

UPLINK: A Review of Skill Mapping, Career Recommendation and Academia–Industry Collaboration for Campus Career Ecosystems

Rohit S Raut¹ · Suyog Patil² · Aishwarya Nagaonkar³
Vishal Bade⁴ · Adinath Jadhav⁵ · Pradnya Borkar⁶ · Srushti Hardikar⁷

¹⁻⁷Department of Computer Science and Engineering (Data Science),

Dr. D. Y. Patil Pratishthan's College of Engineering, Kolhapur, Maharashtra, India

Rohit S Raut¹: rohitraut8680@gmail.com · Suyog Patil²: suyog.patil73@gmail.com
Aishwarya Nagaonkar³: asn.dyp2023@gmail.com · Vishal S Bade⁴: vishalbade1100@gmail.com
Adinath D Jadhav⁵: adinath0632@gmail.com · Pradnya D Borkar⁶: borkarpradnya14@gmail.com
Srushti S Hardikar⁷: srushtih0215@gmail.com

Abstract—Students today have to navigate numerous websites and platforms that manage their resumes, internships, jobs, skill assessments, and professional profiles. Because each activity is handled by a separate website or application, it is very hard for students to update their information across all systems and follow their applications in one place. Recruiters likewise have to use many resources when looking for students who meet the desired specifications. UPLINK is an online and campus-based platform to support students' career and professional development. UPLINK will provide an environment where students can create and manage their own profiles (with descriptions of skills, projects, achievements, and professional experience), in addition to accessing internships, jobs, and other related career opportunities. Recruiters will be able to post opportunities for students and filter students who fit their criteria. In addition to the above-mentioned features, UPLINK will include additional features including, but not limited to, skill mapping, recommended opportunities, resume creation, document scanning/processing, messaging capabilities, and notification capabilities. This paper outlines the problem statement, research gap, objectives of the project, and the design of the UPLINK system and its implementation plans.

Index Terms—UPLINK, campus career ecosystem, student employability, skills mapping, career recommendations, internship management, jobs, Recruiter Interaction, professional profiles, digital portfolios, academia-industry partnerships, resume management, optical character recognition (OCR), recommender systems, career counseling, track applications

I. INTRODUCTION

Students today use different platforms to manage their skills, projects, certifications, internships, job applications, and professional profiles. Since this information is often spread across multiple platforms, students may find it difficult to keep everything organized and up to date. Recruiters also have to use different sources when looking for students who match specific skills and requirements.

A Campus Career and Professional Ecosystem can bring these activities together on a single platform. Features such as student profiles, skill mapping, opportunity management, and recruiter interaction can make career-related activities easier to manage. The proposed UPLINK platform is built around these areas and also includes support for career recommendations, resume generation, document processing, messaging, and notifications. This paper discusses the problem, research gap, objectives, and proposed system architecture of UPLINK.

II. REVIEW METHODOLOGY

This review examines existing research on skill mapping, employability, career recommendation, internship and job recommendation, digital portfolios, and university–industry collaboration. Research papers were collected from academic sources such as IEEE, ScienceDirect, Springer, Emerald, SAGE, and other peer-reviewed publications.

The studies were selected based on their relevance to higher education, student skill development, career guidance, employment opportunities, and interaction between universities and industry. Recent studies were given priority, along with earlier studies that provide important background for the reviewed topics.

The selected studies were examined based on their objectives, approaches, technologies or methods, and the areas of the student career ecosystem they addressed. The literature was then organized into major themes, including skill mapping and skill gaps, employability, career recommendation, internship and job recommendation, digital portfolios, and university–industry collaboration.

The findings were compared to identify common approaches, limitations, and areas that remain separated across

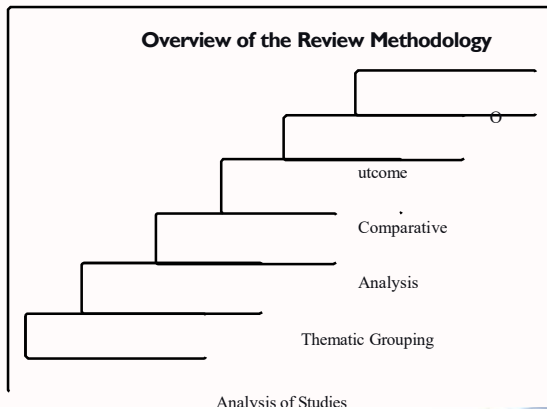


Fig. 1. Overview of the review methodology.

the existing literature. These findings were then used to identify the need for a more integrated campus career ecosystem and to define the proposed direction of the UPLINK project.

III. LITERATURE REVIEW

A. Skill Mapping and Skill Gaps

Skill mapping is an important area in the reviewed literature because a student's academic background and existing competencies do not always show whether they meet the requirements of a particular career opportunity. For this reason, several studies have explored ways to identify student skills, compare competencies with industry requirements, and determine areas where further development may be needed.

Ben Messaoud, Ilahi, and Cheniti-Belcadhi proposed using learning analytics to issue tailored micro-credentials that narrow the distance between what universities teach and what industry expects. Their work concentrates on spotting competency differences and offering recommendations suited to each learner. This shows that skill development can be linked to industry needs instead of being treated only as an academic matter. [3]

Ramazanova et al. built a knowledge-graph model that links the content of university programmes to what employers ask for. Using data on skills, vacancies, and learning resources, it suggests MOOCs that fill gaps in university curricula. The study illustrates how connections among skills, learning materials, and employer needs can be modelled to support student skill growth. [2]

Onukwugha et al. studied a generative-AI framework that analyses skill gaps in real time and adjusts career guidance accordingly. It covers gap analysis, competency testing, guidance, and job matching, which shows that data on student competencies can inform several kinds of career decisions. [13]

Bairi and Prasad used machine learning together with labour-market data to predict suitable career paths for individuals. Their method pairs the prediction with skill-gap

analysis and takes shifting market conditions into account. This suggests that required skills can be examined alongside likely career paths and employment trends. [12]

Seetaworn et al. applied knowledge graphs to personalized internship recommendations in the context of software engineering courses. Their study connects student skills and requirements with internship opportunities, demonstrating how structured relationships between different types of information can be used to identify suitable opportunities. [4]

The reviewed studies show that skill mapping can involve different sources of information, including student competencies, academic information, educational resources, employer requirements, and opportunity requirements. However, the main purpose of these approaches differs across studies. Some focus on reducing skill gaps through learning recommendations, while others use skill information for career-path prediction or internship recommendation. As a result, these studies provide different approaches to understanding and using student skill information rather than examining the complete career-management process as a whole.

This review indicates that skill mapping can act as a connecting component between student profiles, skill-gap identification, learning requirements, and career opportunities. At the same time, the reviewed literature shows a separation between skill assessment and other activities such as opportunity management, application tracking, and recruiter interaction. Bringing these areas together could provide a more complete way of supporting students throughout their career-development process. This fragmentation provides a basis for examining how skill information could be incorporated into a broader campus career ecosystem.

B. Employability and Career Development

Employability is another important theme in the reviewed literature. The studies in this area examine the relationship between students' competencies, university activities, industry exposure, and their preparation for employment. The reviewed studies look at career development from different perspectives, including employability skills, partnerships with industry, internships, and work experience.

Borah, Malik, and Massini looked at teaching-centred partnerships between universities and firms, and at how these affect the employability-related competencies graduates build. [1]

Ng et al. investigated which employability skills gained during higher education help young graduates find better career opportunities. They also point to the part employers play in engaging with higher education and how this relates to students' prospects. [9]

Ishengoma and Vaaland asked whether links between universities and industry can improve how employable students are. They treat internships, shared projects, and the involvement of companies as forms of interaction that may help employability. [8]

Hegade and Shettar qualitatively studied what students experience and learn during internships, in particular how

classroom learning relates to professional practice. Their study stresses the value of linking academic learning to hands-on industry experience. [7]

The reviewed studies examine employability from several related perspectives. Some focus on competencies developed through university education, while others consider industry engagement, internships, and professional experience. Together, these studies show that career development involves multiple aspects of a student's academic and professional development. It is not limited to academic qualifications alone, but also involves the skills and experiences students gain during their education.

However, the reviewed studies generally focus on specific aspects of employability and career development rather than combining them into a unified process. Student competencies, professional profiles, career opportunities, application management, and recruiter interaction are addressed separately across the reviewed literature. This indicates a need to examine how these elements can be connected within a broader campus career ecosystem. Such integration could provide students with a more connected way to manage their skills, experiences, opportunities, and career-related activities.

C. Career and Opportunity Recommendation

Career and opportunity recommendation is another important theme in the reviewed literature. The studies in this area examine how student profiles, skills, academic information, and labour-market requirements can be used to recommend suitable career paths, courses, internships, jobs, and other opportunities.

Yang et al. designed a deep-learning recommender to guide college students toward employment. It combines student-related data with job requirements to produce individualised suggestions, showing how recommendation methods can support career guidance by accounting for each student's characteristics. [5]

Xu and Gao proposed a knowledge graph-integrated recommendation method for college student career planning. Their approach uses relationships between student information, skills, careers, and related requirements to support personalized career planning and recommendations. [11]

Bairi and Prasad applied machine learning and job-market data to forecast career paths for individuals. They combine this forecasting with skill-gap analysis and employment trends, illustrating how shifting labour-market information can feed into career recommendations. [12]

Ramazanov et al. proposed a knowledge-graph model that recommends MOOCs matched to university programmes and employer demands. Although it targets course recommendation, it shows how employer requirements and skill data can be tied to learning suggestions that support career development. [2]

The reviewed studies show that recommendation systems can use different types of information, including student profiles, skills, academic background, employer requirements, job-market information, and career relationships. Machine

learning and knowledge graph approaches are used to establish relationships between these factors and generate personalized recommendations. This shows that recommendation systems can consider more than one aspect of a student when providing career-related suggestions.

However, the reviewed approaches generally focus on a particular recommendation task, such as career planning, employment guidance, course recommendation, or career-path prediction. They do not generally combine career recommendations with broader activities such as opportunity management, application tracking, and recruiter interaction. This indicates that recommendation systems can form an important component of a broader campus career ecosystem, while their integration with other career-management activities remains an area for further consideration.

D. Internship and Job Recommendation

Internship and job recommendation systems aim to connect students with suitable career opportunities by considering information such as skills, academic background, competencies, preferences, and opportunity requirements. The reviewed literature includes approaches based on knowledge graphs, machine learning, deep learning, and skill-based analysis to improve student–opportunity matching.

Seetaworn et al. investigated personalized internship recommendations using knowledge graphs in software engineering courses. Their work connects student-related information with internship opportunities and demonstrates how knowledge graphs can be used to provide personalized internship recommendations. [4]

Yang et al. also proposed a deep-learning recommender for employment guidance in colleges. It weighs a student's academic background and preferences against market demands to give personalised job suggestions, illustrating how student data and employment requirements can be combined to find suitable opportunities. [5]

Onukwugha et al. described a generative-AI framework that performs live skill-gap analysis and adapts career advice. Through competency testing, guidance, and job matching, it ties student competency data to possible jobs, showing that skill-gap findings can also help match students with suitable positions. [13]

Bairi and Prasad developed a machine-learning approach to career-path prediction that adapts to the individual and to job-market insights. It joins career prediction, skill-gap analysis, and evolving market information, showing that skill and labour-market data can be used together to generate tailored career recommendations. [12]

The reviewed studies use different approaches to support student–opportunity matching. Knowledge-graph approaches provide a way to represent relationships between students, skills, educational information, and opportunities, while machine-learning and deep-learning approaches can use student and market-related information for recommendation. These approaches demonstrate that multiple types of student

and opportunity information can be considered when identifying relevant internships and jobs.

However, the reviewed studies generally concentrate on recommendation or matching as a specific function. Broader activities such as opportunity management, application tracking, student–recruiter interaction, and maintaining a unified student career profile are not consistently addressed together. As a result, recommendation may help students identify suitable opportunities, but other parts of the career journey still need to be managed separately. This indicates a gap between recommendation mechanisms and the broader management of the student career journey, providing a basis for the proposed UPLINK campus career ecosystem.

E. Digital Portfolios and Student Profiles

Digital portfolios and student profiles are important parts of student career development because they provide a structured way to present academic achievements, skills, projects, certifications, experiences, and other professional information. Unlike a traditional resume, a digital portfolio can bring different aspects of a student's academic and professional background together in one place. The reviewed literature examines how digital portfolios can help students present their competencies and support their transition from higher education to employment.

Gutiérrez-Santiuste et al. surveyed how higher education students perceive e-portfolios as a means of boosting their employability. They discuss using e-portfolios to showcase skills, achievements, and academic experience, and note both the strengths and the weaknesses of doing so. [19]

Mitchell et al. carried out a systematic scoping review of how e-portfolios can raise graduate employability. They stress the need to present portfolio content in a form that matches what employers expect, which suggests portfolios can bridge students' academic experience and the demands of the job market. [20]

Ciesielkiewicz, Bonilla, and Olave López de Ayala explored, through the views of HR directors, whether e-portfolios could serve in recruitment. They consider how portfolio content can help employers judge candidates beyond formal qualifications, pointing to portfolios as an extra source of information in hiring. [33]

Carroll, Markauskaite, and Calvo examined e-portfolios in an engineering course as a way for students to build and show transferable skills. Their work indicates that portfolios can document skills gained through coursework and learning activities, letting students show not only what they studied but also what they can do. [32]

The reviewed studies show that digital portfolios can provide a richer representation of students than conventional academic records or resumes alone. They can bring together skills, projects, achievements, certifications, and experiences and present them as evidence of student competencies. This makes them useful for both students who want to present their abilities and employers who need additional information when evaluating candidates.

However, the literature mainly examines digital portfolios as tools for skill representation, employability, or recruitment. They are generally not combined with skill-gap analysis, career and opportunity recommendations, application tracking, and recruiter interaction within the same platform. This indicates that digital portfolios can serve as an important foundation for a broader student profile and career-management ecosystem.

F. University–Industry Collaboration

Cooperation between universities and industry is a key theme in the reviewed literature because it gives students chances to build competencies and experience professional settings first-hand. It can also help universities learn what industry needs and strengthen the link between academic learning and workplace expectations.

Borah, Malik, and Massini studied teaching-oriented partnerships between universities and companies and their effect on graduates' employability competencies. They link such partnerships to how those competencies develop, showing that contact with industry can relate to the skills students acquire during their degree. [1]

Ishengoma and Vaaland asked whether ties between universities and industry can boost student employability. They count internships, joint projects, and corporate involvement as forms of interaction that may contribute, giving students practical experience and more direct contact with workplaces. [8]

Hegade and Shettar studied the learning outcomes and experiences of student interns, focusing on how academic learning relates to professional practice. They argue for closer alignment between classroom learning and industry experience, which suggests that practical exposure can complement theory and help students grasp what professional work demands. [7]

Ben Messaoud, Ilahi, and Cheniti-Belcadhi tackled the mismatch between university competencies and industry needs by using learning analytics to offer personalised micro-credentials. Their study ties competency development to industry demands, offering another angle on strengthening university–industry ties and on aligning learning with expected competencies. [3]

These studies show that university–industry collaboration can involve several forms of interaction, including internships, joint projects, employer engagement, and alignment between academic competencies and industry requirements. Together, they indicate that interaction with industry can play an important role in developing student competencies and improving career preparation.

However, the reviewed approaches generally address collaboration and employability as separate activities rather than providing a unified environment for managing student profiles, skills, opportunities, applications, and interaction with industry. Different activities may therefore remain spread across separate processes or platforms.

The literature therefore indicates a gap in integrating university–industry interaction with the broader student career-development process. This provides a basis for considering a

unified campus career ecosystem in which student competencies and industry requirements can be connected with relevant opportunities and career-related activities. Such an approach could bring academic development, skill information, career opportunities, and industry interaction closer together within a common platform.

IV. COMPARATIVE ANALYSIS OF EXISTING STUDIES

The reviewed studies address varied aspects of how students develop careers and how higher education connects to the job market. Although the studies have different objectives and use different approaches, they commonly use information such as student skills, academic background, employer requirements, professional experience, and labour-market information to support career-related activities.

Studies on skill mapping and skill-gap analysis mainly focus on identifying differences between student competencies and industry requirements. Some approaches use learning analytics and micro-credentials, while others use machine learning or knowledge graphs to connect skills with learning resources, career paths, or opportunities. These studies highlight the importance of structured skill information in supporting student development and career planning. [2], [3], [12], [13]

Studies on employability and career development focus more on the development of competencies through university education, internships, professional experiences, and university-industry collaboration. These studies show that employability is influenced by both academic learning and exposure to professional environments. At the same time, the approaches generally examine these activities separately rather than treating them as parts of a common digital platform. [1], [7]–[9]

Career and opportunity recommendation studies mainly use machine learning, knowledge graphs, and recommendation techniques to provide personalized career paths, employment recommendations, courses, or internships. These approaches show the potential of using student and opportunity information to support more personalized career-related decision-making. However, recommendation is generally treated as the main function rather than being combined with complete opportunity and application management. [4], [5], [11], [12]

Research on digital portfolios and student profiles focuses on representing skills, projects, achievements, certifications, and experiences in a structured form. These studies highlight the value of portfolios for demonstrating competencies to employers and supporting employability. However, portfolio systems are generally considered separately from recommendation systems, opportunity tracking, and recruiter interaction. [19], [20], [33]

University-industry collaboration studies emphasize internships, joint projects, employer engagement, and other forms of interaction between educational institutions and industry. These studies demonstrate the importance of industry participation in developing employability and improving alignment between education and workplace requirements. However, the

reviewed literature does not generally provide a unified mechanism for connecting these activities with student profiles, skills, opportunities, and application processes. [1], [3], [7], [8]

Overall, the comparison shows that existing studies provide useful approaches for individual components of a campus career ecosystem. Skill mapping, employability development, recommendation, digital portfolios, and university-industry collaboration are each explored in the literature, but they are often treated as separate areas. This separation suggests an opportunity to examine a more integrated approach in which student profiles, skill information, career opportunities, applications, and industry interaction can be connected within a common campus career ecosystem. Such an approach could bring these related activities together while building on the approaches already explored in the existing literature.

V. RESEARCH GAPS IDENTIFIED

The reviewed literature covers several important aspects of student career development, including skill mapping, skill-gap analysis, employability, career recommendation, internship and job matching, digital portfolios, skill extraction, and university-industry collaboration. However, these areas are generally studied as separate functions across the existing literature, with limited integration between them.

First, studies on skill mapping and skill-gap analysis mainly focus on identifying competencies, comparing them with industry requirements, or recommending suitable learning resources. These approaches provide useful information about student skills and areas for improvement. However, they do not consistently connect skill assessment with the complete management of career opportunities and related activities.

Second, career and opportunity recommendation studies focus on recommending careers, internships, jobs, courses, or learning resources using techniques including knowledge graphs, neural models, and other machine-learning methods. These studies show how student and market-related information can be used to generate personalized recommendations. However, recommendation is generally treated as the main outcome rather than as one part of a broader career-management process.

Third, internship and job recommendation studies provide mechanisms for matching students with suitable opportunities. While these approaches can help students identify relevant internships or jobs, broader activities such as application tracking, maintaining opportunity information, and communication between students and recruiters are not consistently integrated with the recommendation process.

Fourth, digital portfolio and skill-representation studies provide ways to document and present students' competencies, achievements, projects, and transferable skills. These approaches can give students a more detailed professional profile than a traditional academic record alone. However, the information represented in these portfolios is not consistently connected with opportunity recommendation, application management, or other career-related activities.

Finally, university–industry collaboration studies highlight the importance of internships, joint projects, employer engagement, and alignment between academic competencies and industry requirements. These studies show the value of stronger interaction between educational institutions and industry. However, such relationships are generally examined as educational or employability activities rather than as part of a unified digital career platform.

Overall, the reviewed literature indicates a fragmentation between student skill representation, skill-gap identification, career and opportunity recommendation, application management, and university–industry interaction. The identified gap is therefore not the absence of individual solutions, since each of these areas has already been explored through different approaches. Instead, the gap lies in the limited integration of these functions within a single campus-focused career ecosystem. UPLINK is proposed in response to this integration gap by bringing these related activities together within a unified platform, while building on the approaches identified in the existing literature.

VI. IMPLICATIONS FOR A UNIFIED CAMPUS CAREER ECOSYSTEM

The reviewed literature indicates that student career development involves several interconnected activities, including skill identification, skill-gap analysis, employability development, career guidance, opportunity recommendation, digital portfolio development, and university–industry interaction. However, these activities are commonly addressed through separate approaches and systems.

The findings suggest that student information can serve as a common link between these activities. A structured student profile containing academic information, skills, projects, certifications, achievements, and professional experiences can provide the foundation for skill assessment and career-related services. Skill information can then be connected with industry requirements to identify skill gaps and support suitable learning or career recommendations.

The literature also indicates that career opportunities should not be considered independently from student skills and profiles. Internship, job, training, hackathon, and other opportunities can be associated with required skills and eligibility conditions, allowing students to identify opportunities relevant to their profiles. Application tracking can further connect recommendations with the actual progress of students through different opportunities.

Another implication concerns the role of industry interaction. Recruiters and companies require relevant information about student competencies and experiences when identifying potential candidates. A unified ecosystem can provide structured student profiles and portfolios while also supporting opportunity publishing, candidate discovery, and communication between students and industry.

Based on these observations, a unified campus career ecosystem can be viewed as an integration of several existing research areas rather than as a replacement for them. Skill

mapping, student profiles, digital portfolios, recommendation systems, opportunity management, application tracking, and university–industry interaction can be connected to support a more continuous career-development process.

These implications provide the basis for the proposed direction of UPLINK, which aims to bring these career-related activities together within a common campus-oriented ecosystem. The project is therefore positioned as a proposed application of the themes identified through the literature review rather than as a replacement for the individual approaches presented in existing studies.

VII. PROPOSED DIRECTION FOR UPLINK

In light of the shortcomings found in the reviewed studies, UPLINK is put forward as a single, campus-oriented career ecosystem that links student profiles, skills, career opportunities, applications, and industry interaction within one platform.

The proposed direction brings together several capabilities that are commonly addressed separately in existing studies. Student profiles can include relevant academic information, competencies, skills, projects, and other career-related details. Skill mapping can then be used to identify relationships between student competencies and the requirements of available opportunities. This can provide a basis for identifying and recommending relevant internships, jobs, and other career opportunities.

UPLINK is also intended to connect recommendation with broader career-management activities. Rather than limiting the platform to recommending an opportunity, the proposed system can support opportunity management, application tracking, and interaction between students and recruiters. In this way, recommendation can become part of a larger career-development process rather than functioning as an isolated feature.

The reviewed literature also highlights the importance of connecting academic development with industry requirements. Therefore, UPLINK is proposed to provide a common environment in which student skills and competencies can be considered alongside employer and opportunity requirements. This can help create a clearer connection between what students have learned, the skills they possess, and the requirements associated with available opportunities.

The proposed direction is intended to reduce the fragmentation identified across the reviewed studies by bringing skill mapping, opportunity recommendation, application-related activities, and university–industry interaction into a unified campus platform. It also provides a common space for students and recruiters to manage career-related activities that are otherwise handled through separate systems.

This direction follows from the research gaps found in the review and describes the intended scope of UPLINK. Its actual effectiveness would depend on further implementation, testing, and evaluation, and is therefore not established by this literature review alone.

VIII. LIMITATIONS OF THE REVIEW

This review has several limitations. First, the literature included in the review was selected from the academic sources available for the study and may not cover every relevant publication related to skill mapping, employability, career recommendation, digital portfolios, and university–industry collaboration. Some relevant studies or approaches may therefore not be represented in the review.

Second, the reviewed studies use different methods, datasets, technologies, and evaluation approaches. Because of these differences, directly comparing their results and measuring the effectiveness of one approach against another is difficult. The findings of the studies therefore need to be understood according to their individual objectives and contexts.

Third, many of the reviewed studies focus on specific components such as skill-gap analysis, recommendation systems, internships, digital portfolios, or industry collaboration. As a result, the review identifies fragmentation across these areas, but it does not provide empirical evidence that combining all of these functions into a single platform will necessarily lead to better outcomes.

Finally, the proposed UPLINK direction is derived from observations made during the literature review. The review does not evaluate the effectiveness, usability, accuracy, scalability, or real-world impact of the proposed UPLINK ecosystem. These aspects would require an implemented system, appropriate datasets, user studies, and empirical testing in future work.

IX. CONCLUSION

This review examined existing research related to student skill mapping, skill-gap analysis, employability, career development, career and opportunity recommendation, internship and job matching, digital portfolios, skill extraction, and university–industry collaboration. The reviewed studies show that these areas have been explored using different approaches, including graph-based models, predictive learning methods, analysis of learner data, and generative AI.

The analysis also shows that these capabilities are generally addressed separately across the existing literature. Skill assessment, opportunity recommendation, employability development, application-related activities, and university–industry interaction are not consistently brought together within a single campus-focused platform. This separation represents the main research gap identified through the review.

Based on this gap, UPLINK is proposed as a unified campus career ecosystem that connects student profiles and skills with career opportunities and industry requirements while also supporting broader career-management activities. The proposed direction brings together concepts and approaches identified across the reviewed literature rather than introducing a completely separate research area.

The review therefore provides the literature foundation and research justification for UPLINK. It shows why integrating these related areas can be considered as a direction for further

study. Future work can focus on developing and evaluating the proposed platform to determine how effectively these separate career-related functions can be integrated within a common environment and how the platform performs in practical use.

REFERENCES

- [1] D. J. Borah, K. Malik, and S. Massini, "Teaching-focused university–industry collaborations: Determinants and impact on graduates' employability competencies," *Research Policy*, vol. 50, no. 3, Art. no. 104172, 2021, doi: [10.1016/j.respol.2020.104172](https://doi.org/10.1016/j.respol.2020.104172).
- [2] V. Ramazanov, M. Sambetbayeva, S. Serikbayeva, Z. Sadimekova, and A. Yerimbetova, "Development of a Knowledge Graph-Based Model for Recommending MOOCs to Supplement University Educational Programs in Line With Employer Requirements," *IEEE Access*, vol. 12, pp. 193313–193331, 2024, doi: [10.1109/ACCESS.2024.3519263](https://doi.org/10.1109/ACCESS.2024.3519263).
- [3] S. Ben Messaoud, M. Ilahi, and L. Cheniti-Belcadhi, "Towards a personalized micro-credentials approach based on learning analytics for reducing the gap university–industry," in *2022 IEEE Global Engineering Education Conference (EDUCON)*, 2022, doi: [10.1109/EDUCON52537.2022.9766585](https://doi.org/10.1109/EDUCON52537.2022.9766585).
- [4] S. Seetaworn, P. Phenhiran, P. Ngokpol, M. Innoy, S. Ingboon, T. Utasri, and A. Takhom, "Leveraging Knowledge Graphs for Personalized Internship Recommendations: A Case Study on Software Engineering Courses," in *2025 IEEE International Conference on Cybernetics and Innovations (ICCI)*, 2025, doi: [10.1109/ICCI64209.2025.10987407](https://doi.org/10.1109/ICCI64209.2025.10987407).
- [5] G. Yang, J. Yang, Y. Wang, and Y. Zhang, "Research on Optimization of Intelligent Recommendation System for College Employment Guidance Based on Deep Learning," in *2024 5th International Conference on Information Science and Education (ICISE-IE)*, 2024, doi: [10.1109/ICISE-IE64355.2024.11025487](https://doi.org/10.1109/ICISE-IE64355.2024.11025487).
- [6] S. El-Ferik and M. Al-Naser, "University Industry Collaboration: A Promising Trilateral Co-Innovation Approach," *IEEE Access*, vol. 9, pp. 112761–112769, 2021, doi: [10.1109/ACCESS.2021.3104096](https://doi.org/10.1109/ACCESS.2021.3104096).
- [7] P. Hegade and A. Shettar, "Student Internship Experiences and Learning Outcomes – A Qualitative Study," in *2024 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)*, 2024, doi: [10.1109/TALE62452.2024.10834349](https://doi.org/10.1109/TALE62452.2024.10834349).
- [8] E. K. Ishengoma and T. I. Vaaland, "Can university–industry linkages stimulate student employability?," *Education + Training*, vol. 58, no. 1, pp. 18–44, 2016, doi: [10.1108/ET-11-2014-0137](https://doi.org/10.1108/ET-11-2014-0137).
- [9] P. M. L. Ng, J. K. Y. Chan, T. M. Wut, M. F. Lo, and I. Szeto, "What makes better career opportunities for young graduates? Examining acquired employability skills in higher education institutions," *Education + Training*, vol. 63, no. 6, pp. 852–871, 2021, doi: [10.1108/ET-08-2020-0231](https://doi.org/10.1108/ET-08-2020-0231).
- [10] E. Yi and D.-H. Park, "The effect of core competencies of university students on employment and first year salary level based on school activity log," *Heliyon*, vol. 10, no. 7, Art. no. e28474, 2024, doi: [10.1016/j.heliyon.2024.e28474](https://doi.org/10.1016/j.heliyon.2024.e28474).
- [11] X. Xu and H. Gao, "A knowledge graph-integrated recommendation method for college student career planning," *Discover Artificial Intelligence*, vol. 6, Art. no. 406, 2026, doi: [10.1007/s44163-026-00996-9](https://doi.org/10.1007/s44163-026-00996-9).
- [12] N. Bairi and G. Prasad, "Development of a Dynamic and Personalized Career Path Prediction using Machine Learning and Job Market Insights," in *2026 International Conference on Intelligent and Sustainable AI Systems (ICOSAAS)*, 2026, doi: [10.1109/ICOSAAS68663.2026.11649326](https://doi.org/10.1109/ICOSAAS68663.2026.11649326).
- [13] C. G. Onukwugh, C. Ofogbu, O. Aliche, and C. U. Bertrand, "Real-Time AI-Based Skill Gap Analysis and Adaptive Career Guidance Using a Generative AI Framework for the Modern Job Market," in *2025 5th Asian Conference on Innovation in Technology (ASIANCON)*, 2025, doi: [10.1109/ASIANCON66527.2025.11280793](https://doi.org/10.1109/ASIANCON66527.2025.11280793).
- [14] "Future-oriented learning: A market-driven course recommendation system," in *2025 IEEE International Symposium on Computational Intelligence and Machine Learning (ISCMIL)*, 2025, doi: [10.1109/IS-CMIL67495.2025.11358460](https://doi.org/10.1109/IS-CMIL67495.2025.11358460).
- [15] G. Malik and A. Venkatraman, "The great divide: Skill gap between employer expectations and skills possessed by employees," *Industrial and Commercial Training*, 2017, doi: [10.1108/ICT-11-2016-0071](https://doi.org/10.1108/ICT-11-2016-0071).
- [16] I. Wings, R. Nanda, and K. J. Adebayo, "A Context-Aware Approach for Extracting Hard and Soft Skills," *Procedia Computer Science*, vol. 193, pp. 163–172, 2021, doi: [10.1016/j.procs.2021.10.016](https://doi.org/10.1016/j.procs.2021.10.016).

- [17] J. Unni, "Skill Gaps and Employability: Higher Education in India," *Margin: The Journal of Applied Economic Research*, vol. 1, no. 1, 2016, doi: [10.1177/2455133315612310](https://doi.org/10.1177/2455133315612310).
- [18] N. Bhatnagar, "Employability and skill gap among MBA graduates in India: a literature review," *Industrial and Commercial Training*, vol. 53, no. 1, pp. 92–104, 2021, doi: [10.1108/ICT-10-2019-0098](https://doi.org/10.1108/ICT-10-2019-0098).
- [19] E. Gutiérrez-Santiuste, S. García-Segura, M. Á. Olivares-García, and E. González-Alfaya, "Higher Education Students' Perception of the E-Portfolio as a Tool for Improving Their Employability: Weaknesses and Strengths," *Education Sciences*, vol. 12, no. 5, Art. no. 321, 2022, doi: [10.3390/educsci12050321](https://doi.org/10.3390/educsci12050321).
- [20] L. Mitchell, C. Campbell, M. Somerville, E. Cardell, and L. T. Williams, "Enhancing graduate employability through targeting ePortfolios to employer expectations: A systematic scoping review," *Journal of Teaching and Learning for Graduate Employability*, vol. 12, no. 2, 2021, doi: [10.21153/jtlge2021vol12no2art1003](https://doi.org/10.21153/jtlge2021vol12no2art1003).
- [21] A. Hamilton, T. Downer, B. Flanagan, and L. Chilman, "The use of ePortfolio in health profession education to demonstrate competency and enhance employability: A scoping review," *Journal of Teaching and Learning for Graduate Employability*, vol. 14, no. 1, pp. 169–181, 2023, doi: [10.21153/jtlge2023vol14no1art1704](https://doi.org/10.21153/jtlge2023vol14no1art1704).
- [22] C. Lahoud, S. M. Moussa, C. Obeid, H. El Khoury, and P.-A. Champin, "A comparative analysis of different recommender systems for university major and career domain guidance," *Education and Information Technologies*, vol. 28, pp. 8733–8759, 2023, doi: [10.1007/s10639-022-11541-3](https://doi.org/10.1007/s10639-022-11541-3).
- [23] A. José-García, A. Sneyd, A. Melro, A. Ollagnier, G. Tarling, H. Zhang, M. Stevenson, R. Everson, and R. Arthur, "C3-IoC: A Career Guidance System for Assessing Student Skills using Machine Learning and Network Visualisation," *International Journal of Artificial Intelligence in Education*, vol. 33, pp. 1092–1119, 2023, doi: [10.1007/s40593-022-00317-y](https://doi.org/10.1007/s40593-022-00317-y).
- [24] R. Liu, W. Rong, Y. Ouyang, and Z. Xiong, "A hierarchical similarity based job recommendation service framework for university students," *Frontiers of Computer Science*, vol. 11, no. 5, pp. 912–922, 2017, doi: [10.1007/s11704-016-5570-y](https://doi.org/10.1007/s11704-016-5570-y).
- [25] "JobEdKG: An uncertain knowledge graph-based approach for recommending online courses and predicting in-demand skills based on career choices," *Engineering Applications of Artificial Intelligence*, 2023, doi: [10.1016/j.engappai.2023.107779](https://doi.org/10.1016/j.engappai.2023.107779).
- [26] D. Vlachopoulos and O. Pachni Tsitiridou, "Preparing University Graduates for the Labour Market Through Employability Skills Development and University-Industry Collaboration: A Systematic Review," *Education Sciences*, vol. 16, no. 3, Art. no. 426, 2026, doi: [10.3390/educsci16030426](https://doi.org/10.3390/educsci16030426).
- [27] T. P. Nguyen, "Graduate skill gaps in applied higher education: a triadic analysis from a work-based learning perspective," *Higher Education, Skills and Work-based Learning*, vol. 16, no. 3, pp. 677–692, 2026, doi: [10.1108/HESWBL-01-2026-0063](https://doi.org/10.1108/HESWBL-01-2026-0063).
- [28] J. Chen, Y. Li, L. Wang, and T. London, "An ecosystemic approach to sustainable graduate employability: A case study of a Sino-British joint university in China," *Education + Training*, vol. 68, no. 6, pp. 921–938, 2026, doi: [10.1108/ET-03-2025-0140](https://doi.org/10.1108/ET-03-2025-0140).
- [29] J. E. E. Goh, M. L. I. Goh, C. V. Mojado, G. E. S. Florendo, and J. T. B. Morales, "Design and Evaluation of an Intelligent Internship Matching E-System Using NLP for IT Education," in *2026 17th International Conference on E-Education, E-Business, E-Management and E-Learning (IC4e)*, pp. 312–317, 2026, doi: [10.1109/IC4e69618.2026.11631568](https://doi.org/10.1109/IC4e69618.2026.11631568).
- [30] "TechTrack: An Internship Matching Platform for Career Recommendation Using Machine Learning," in *2026 IEEE International Conference on Business and Information Research (ICBIR)*, 2026, doi: [10.1109/ICBIR69932.2026.11584730](https://doi.org/10.1109/ICBIR69932.2026.11584730).
- [31] "Facilitating Employability: The Role of Internships, Professional Practices in Industry, and Educational Partners in Engineering Programs," in *2025 World Engineering Education Forum-Global Engineering Deans Council (WEEF-GEDC)*, 2025, doi: [10.1109/WEEF-GEDC66748.2025.11256467](https://doi.org/10.1109/WEEF-GEDC66748.2025.11256467).
- [32] N. L. Carroll, L. Markauskaite, and R. A. Calvo, "E-Portfolios for Developing Transferable Skills in a Freshman Engineering Course," *IEEE Transactions on Education*, vol. 50, no. 4, pp. 360–366, 2007, doi: [10.1109/TE.2007.907554](https://doi.org/10.1109/TE.2007.907554).
- [33] M. Ciesielkiewicz, C. Bonilla, and C. Olave López de Ayala, "The Potential of the ePortfolio as a Recruitment Tool: From the Perspective of HR Directors," *International Journal of Interactive Mobile Technologies*, vol. 14, no. 3, pp. 95–106, 2020, doi: [10.3991/ijim.v14i03.11557](https://doi.org/10.3991/ijim.v14i03.11557).
- [34] M. Bikanga Ada, "Exploring the Potential of ePortfolios to Support Transition among International Students and Second-Year Entrants in Higher Education," in *2024 IEEE International Conference on Advanced Learning Technologies (ICALT)*, pp. 272–273, 2024, doi: [10.1109/ICALT61570.2024.00085](https://doi.org/10.1109/ICALT61570.2024.00085).
- [35] "Bridging Academia and Industry With Generative AI: A Platform for Dynamic Skill Development and Recruitment," in *2025 16th International Conference on E-Education, E-Business, E-Management and E-Learning (IC4e)*, 2025, doi: [10.1109/IC4e65071.2025.11075412](https://doi.org/10.1109/IC4e65071.2025.11075412).