relevant records, screening based on predefined criteria, eligibility assessment through title, abstract, and full-text examination, and final inclusion of studies for synthesis. To integrate heterogeneous findings across the included studies, narrative synthesis and thematic analysis were employed.

The literature search was conducted once on 15 March 2026, which also served as the final search date. The search was performed using a Boolean search string in the TITLE-ABS-KEY fields with the following combination of terms: (("TVET" OR "vocational training" OR "training institution") AND ("instructor competence" OR "trainer" OR "teacher") AND ("upskilling" OR "reskilling" OR "professional development") AND ("industry relevant skills" OR "graduate employability")). (Dahalan et al., 2023; M. Yusop et al., 2022).

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

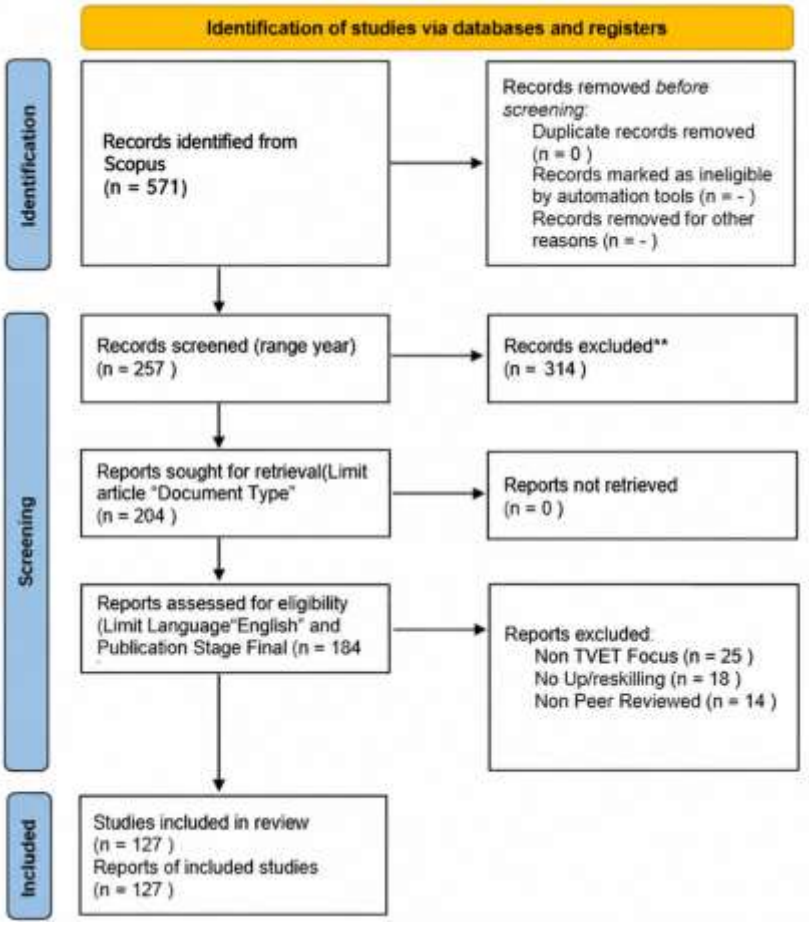


Figure 1. PRISMA 2020 flow diagram.

The identification process yielded 571 records. After applying the publication-year restriction, 257 articles proceeded to title and abstract screening. Restricting the document type to Article reduced the number to 204, language screening reduced it to 187, and applying the publication stage criterion of Final resulted in 184 articles for full-text eligibility assessment. At the eligibility stage, 57 articles were excluded, leaving 127 articles for the final synthesis. The final inclusion rate was approximately 22.2% of the initial 571 records. The detailed results of the screening and study selection process are summarized in Table 1.

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Focuses on TVET / vocational training	Outside the field of vocational education
Addresses instructor or trainer competence	Does not address instructors or graduates
Examines upskilling/reskilling models	Does not address upskilling/reskilling
Focuses on industry-relevant graduate skills	Does not involve a relationship with industry
Includes a relationship between education and industry	Non-academic publication type
Publication year: 2022-2025	Duplicate data or multiple versions
Peer-reviewed sources (Scopus / reputable scholarly journals)	Non-English language without translation

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

Inclusion Criteria	Exclusion Criteria
English language	Full text unavailable

The screening process was conducted by the lead author in two stages. In the first stage, automated keyword screening was applied to the exported dataset using the predefined keywords related to TVET, instructor competence, upskilling, reskilling, and employability. In the second stage, the titles, abstracts, and available full texts were manually examined against the predefined inclusion and exclusion criteria. Articles were excluded if they focused on contexts outside vocational education, did not address instructors or graduates, did not discuss upskilling-reskilling, or did not establish a connection with industry needs. Following the eligibility screening, a quality appraisal was conducted to assess the methodological adequacy and relevance of the studies considered for the final synthesis. Each study was evaluated using five criteria: (1) clarity of the research objective, (2) clarity of the methodological description, (3) adequacy of the description of the sample or data source, (4) consistency between the reported findings and the supporting evidence, and (5) relevance of the study to the research questions. Each criterion was scored dichotomously, with 1 indicating that the criterion was adequately met and 0 indicating that it was not adequately met. The maximum quality score was therefore 5. Studies obtaining a total score of at least 4 were considered to have sufficient methodological quality for inclusion in the final synthesis, whereas studies scoring below 4 were excluded.

Table 2. Quality appraisal criteria.

Quality Appraisal Criterion	Score
Research objective clearly stated	0–1
Method clearly described	0–1
Sample/data source clearly described	0–1
Findings supported by evidence	0–1
Relevance to the research question	0–1
Maximum score	5
Inclusion threshold	≥ 4

All 127 eligible studies met the predefined quality threshold (≥4 out of 5) and were therefore retained for the final thematic synthesis. The quality appraisal was conducted after full-text eligibility assessment and before thematic synthesis. Only studies meeting the predefined quality threshold were used as evidence in the final thematic synthesis and conceptual framework development. Data were analyzed using thematic analysis within a narrative synthesis framework. Three initial domains were used as the basis for categorization: Instructor Competence, Graduate Skills & Employability, and Upskilling-Reskilling Models. Patterns of relationships across these domains were then compared to identify cross-study themes and to develop a conceptual framework linking instructor competence enhancement, training design, competence transfer, and industry feedback.

3. RESULTS AND DISCUSSION

3.1. General Characteristics of the Reviewed Studies

A total of 127 articles met the inclusion criteria. Within the 2022–2025 review period, the literature reflects growing attention to digital upskilling, Industry 4.0/5.0, artificial intelligence, technology-enhanced training, and institution-industry partnerships. Emerging approaches identified in the reviewed studies include

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

personalized training frameworks for Industry 5.0 (Fraile et al., 2023) and the integration of AI competencies into TVET programs (RABIU, 2025).

The geographical distribution of the reviewed studies is concentrated in Asia, particularly Southeast Asia, with additional contributions from Africa and Europe. In Southeast Asia, the literature frequently emphasizes curriculum alignment, industry partnerships, digital entrepreneurship, and the strengthening of technical skills. In Africa, major areas of attention include industry collaboration, competency standardization, work-integrated learning, and efforts to address skill mismatches. In Europe, lifelong learning, upskilling, and the inclusion of vulnerable groups also emerge as elements of skills policy (Bonoli & Otmani, 2022).

3.2. Upskilling-Reskilling Models in TVET (RQ1)

The synthesis indicates that upskilling-reskilling models in TVET are diverse and are influenced by industry context, participant characteristics, and institutional capacity. Continuous Professional Development (CPD) is one of the most consistently identified strategies for updating instructors' pedagogical and technological competencies. The need for CPD among TVET teachers and instructors has also been identified in studies of professional competence in Kenya (Njenga, 2022). CPD functions as a renewal mechanism that enables instructors to continually adapt learning content, methods, and assessment to evolving workplace requirements.

Competency-Based Education and Training (CBET) and job-analysis-based approaches such as DACUM position industry competency standards as key curriculum reference points. In curriculum development, industry involvement in the CBET process is considered essential for maintaining the relevance of the competencies being taught (Ododa, 2025). Other prominent models include industry-based internships and work-integrated learning, which expose learners to authentic workplace practices, work cultures, and performance standards.

Digital upskilling in TVET is implemented through technology-enhanced learning, personalized training, project-based activities, and immersive technologies. Personalized training frameworks for Industry 5.0 emphasize data integration, training personalization, and continuous improvement (Fraile et al., 2023) The integration of Industry 4.0 technologies, including immersive and technology-supported learning, also requires instructors to strengthen their digital and pedagogical competencies (Festus et al., 2025) In specific vocational contexts, intensive practical training such as SMAW welding highlights the importance of hands-on learning and performance-based assessment (Mohd. Ahyan et al., 2024)

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

Table 3. Mapping of upskilling-reskilling models, instructor competencies, and graduate outcomes.

Model	Key Characteristics	Instructor Competencies	Graduate Outcomes	Sources
Digital upskilling / personalized training	Technology-enhanced, personalized, and adaptive training aligned with emerging industrial technologies	Digital literacy, technology integration, adaptive learning design	Improved digital competence and technological adaptability	
Continuous CPD	Periodic pedagogical and technology training	Active pedagogy, authentic assessment, EdTech adoption	Improved soft skills and work readiness	
Industry-linked CBET	Industry involvement in competency standardization and curriculum development	Industry engagement, competency interpretation, and standards-based curriculum alignment	Improved alignment between vocational competencies and industry requirements	
AR/VR and I4.0 integration	Simulation of workplace environments and modern technologies	Technology integration, safety and standards, learning experience design	Technological adaptability and future-ready skills	
Occupation-specific upskilling	Intensive hands-on and task-specific training	Task analysis, practical coaching, skills assessment	Improved technical employability	
Policy coordination and partnerships	Industry MoUs and collaborative governance	Partnership management and impact evaluation	Sustained skills alignment	

3.3. Instructor Competencies and Graduate Competencies (RQ2)

The instructor competencies most consistently identified can be grouped into four domains: pedagogical, technical, digital, and industry engagement. Pedagogical competence includes the ability to design active learning, project-based learning, authentic assessment, and problem-based learning. Technical competence concerns mastery of procedures, tools, standards, and workplace practices within a specific vocational field. Digital competence includes technological literacy, the integration of digital platforms, AI, IoT, and AR/VR, as well as the use of technology in learning design. Industry engagement, meanwhile, includes the ability to interpret labor-market needs,

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

build partnerships, and translate industry standards into curricula and assessment (Festus et al., 2025; Mohd Noor et al., 2023).

Continuous learning is a cross-cutting element across these domains. Instructor adaptability requires periodic competency renewal through CPD, industry attachments, micro-credentials, communities of practice, and technology training. Literature on continuous learning cultures also indicates that reskilling and upskilling are associated with the ability to adapt to changes in the work environment (Kalsum et al., 2025). Thus, instructor competence should not be viewed merely as a static set of abilities, but as the capacity to continuously renew professional practice.

From the graduate perspective, the literature consistently identifies a combination of hard and soft skills as a prerequisite for industry relevance. Hard skills include field-specific technical skills, digital literacy, and the ability to use emerging technologies. Prominent soft skills include communication, teamwork, problem-solving, adaptability, and self-directed learning. Employability requirements among Malaysian TVET graduates demonstrate the importance of balancing technical competence with transferable workplace capabilities (Halik Bassah & Mohd Noor, 2023; Mohd Noor et al., 2023).

These findings indicate that graduate quality is strongly influenced by how instructors integrate technical, pedagogical, and digital competencies into the learning experience. Instructors who are able to employ authentic assessment, industry-based projects, and relevant technologies occupy a strategic position as knowledge brokers who translate industry needs into learning experiences.

3.4. Relationships among Instructors, Graduates, and Industry (RQ3)

The relationship among instructors, graduates, and industry is a key mechanism explaining how upskilling-reskilling can contribute to the industry relevance of graduate competencies. Industry provides signals regarding technological change, workplace standards, and emerging skills. Institutions and instructors then translate these signals into curricula, learning materials, instructional strategies, and assessment. Once learners enter the workforce, their performance becomes a source of feedback for institutions.

Industry–institution collaboration can support the alignment of vocational training with changing workplace requirements through curriculum coordination, competency-based training, collaborative program implementation, and continuous evaluation. Recent studies emphasize that sustainable collaboration between TVET institutions and industry is important for maintaining the relevance of training programs and strengthening the alignment between institutional provision and industry needs (Mohd. Ahyan et al., 2024; Omar & Kamaruzaman, 2024).

From the perspective of the synthesis, the instructor's role extends beyond content delivery. Instructors serve as a bridge between industry standards and learners' educational experiences. Therefore, instructor competence development must be followed by mechanisms that transfer these competencies into learning, for example through project-based learning, authentic assessment, simulations, industry projects, or field practice. If instructor training is not translated into classroom and training practices, the relationship between CPD and graduate outcomes will remain difficult to demonstrate.

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

Table 4. Cross-national analysis of TVET upskilling-reskilling practices.

Region/Country	Approach Focus	Implementation	Impact	Sources
Malaysia & Indonesia (Southeast Asia)	Industry-institution collaboration; CBET/DACUM; practical training	Curriculum co-design; technical skills upskilling; strengthening digital entrepreneurship	Improved employability and authentic workplace experience	
Africa (Kenya, Ghana, South Africa, Nigeria)	Industry partnerships to reduce skill mismatch	Work-integrated learning; CBET; competency standardization	Greater alignment of graduate competencies with labor-market needs and workplace standards	

3.5. Research Gaps and Practical Implications

First, a disconnect remains between instructor capacity development and graduate outcomes. Many studies examine instructor training or graduate employability separately, while the relationship between the two is not always measured using designs that allow competence transfer to be traced. This finding reinforces the need for evaluation approaches that connect CPD, changes in instructional practice, and indicators of graduate performance.

Second, longitudinal evaluation remains limited. The effects of upskilling-reskilling programs on graduates' workplace performance are rarely tracked over a sufficiently long period. Studies on industry-academia alignment likewise emphasize the need for longitudinal research to understand the sustainability of program effects (Dubey & Noronha, 2025).

Third, industry feedback loops are not yet systematic in many contexts. Industry input is often used during the initial stages of curriculum development but is not always maintained as part of a continuous evaluation cycle. Fourth, variations in national policies affect funding support, standards, incentives, and technological readiness. Fifth, issues of standardization and financing make program outcomes difficult to compare across regions.

In practical terms, TVET institutions need to establish structured institutional CPD with an emphasis on active pedagogy, digital literacy, and the integration of Industry 4.0/5.0 technologies; use employability KPIs and multi-stakeholder feedback to update curricula; and combine CBET, industry-linked learning, digital and personalized upskilling, and technology-enhanced simulations. Industry can strengthen its role through the co-design of competency standards, the provision of mentors or guest trainers, recognition of micro-credentials, and the provision of more up-to-date data on skill requirements.

3.6. Proposed Conceptual Framework

Based on the synthesis, a conceptual framework was developed to connect three pillars: Instructor Competence Enhancement, Institutional Upskill-Reskill Model, and Industry-Relevant Graduate Competence. The framework integrates competency-based

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

education and training, industry–institution collaboration, continuous professional development, and adaptive technology-enhanced training. These elements emphasize the alignment of training with occupational requirements, continuous renewal of instructor competence, and responsiveness to emerging industry needs (Fraile et al., 2023; Njenga, 2022; Omar & Kamaruzaman, 2024).

Instructor Competence Enhancement encompasses the strengthening of pedagogical, technical-digital, and industry-engagement competencies through CPD, industry-based training, micro-credentials, and communities of practice. The Institutional Upskill-Reskill Model encompasses curriculum design, delivery strategies, and evaluation that integrate CBET, work-integrated learning, digital upskilling, simulations, and immersive learning. Industry-Relevant Graduate Competence encompasses technical and digital skills combined with communication, problem-solving, teamwork, adaptability, and employability.

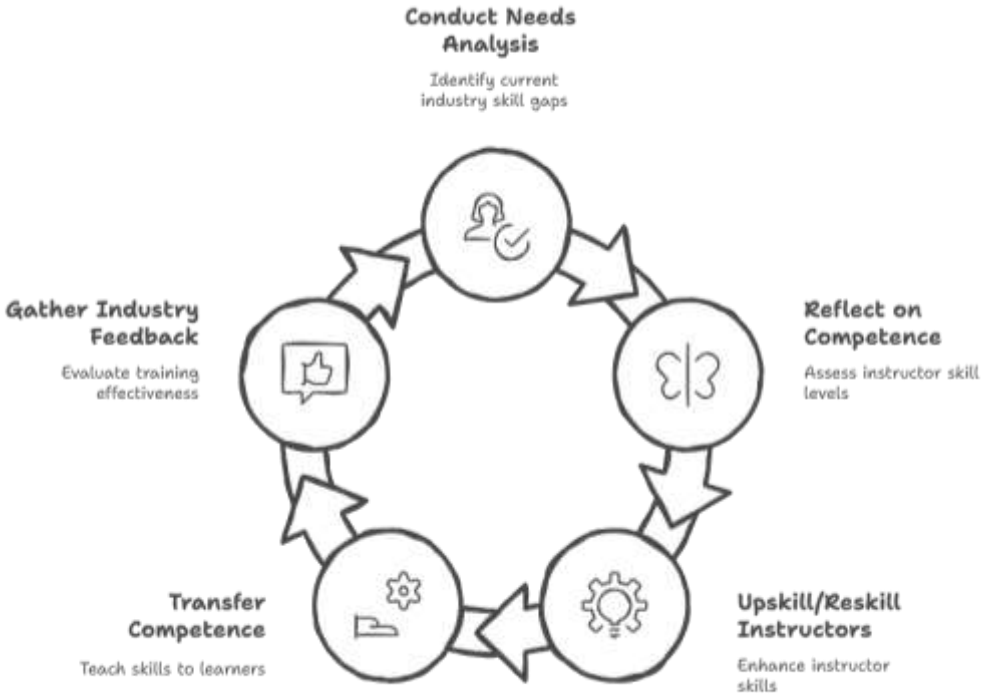


Figure 2. Industry-Driven Reflective Upskilling-Reskilling (IRUR) framework.

The framework mechanism consists of five operational stages and one renewal cycle. The first stage, Industrial Needs Analysis, maps skill gaps and competency priorities. The second stage, Instructor Competence Reflection, compares instructors' competency profiles with industry requirements. The third stage, Adaptive Upskill-Reskill, involves CPD, industry attachments, micro-credentials, online training, simulations, and collaborative projects. The fourth stage, Competence Transfer to Learners, employs project-based learning, work-integrated learning, and authentic assessment. The fifth stage, Industry Feedback, evaluates graduate performance and training effectiveness. This information is then used in a Continuous Loop/Adaptive Renewal process to update competency targets and CPD plans.

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

Table 5. Operationalization of the framework and measurement indicators.

Component	Key Indicators	Data Sources	References
Industrial Needs Analysis	List of priority competencies; percentage skill gap; I4.0/5.0 technology priorities; mapping of occupational standards	Industry surveys/FGDs; job advertisements; job descriptions; competency standards	
Instructor Competence Reflection	Self-assessment scores; certifications/micro-credentials; readiness to teach emerging technologies	Self-assessment; teaching portfolios; CPD records; certificates	
Adaptive Upskill-Reskill	CPD hours; completion rate; industry attachments; pre-post improvement; adoption of AI/IoT/AR/VR	LMS logs; certificates; attachment reports; pre-post tests; technology-use logs	
Competence Transfer to Learners	Proportion of PBL/WIL; authentic assessment; project portfolios; student certifications	Course plans/syllabi; industry rubrics; e-portfolios; internship records	
Industry Feedback	Placement rate; time to employment; employer satisfaction; job-skill match; retention	Tracer studies; employer surveys; partner HR data; collaboration outputs	
Continuous Loop / Adaptive Renewal	Periodic competency-profile revision; incorporation of industry feedback; revision of training and CPD priorities	Meeting minutes; revised curriculum/program documents; CPD roadmaps; internal evaluation reports	

4. CONCLUSION

This SLR demonstrates that upskilling-reskilling in TVET is not represented by a single model. The most prominent approaches identified within the 2022–2025 review period include Continuous Professional Development (CPD), Competency-Based Education and Training (CBET), industry-linked learning, digital and personalized upskilling, immersive technology-based learning, and occupation-specific practical training. Across these approaches, a common orientation is evident: responsiveness to changing labor-market needs and stronger alignment between vocational institutions, instructors, and industry.

The instructor competencies required to support industry-relevant graduates include pedagogical, technical, digital, and industry-engagement competencies. This

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781

combination enables instructors to translate industry standards into more authentic learning experiences, assessments, and projects. From the graduate perspective, industry relevance is characterized by a combination of technical and digital skills with communication, collaboration, problem-solving, adaptability, and employability.

The synthesis indicates that the relationship between instructor upskilling-reskilling and industry-relevant graduate competencies can be conceptualized as a continuous cycle involving industry needs analysis, instructor competence reflection, adaptive competence development, competence transfer into learning, and industry feedback. The proposed conceptual framework summarizes this cycle and provides a basis for future instrument development and empirical evaluation. Future research should examine these relationships longitudinally, particularly the extent to which instructor professional development contributes to changes in instructional practice and graduate employment outcomes.

5. AUTHORS' NOTE

The authors declare that there are no conflicts of interest related to the publication of this article. The authors further confirm that the manuscript is free from plagiarism.

6. REFERENCES

Agbo, N. M., & Nnajiofor, F. N. (2023). The Role of University-Industry Linkage in Creating a Functional Technical and Vocational Education and Training (TVET) in Nigeria. *Journal of Vocational Education Studies*. https://doi.org/10.12928/joves.v6i1.7233

Bonoli, G., & Otmani, I. (2022). Upskilling as Integration Policy: Making the Most of Refugees' Human Capital in a Context of Skill Shortage. *Social Policy and Administration*. https://doi.org/10.1111/spol.12868

Dahalan, F., Alias, N., & Nizam Shaharom, M. S. (2023). Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. *Education and Information Technologies*. https://doi.org/10.1007/s10639-022-11548-w

Dubey, A. K., & Noronha, M. (2025). Transforming Technical and Vocational Education and Training (TVET) in India: Need for a Longitudinal Study on Industry and Academic Alignment. *International Journal for Multidisciplinary Research*. https://doi.org/10.36948/ijfmr.2025.v07i04.50064

Dzia-Uddin, D. N., Ngah, H. C., Mohd Noor, J. A., & Minghat, A. D. (2025). Developing Work-Ready TVET Hospitality Graduates: Key Skills for Industry Success. *International Journal of Research and Innovation in Social Science*. https://doi.org/10.47772/ijriss.2025.906000128

Festus, C., Nadum, T. A., & Igulu, K. (2025). Innovative Pedagogies in Teaching and Learning: A Strategy for Upskilling and Reskilling Industry-4.0 TVET Workforce. *International Journal of Innovative Science and Research Techno*. https://doi.org/10.38124/ijisrt/25apr087

Fraile, F., Psarommatis, F., Valero, F. A., & Joan, J. (2023). A Methodological Framework for Designing Personalised Training Programs to Support Personnel Upskilling in Industry 5.0. *Computers*. https://doi.org/10.3390/computers12110224

Halik Bassah, N. S., & Mohd Noor, M. A. (2023). Employability Skills Needed for TVET Graduates in Malaysia: Perspective of Industry Expert. *Online Journal for TVET Practitioners*, *8*(1). https://doi.org/10.30880/ojtp.2023.08.01.005

Kalsum, E. R. U., Budiman Djatisara, R. R., & Novitasari, S. A. (2025). Analysis of Reskilling, Upskilling, and Continuous Learning Culture on Adaptability of Hospitality

Employees in West Java. *West Science Interdisciplinary Studies*. https://doi.org/10.58812/wsis.v3i03.1778

M. Yusop, S. R., Rasul, M. S., Yasin, R. M., Hashim, H. U., & Jalaludin, N. A. (2022). An Assessment Approaches and Learning Outcomes in Technical and Vocational Education: A Systematic Review Using PRISMA. *Sustainability*. https://doi.org/10.3390/su14095225

McKee, S., & Gauch, D. (2020). *Implications of Industry 4.0 on Skills Development*. https://doi.org/10.1007/978-981-15-7018-6_34

Mohd. Ahyan, N. A., Nasir, N., Muhamad, M., & Noh, N. H. (2024). The Efficiency of Upskilling Graduate Diploma Students at Malaysian Vocational Colleges in 3g Smaw Welding Work – A Case Study. *International Journal of Modern Education*. https://doi.org/10.35631/ijmoe.623008

Mohd Noor, M. S., Mohamad, M., & Paimin, A. N. (2023). Implementation of Skilled Training Programs at Vocational College: A View of the Instructors' Perspectives. *Online Journal for Tvet Practitioners*. https://doi.org/10.30880/ojtp.2023.08.03.014

Mswephu, Khayakazi., & Nqunqa, L. (2024). Revisiting Maritime Education and Training Offerings in the Public TVET Sector to Advance a Sustainable Ocean Economy. *Sajmet*. https://doi.org/10.47348/sajmet/2024/i1a4

Mustaffa, M., Tawil, N. M., Selvaratnam, D. P., Techanamurthy, U., & Affandi, H. M. (2024). Empowering Digital Entrepreneurship in Technical and Vocational Education and Training (TVET) Education. *Jurnal Kejuruteraan*. https://doi.org/10.17576/jkukm-2024-36(4)-11

Navarro, J. C., & Cathles, A. (2019). *Disrupting Talent: The Emergence of Coding Bootcamps and the Future of Digital Skills*. https://doi.org/10.18235/0001651

Njenga, M. (2022). Professional Competencies and the Continuing Professional Development Needs of Technical, Vocational Education and Training (TVET) Teachers in Kenya. *The Hungarian Educational Research Journal*. https://doi.org/10.1556/063.2022.00118

Ododa, F. (2025). The Role of Industry in CBET Curriculum Development Process. A Case of Nyandarua National Polytechnic, Kenya. *Jkncu*. https://doi.org/10.62049/jkncu.v5i2.334

Omar, M., & Kamaruzaman, F. M. (2024). Technical and Vocational Education Training and Industry Collaboration: A Bibliometric Review. *Journal of Education and Learning (Edulearn)*. https://doi.org/10.11591/edulearn.v18i4.21120

Owusu-Agyeman, Y., Brenya, B., Tiwaah Kwapong, O. A., & Abrefa-Gyan, T. (2024). Teacher Perceptions About the Reputation of Technical and Vocational Education and Training in Ghana. *Education + Training*. https://doi.org/10.1108/et-10-2023-0446

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *BMJ* (Vol. 372). BMJ Publishing Group. https://doi.org/10.1136/bmj.n71

RABIU, A. (2025). DACUM Approach for Integrating AI Competencies and Product Design Skills in Nigeria's TVET Programs. *International Journal of Research and Innovation in Social Science*. https://doi.org/10.47772/ijriss.2025.907000293

Tshong, P. K., & Yasin, R. M. (2023). TVET Educational Learning Strategies and Their Impact on Students: A Systematic Literature Review. *International Journal of*

Academic Research in Business and Social Sciences. https://doi.org/10.6007/ijarbss/v13-i11/19558

Vinayan, G., Harikirishanan, D., & Ling, S. M. (2020). *Upskilling and Reskilling the Workforce via Industry Driven Technical and Vocational Education and Training: Strategies to Initiate Industry/Institution Partnership in Malaysia*. https://api.semanticscholar.org/CorpusID:222449632

Wahungu, D. (2022). *Bridging Soft Skills Gaps Among Automotive Engineering Trainees in TVET: A Case of Thika Technical*. https://doi.org/10.56059/pcf10.6562

DOI: https://doi.org/10.17509/e.v25i3.105355
P-ISSN 0852-1190 E-ISSN 2502-0781