Bridging Academia–Industry Gaps through the KSAM Framework: Competency Assessment in IT Education and Industrial Training

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Abstract This review examines competency assessment in Information Technology (IT) education and industrial training with a focus on internships as a bridge to employability. It synthesizes peer-reviewed studies published in English between 2010–2024, identified using inclusion criteria limited to IT/ICT higher education, work-integrated learning (WIL)/internships, and explicit competency frameworks. Evidence is global with a strong concentration in South and Southeast Asia particularly Sri Lanka, India, Thailand, and the Philippines allowing regional contrasts within a broader international picture. Across this corpus, employers consistently prioritize a solid technical foundation (programming, QA/testing, data management, cloud) alongside transversal skills communication, teamwork, analytical thinking, adaptability, and professional attitude that enable effective performance in collaborative, client-oriented environments. The study emphasizes that the *quality* of internship experiences, rather than their duration, is the most influential factor in enhancing employability. Internships that incorporate authentic project tasks, defined learning outcomes, structured mentoring, and multi-source assessment mechanisms tend to yield stronger professional readiness. Common competency assessment methods include structured surveys, rubric-based frameworks, supervisor evaluations, project artefact reviews, and reflective learning reports. Competency mapping frequently employs the Knowledge–Skills–Attitudes (KSA) framework, while the 4Cs (Critical thinking, Communication, Collaboration, Creativity) and Emotional Intelligence models are used to assess behavioral and interpersonal competencies crucial for modern IT workplaces. Employer-driven competency clusters and Industry 4.0/5.0 taxonomies further align academic outcomes with evolving technological roles but require localization to fit specific regional and industrial contexts. Distinct regional emphases were noted: Southeast Asian employers highlighted delivery management and analytics, whereas Sri Lankan employers emphasized English proficiency, discipline, and professional conduct. Overall, the review concludes that graduate employability improves significantly when curricula and internships are explicitly aligned with validated competency frameworks, when assessments are behavior-based and triangulated across multiple evidence sources, and when authentic work artefacts are integrated into the evaluation process.

Keywords: IT internships, Competency assessment, Employability, Industry–academia collaboration, KSA framework.

Introduction

IT education is undergoing a profound transformation as digitalization, automation, and data-driven work continue to redefine the skills demanded by employers. The rapid advancement of technologies such as cloud computing, artificial intelligence, and analytics has shifted expectations beyond technical expertise toward a broader set of professional capabilities. However, multiple studies across different countries reveal a persistent and widening gap between what universities teach and what industries require particularly in the areas of practical application, communication, teamwork, and problem-solving skills (Wickramasinghe & Perera, 2010; Siddoo et al., 2017; Herbert et al., 2024). This mismatch indicates that graduates often possess theoretical knowledge but lack the applied competencies necessary to thrive in complex, collaborative IT environments.

To address these gaps, several competency frameworks have been developed to create a shared language for educators, employers, and policymakers. Among them, the Knowledge–Skills–Attitudes (KSA) model remains a foundational approach for aligning curricula with job requirements and assessing technical and behavioral proficiency. Complementing this, the 4Cs model Critical thinking, Communication, Collaboration, and Creativity emphasizes the transversal skills required for innovation and teamwork in dynamic digital workplaces. Similarly, Emotional Intelligence frameworks focus on self-awareness, empathy, and interpersonal regulation, which are crucial for effective leadership and client relations in IT settings (Thornhill-Miller et al., 2023; Boyatzis, 2018).

Evidence also highlights that well-structured internships, work-integrated learning (WIL), and project-based pedagogies contribute significantly to developing these competencies. When internship goals, feedback mechanisms, and assessment criteria are clearly defined, students demonstrate notable improvements in professional communication, adaptability, and teamwork (Ionescu et al., 2013; Saimon et al., 2023; Herbert et al., 2024). Such experiences bridge theoretical and practical learning, reinforcing the relevance of academic content in real-world contexts.

Nevertheless, challenges persist. Assessment methods and competency measures vary widely between institutions and industries, leading to limited comparability of outcomes. Moreover, predictive evidence connecting specific competencies to long-term employability remains fragmented and inconclusive (Wickramasinghe & Perera, 2010; Herbert et al., 2024). To fill these gaps, this review systematically maps the competency models applied within IT education, examines how competencies are assessed across multiple stakeholders including students, educators, and employers and synthesizes regional evidence linking competency development and work-integrated learning (WIL) to graduate employability (Siddoo et al., 2017; Dissanayake, 2018; Sharma et al., 2024).

Methodology

This review adopted a structured and systematic protocol to identify, screen, and synthesize empirical and conceptual studies concerning competency assessment in Information Technology (IT) education and industrial training. The methodological approach was designed to ensure transparency, replicability, and comprehensive coverage of the existing literature on competency-based learning and work-integrated learning (WIL) within the IT and ICT domains.

Database searches were conducted primarily in *Emerald Insight*, which hosts reputable journals in education, management, and information systems, and *Google Scholar* for broader interdisciplinary coverage. The search was limited to studies published in English from 2010 onwards, reflecting the period during which competency-based education, employability frameworks, and WIL practices became increasingly formalized and integrated into IT curricula (Wickramasinghe & Perera, 2010; Siddoo et al., 2017; Boyatzis, 2018).

The search employed combinations of keywords and Boolean operators such as *internship*, *industrial training*, *graduate employability*, *student skills*, *competencies*, *KSAM*, *IT industry*, *ICT*, *higher education*, and *university education*.

Inclusion criteria comprised studies that:

1. Focused on IT or ICT higher education contexts.
2. Examined internships, work placements, or other WIL mechanisms.
3. Explicitly addressed competency models or frameworks (e.g., KSA, 4Cs, Emotional Intelligence, or employer-defined clusters).
4. Were published in peer-reviewed journals.

5. Were written in English and published from 2010 onwards.

Exclusion criteria eliminated studies that:

1. Belonged to non-IT or non-technical fields.
2. Lacked a focus on training, internship, or employability development.
3. Did not incorporate a competency discussion or framework.
4. Were published before 2010.
5. Were grey literature or non-indexed sources.

A structured data extraction matrix was used to capture bibliographic details, geographical region, target stakeholders (students, employers, or academics), competency frameworks applied, assessment or measurement methods (e.g., Likert-scale surveys, behavioral rubrics, or gap indices), internship/WIL design elements, and reported outcomes (employability, readiness, early career performance).

Due to the heterogeneity of the studies in scope, a narrative synthesis approach was employed. This method facilitated comparison across diverse study designs and analytical frameworks, allowing the reviewer to map how different competency models were operationalized, measured, and aligned with employability indicators and stakeholder perceptions (Thornhill-Miller et al., 2023; Boyatzis, 2018).

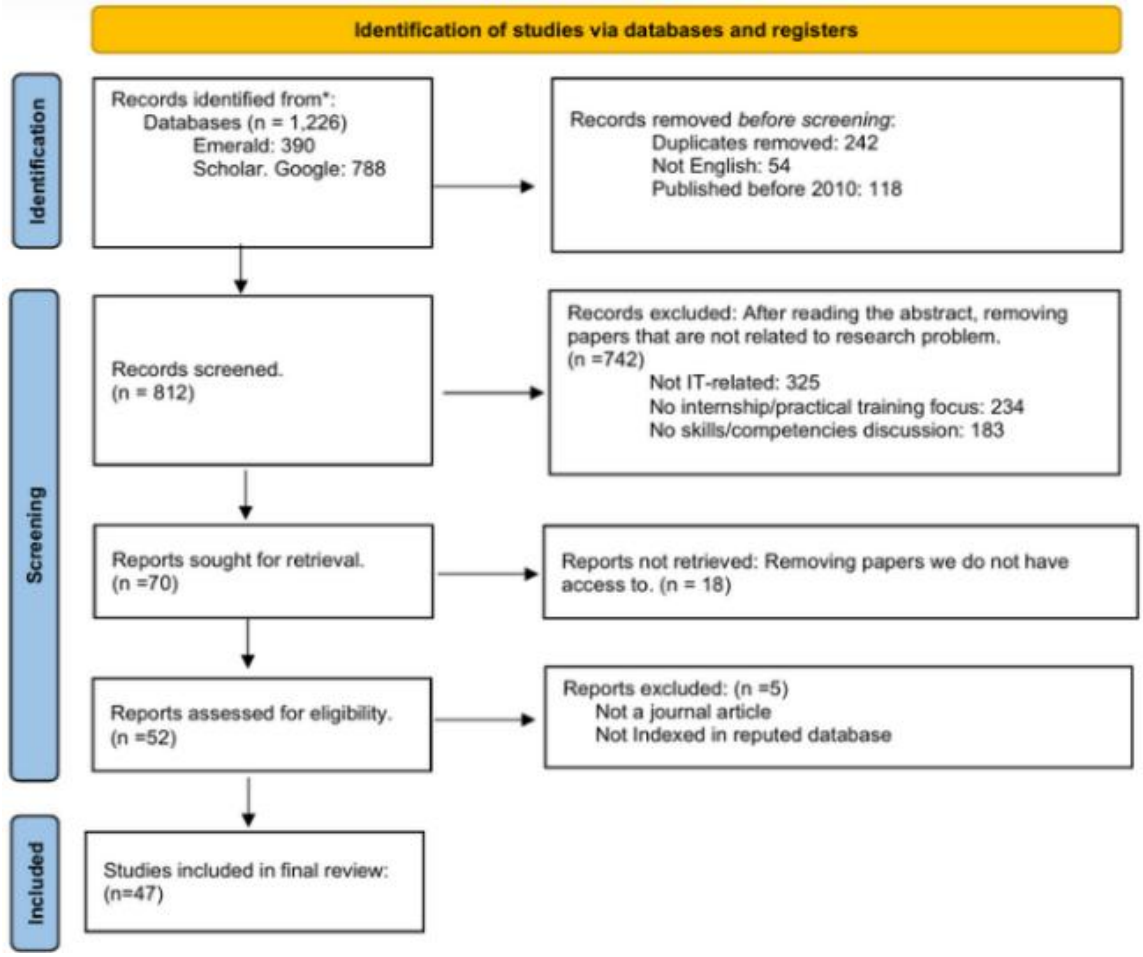

Figure 1: Article Screening Process

Results

A. Characteristics of Included Studies

The final review synthesized 47 empirical journal articles and seven competency-model sources including KSA (Knowledge, Skills, Attitudes), 4Cs (Critical thinking, Communication, Collaboration, Creativity), Emotional Intelligence (EI), and extended KSA taxonomies. The studies spanned from 2010 to 2024, with a noticeable increase in publications post-2017. This increase aligns with growing pressures on higher education to align IT curricula with industry demands and evolving technologies (Wickramasinghe & Perera, 2010; Siddoo et al., 2017; Herbert et al., 2024).

The majority of studies came from South and Southeast Asia (Sri Lanka, India, Thailand, Philippines), with some contributions from Europe and Australia. Methodologically, the majority of studies employed cross-sectional surveys using Likert scales, often comparing students, employers, and academics. A smaller subset used case studies or program evaluations focused on internships and co-op programs (Ionescu et al., 2013; Herbert et al., 2024).

Quantitative studies utilized t-tests/ANOVA, correlations, and regression analysis, while qualitative and mixed-methods studies focused on internship design and stakeholder experiences (Siddoo et al., 2017). The competencies assessed in these studies were primarily framed through the KSA model, the 4Cs model for transversal skills, and EI models to capture behavioural aspects (Thornhill-Miller et al., 2023; Boyatzis, 2018; Livesey, 2017). Recent studies extended KSA to include Industry 4.0/5.0 competencies, such as data literacy and systems thinking (Caratozzolo et al., 2023; Herbert et al., 2024). Internships varied in length, from short-term placements to extended co-op programs, with supervision, feedback, and task relevance consistently highlighted as crucial design features.

Overall, the studies provide broad coverage across geographies, methodologies, and stakeholders, enabling a comprehensive synthesis of findings on internship structures, competency models, measurement approaches, and employability outcomes.

B. Stakeholder Perspectives

The review reveals a three-way view of the roles of employers, students, and academics in the context of IT internships and employability. Employers emphasize the need for job-ready graduates who possess both core technical skills (e.g., programming, data management) and transversal skills (e.g., communication, teamwork, problem solving, and self-management), with a focus on faster onboarding to meet the evolving needs of Industry 4.0/5.0 (Siddoo et al., 2017; Sharma et al., 2024; Herbert et al., 2024).

From the students' perspective, internships contribute to building confidence and employability when tasks are authentic and feedback is structured. However, students report that weak supervision limits the effectiveness of the internship experience in building practical skills (Ionescu et al., 2013; Dissanayake, 2018; Herbert et al., 2024).

Academics, on the other hand, focus on aligning the curriculum and assessment with competency frameworks such as KSA, 4Cs, and EI to ensure that these skills are observable and assessable (Thornhill-Miller et al., 2023; Boyatzis, 2018). All stakeholders agree that internships are critical to enhancing employability, though there are differences regarding the balance of autonomy vs. guidance and the assessment burden on faculty and employers.

Overall, it is clear that competency gains are more influenced by the quality of internship design such as clear goals, meaningful work, and feedback cycles than by the duration of the internship alone (Ionescu et al., 2013; Herbert et al., 2024).

C. Competency Models and Factors

This section synthesizes the key domains and factors identified across the studies in relation to competency assessment in IT education and industrial training. The table below provides a summary of the competency domains Knowledge, Skills, Attitudes, and Mindset along with the key factors associated with each domain and the number of studies addressing these factors.

Table 1.KSAM Potential factors

Domain	Factor	Source	Count
KNOWLEDGE	Business and Financial Knowledge	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Zeidan, S., & Bishnoi, M. M. (2020); Tan, L. M., Laswad, F., & Chua, F. (2022);Ayodele, T. O., Oladokun, T. T., & Kajimo-Shakantu, K. (2020)	4
	Cybersecurity and Technology Knowledge	Sajdak, M., Młody, M., & Bartkowiak, P. (2022);Sinha, S., Ghosh, P., & Mishra, A. (2020); Zeidan, S., & Bishnoi, M. M. (2020); Celarta, C. B., & Esponilla II, F. D. (2021),Mukminin et al. (2024); Samarasinghe et al. (2022); Daka et al. (2023)	7
	Computer Science and Programming Knowledge	Mukminin et al. (2024); Ahmed et al. (2022);Wickramasinghe, V., & Perera, L. (2010)	3
	Legal and Regulatory Knowledge	Tan, L. M., Laswad, F., & Chua, F. (2022);Ayodele, T. O., Oladokun, T. T., & Kajimo-Shakantu, K. (2020)	2
	Industry-wide IT foundation knowledge	Siddoo, V., Sawattawee, J., Janchai, W., & Yodmongkol, P. (2017);Ahmed et al. (2022); R. et al. (2024); Samarasinghe et al. (2022)	4
SKILL	Problem-Solving Skills	Bawica (2021); Tan & Laswad (2021); Mukminin et al. (2024);Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Sinha, S., Ghosh, P., & Mishra, A. (2020); Wickramasinghe, V., & Perera, L. (2010); Siddoo, V., Sawattawee, J., Janchai, W., & Yodmongkol, P. (2017); Tan, L. M., Laswad, F., & Chua, F. (2022); Celarta, C. B., & Esponilla II, F. D. (2021); Zeidan, S., & Bishnoi, M. M. (2020); Celarta, C. B., & Esponilla II, F. D. (2021)	9
	Communication and Interpersonal Skills	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Sinha, S., Ghosh, P., & Mishra, A. (2020); Wickramasinghe, V., & Perera, L. (2010); Siddoo, V., Sawattawee, J., Janchai, W., & Yodmongkol, P. (2017); Zeidan, S., & Bishnoi, M. M. (2020); Tan, L. M., Laswad, F., & Chua, F. (2022); Celarta, C. B., & Esponilla II, F. D. (2021);Tan & Laswad (2021); Samarasinghe et al. (2022); Daka et al. (2023); Bawica (2021)	13

	Leadership Skills	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Wickramasinghe, V., & Perera, L. (2010); Zeidan, S., & Bishnoi, M. M. (2020); Celarta, C. B., & Esponilla II, F. D. (2021);Tan & Laswad (2021); Daka et al. (2023); Bawica (2021)	7
	Decision-making and Analytical Thinking	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Wickramasinghe, V., & Perera, L. (2010); Celarta, C. B., & Esponilla II, F. D. (2021);Sinha, S., Ghosh, P., & Mishra, A. (2020); Bawica (2021); Daka et al. (2023); Tan & Laswad (2021)	8
	Practical and Workplace Skills	Celarta, C. B., & Esponilla II, F. D. (2021);Ahmed eta al. (2022); Mukminin et al. (2024); Franco et al. (2019);Siddoo, V., Sawattawee, J., Janchai, W., & Yodmongkol, P. (2017)	5
ATTITUDE	Responsibility and Self-Management	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Wickramasinghe, V., & Perera, L. (2010); Ayodele, T. O., Oladokun, T. T., & Kajimo-Shakantu, K. (2020); Celarta, C. B., & Esponilla II, F. D. (2021);Tan & Laswad (2021); Samarasinghe et al. (2022); Mukminin et al. (2024);Bawica (2021); Thakur et al. (2024)	11
	Confidence	Tan & Laswad (2021); Bawica (2021); Franco et al. (2019);Wickramasinghe, V., & Perera, L. (2010); Celarta, C. B., & Esponilla II, F. D. (2021)	5
	Openness and Motivation to Learn	Ahmed et al. (2022); R. et al. (2024); Samarasinghe et al. (2022);Bawica (2021); Franco et al. (2019);	5
	Work Ethics and Professionalism	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Sinha, S., Ghosh, P., & Mishra, A. (2020); Ayodele, T. O., Oladokun, T. T., & Kajimo-Shakantu, K. (2020); Zeidan, S., & Bishnoi, M. M. (2020); Celarta, C. B., & Esponilla II, F. D. (2021);Bawica (2021); Samarasinghe et al. (2022); Thakur et al. (2024); Ahmed et al. (2022); Mukminin et al. (2024); Franco et al. (2019);Tan, L. M., Laswad, F., & Chua, F. (2022)	9
	Commitment and Reliability	Celarta, C. B., & Esponilla II, F. D. (2021);Wickramasinghe, V., & Perera, L. (2010);Sajdak, M., Młody, M., & Bartkowiak, P. (2022)	3
MINDSET	Adaptability and Flexibility	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Sinha, S., Ghosh, P., & Mishra, A. (2020); Wickramasinghe, V., & Perera, L. (2010); Zeidan, S., & Bishnoi, M. M. (2020); Celarta, C. B., & Esponilla II, F. D. (2021);Celarta, C. B., & Esponilla II, F. D. (2021)	6
	Lifelong Learning &	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Tan, L. M., Laswad, F., & Chua, F. (2022); Celarta, C. B.,	5

Learning Orientation	& Esponilla II, F. D. (2021);Sinha, S., Ghosh, P., & Mishra, A. (2020); Wickramasinghe, V., & Perera, L. (2010)	
Collaborative Mindset	Ahmed et al. (2022); R. et al. (2024); Franco et al. (2019); Thakur et al. (2024)	4
Entrepreneurial thinking	Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Zeidan, S., & Bishnoi, M. M. (2020);Ahmed et al. (2022); R. et al. (2024); Daka et al. (2023)	5
Creativity and Innovation Mindset	Wickramasinghe, V., & Perera, L. (2010); Celarta, C. B., & Esponilla II, F. D. (2021);Sajdak, M., Młody, M., & Bartkowiak, P. (2022); Zeidan, S., & Bishnoi, M. M. (2020);Ahmed et al. (2022); R. et al. (2024); Mukminin et al. (2024)	7

D. Internship Structure and Educational Framework

Internships in IT education are increasingly viewed as structured learning opportunities, rather than just exposure to workplace environments. Most internship programs define learning outcomes, assign workplace mentors, and use a variety of assessment methods, such as supervisor ratings, reflective logs, and project deliverables (Ionescu et al., 2013; Herbert et al., 2024).

Internship placements can range from short-term (4–12 weeks) to extended co-op programs, with stronger results typically seen when internships are linked to capstone projects or client work (Kuptasthien, 2010; Oguz & Oguz, 2019). Effective internship designs feature authentic tasks, regular feedback, and multi-source assessments involving mentors, students, and academic staff (Herbert et al., 2024; Galbraith & Mondal, 2020). Many internship programs now map outcomes to the KSA, 4Cs, or EI frameworks, with Industry 4.0/5.0 skills like data analytics, cloud technologies, and systems thinking increasingly embedded in the curriculum (Boyatzis, 2018; Thornhill-Miller et al., 2023; Caratozzolo et al., 2023).

Weaknesses were observed in internships that were observational-only or assessed only by attendance, which resulted in limited skill development (Hora et al., 2020). Stronger alignment between universities and industry through pre-placement training, structured debriefs, and formal university–industry agreements was shown to improve the quality of internships and support reflective learning (Kamp & Verdegaal, 2015; Ahmed et al., 2022).

Regional studies highlighted the importance of mentoring and employer evaluations in Sri Lanka (Dissanayake, 2018), while delivery management and analytics were prioritised in Thailand (Siddoo et al., 2017). Overall, internships are most effective when they include five key features: clear competency-linked outcomes, authentic tasks, structured mentoring, multi-source assessment, and formal industry partnerships, all of which contribute to stronger employability outcomes (Herbert et al., 2024; Thornhill-Miller et al., 2023).

E. Outcome Frameworks and Standards

Accreditation and curriculum frameworks play a crucial role in defining program outcomes (POs) and establishing the evidence required to demonstrate their attainment. For computing programs, ABET/CAC accreditation standards require programs to publish outcomes, evaluate student performance using systematic measures, and use results for continuous improvement (i.e., “closing the loop”) (ABET, 2024). Similarly, the CDIO Standards 3.0 and the updated CDIO Syllabus organize outcomes into disciplinary knowledge, personal/interpersonal skills, and system/product building competencies, with a

focus on rubric-based assessment and program evaluation (CDIO, 2020; Malmqvist et al., 2022).

Computing Curricula 2020 offers a framework for linking competencies to explicit learning outcomes and provides templates for curriculum mapping and benchmarking. In practice, program teams are encouraged to map each course outcome to one or more POs, define indicators and rubrics, set target levels, and collect both direct evidence (e.g., capstone rubrics, portfolios, code repositories) and indirect evidence (e.g., surveys of students, employers, and external examiners). Evidence is aggregated by PO each term and reviewed in program boards to plan actions and document loop-closure for accreditation (ABET, 2024; CDIO, 2020).

For transversal skills (e.g., communication, teamwork, problem-solving), VALUE-style rubrics can be adapted to IT contexts to improve scoring reliability across courses and internships (AACU, 2013–2015). These frameworks shift the emphasis from identifying what is missing in student competencies to showing proof of attainment. They also allow for comparability across cohorts and regions because the same POs and rubrics drive both classroom and internship assessments (ABET, 2024; CDIO, 2020).

Discussion

This review highlights the critical importance of aligning internship programs and curricula with the evolving demands of the IT industry, particularly in the context of Industry 4.0/5.0. The rapid advancement of technologies such as artificial intelligence, cloud computing, data analytics, and automation necessitates that graduates not only possess core technical knowledge but also transversal skills that enable them to adapt, collaborate, and innovate in increasingly complex work environments. This is particularly relevant as companies require employees who can integrate new technologies into existing systems, leading to a need for agile and innovative thinkers (Wickramasinghe & Perera, 2010; Siddoo et al., 2017; Herbert et al., 2024).

The findings of this review suggest that employability outcomes improve significantly when internship tasks are authentic and directly linked to real-world problems. Internships that incorporate authentic tasks, such as client projects, hands-on software development, or data-driven decision-making, help students apply theoretical knowledge in a practical context, enhancing their employability readiness (Ionescu et al., 2013; Dissanayake, 2018). These authentic experiences give students a deeper understanding of the professional landscape, enabling them to better align their academic preparation with industry expectations. Furthermore, the structured mentoring and regular feedback as integral components of internship design were shown to significantly enhance students' ability to transition from academic learning to professional environments. This highlights that merely increasing the number of internship hours is insufficient; rather, it is the quality of the internship experience such as clear learning outcomes, authentic work tasks, and structured reflection that plays a pivotal role in equipping students with the skills and competencies employers demand (Herbert et al., 2024).

The review also emphasizes the role of stakeholders, employers, students, and academics in bridging the skills gap. Employers consistently prioritize graduates who are not only technically proficient but also possess essential transversal skills such as communication, teamwork, problem-solving, and self-management. Employers seek job-ready graduates who can effectively contribute to teams, understand client needs, and innovate in dynamic, technology-driven environments. This requires a blend of core technical competencies and behavioral skills (Siddoo et al., 2017; Sharma et al., 2024; Herbert et al., 2024).

From the students' perspective, internships are most beneficial when they offer hands-on work experience and the opportunity to apply

knowledge to authentic challenges. However, students report that weak supervision and insufficient feedback during internships often limit their ability to grow professionally (Ionescu et al., 2013; Dissanayake, 2018). Quality mentoring and structured feedback mechanisms are necessary to provide students with the guidance and refinement they need to develop their skills in a real-world context.

Academics also play a critical role in aligning curricula with competency frameworks such as KSA (Knowledge, Skills, Attitudes), 4Cs (Critical thinking, Communication, Collaboration, Creativity), and EI (Emotional Intelligence). These frameworks provide a common language for mapping learning outcomes to employability skills, ensuring that graduates are well-equipped to meet the demands of the job market (Thornhill-Miller et al., 2023; Boyatzis, 2018). However, a recurring challenge identified in the literature is the fragmented nature of competency measurement. While frameworks like KSA offer a scaffold for curriculum mapping, the assessment of transversal skills such as teamwork, communication, and problem-solving often lacks standardized measures. This creates a disparity in the operationalization of these competencies across institutions. The evidence linking competency development to employability remains largely anecdotal, with few longitudinal studies to test their predictive validity (Herbert et al., 2024).

The review indicates that the most effective internship programs are those that are well-designed and aligned with competency frameworks. Internships that integrate authentic tasks, structured mentoring, and multi-source assessments (involving mentors, students, and academics) tend to produce stronger employability outcomes. These programs not only foster technical skill development but also enable students to build transversal competencies such as teamwork, leadership, and client communication. Importantly, as Industry 4.0/5.0 continues to shape the future of work, integrating competencies such as data literacy, systems thinking, and cloud technologies into internship programs will be critical for ensuring that graduates remain competitive in the digital economy (Caratozzolo et al., 2023; Herbert et al., 2024).

While the demand for these advanced competencies is growing, it is important to recognize the regional differences in employer expectations and curriculum priorities. For example, Sri Lankan studies highlight the importance of English proficiency and professionalism as key employability factors (Dissanayake, 2018), while in Thailand, delivery management and analytics are considered crucial for IT graduates (Siddoo et al., 2017). Despite these regional variations, the core principles of effective internship design such as authentic project work, clear learning goals, regular feedback, and structured mentoring remain consistent across contexts.

Finally, while KSA, 4Cs, and EI frameworks provide a comprehensive approach to mapping competencies, there remains a need for further refinement of assessment methods to better capture transversal skills and their impact on employability. Future studies should focus on developing behavior based rubrics for assessing transversal competencies and exploring longitudinal data to better understand the link between competency development during internships and early career outcomes (Chaengpromma & Pattanapairoj, 2022; Herbert et al., 2024).

Conclusion

This review underscores a clear and compelling narrative regarding the alignment between internships, curricula, and the evolving demands of the IT industry, particularly in the context of Industry 4.0/5.0. Employers continue to seek graduates who are not only technically proficient but also equipped with essential transversal skills such as communication, teamwork, problem-solving, and self-management (Siddoo et al., 2017; Sharma et al., 2024). The findings from this

review indicate that authentic, project-based internships, which are structured around real-world tasks, offer the most significant improvements in employability. Moreover, structured mentoring, regular feedback, and the clear alignment of learning objectives with industry standards were identified as critical factors in fostering graduate readiness (Ionescu et al., 2013; Dissanayake, 2018; Herbert et al., 2024).

Despite the clear evidence supporting the importance of authentic internships in enhancing employability, this review reveals persistent gaps in the measurement and evaluation of transversal competencies such as communication and teamwork. While frameworks like KSA and 4Cs provide foundational structures for competency mapping, transversal skills are often difficult to assess reliably without behaviour-anchored rubrics and consistent multi-source feedback. Moreover, while the integration of Industry 4.0/5.0 competencies (such as data literacy and systems thinking) is growing, there is still limited regional standardisation of curriculum designs and competency measures, reflecting a broader challenge of contextualising these frameworks to fit the diverse needs of the global workforce (Caratozzolo et al., 2023; Herbert et al., 2024).

The review also highlights the importance of stakeholder collaboration between universities, industry, and government to bridge the skills gap. Effective internships cannot be seen in isolation; they must be integrated into a holistic educational strategy that includes pre-placement training, curriculum innovation, and structured debriefing sessions to ensure that graduates are not only academically prepared but also professionally competent (Kamp & Verdegaal, 2015; Ahmed et al., 2022). The increasing demand for interdisciplinary and innovative thinking in Industry 4.0/5.0 necessitates the continuous evolution of educational practices to ensure graduates are equipped with the skills needed for emerging job roles.

While the review identifies strong internship design principles, such as authentic tasks, clear goals, and multi-source assessment, it also highlights the need for longitudinal studies that explore the long-term impact of competency-based internships on graduate employability. Future research should focus on developing clearer, behavior-based rubrics for assessing transversal competencies and testing the predictive power of these frameworks in terms of job outcomes across diverse industries and educational contexts (Chaengpromma & Pattanapairoj, 2022; Herbert et al., 2024).

In conclusion, while significant progress has been made in aligning internship programs with industry needs, there is an ongoing need for innovative educational practices, robust assessment models, and stronger industry-academia partnerships. A blended approach combining the KSA model, 4Cs, and EI frameworks with new Industry 4.0/5.0 competencies provides a comprehensive strategy for preparing graduates who can not only meet but exceed the demands of the rapidly changing IT landscape. As the world of work continues to evolve, it is essential that educational institutions continue to refine their models of competency assessment and work-integrated learning, ensuring that the graduates of tomorrow are equipped with the skills to succeed in highly competitive, technology-driven environments.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Author Contributions

The corresponding author takes primary responsibility for communication with the journal during the manuscript submission. All authors listed on the manuscript must have made significant contributions to the study. An author statement indicating the specific details of the contribution from each author (must be listed using their initials only) for the manuscript based on the relevant CRediT (Contributor Roles

Taxonomy) roles should be included: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, review and editing.

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Ethical approval

Not applicable. This study is a systematic literature review and did not involve human participants, animals, or identifiable personal data. Therefore, institutional ethical clearance was not required.

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