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Enhancing Talent Development using AI-Driven Curriculum-Industry Integration

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Abstract

The specific hiring needs render low-skill-based job-seeking invalid in coping with the nation's economic development. There needs to be more graduate readiness for the industry's needs. This paper explores the transformative potential of Artificial Intelligence (AI) in fostering a symbiotic relationship between academic curricula and industry demands, aimed at building a robust talent pool for the future. A new hiring selection model that matches industry-identified hiring parameters with the knowledge and skills obtained from the university. By aligning educational programs with real-world challenges and market needs, this novel approach seeks to propel the growth of talents.

Keywords: Talent Development: Artificial Intelligence: Graduate Employability: Industry Needs

1.0 Introduction

Ensuring a skilled and adaptable workforce is crucial for national progress in academia and industry. Hiring practices require higher knowledge and skills. Bridging the gap between higher learning institutes and industry demands is necessary to avoid economic instability and high unemployment rates. Currently, a significant mismatch exists between the skill sets possessed by graduates and the skills demanded by industries, creating challenges in meeting industry requirements (Weaver & Osterman, 2017). This disparity is projected to become more challenging to address as technological disruptions reshape various sectors, leading to shifts in available job opportunities. According to a survey by ManpowerGroup, 77% of employers across 41 countries face difficulties filling high-skilled positions in 2023 (ManpowerGroup, 2023). This global perspective underscores the widespread nature of the challenge, transcending geographical boundaries and industry sectors. In the United States, it is observed that 92% of small businesses trying to fill job openings in July 2023 found few or no qualified applicants (National Federation of Independent Business, 2023). These figures indicate a significant gap between the skills employers are seeking and the skills possessed by the available workforce. This concern gains further support from a report by the Department of Statistics Malaysia, which indicates that approximately 3.52% of graduates remain unemployed, and another 15% work outside the labor force out of 5.61 million graduates in 2021. It is also observed that the rate of skill-

related underemployment for graduates continued to increase, registering 33.9 percent or 1.55 million persons (2020: 1.36 million persons; 31.2%). This unemployment and working outside the labor force trend can be attributed to graduates' skill sets needing to align with the specific needs of industries.

The mismatch between academia and industry is apparent in the rigid curriculum structures imposed on university students based on their selected programs. Currently, students are compelled to adhere to a predetermined curriculum without the flexibility to select courses that align with their preferences. This uniform approach persists even if students encounter difficulties with prerequisite subjects, which affects the entire cohort's progression. Regrettably, personalized learning is not a current offering, leading to a situation where the curriculum is tailored according to the design rather than students' needs. An additional challenge arises from course designers often overlooking the varying paces at which students grasp course competencies (Dietz-Uhler & Hurn, 2013). In response to this challenge, the implementation of personalized learning strategies has the potential to yield significant benefits (Hughey, 2020). Students can receive tailored support that matches their unique learning needs by pinpointing specific areas based on individual. This approach addresses the mismatch between students' skills and industry demands and fosters a more dynamic and responsive educational environment.

However, there appears to be a need for concerted efforts among Higher Education Institutions (HEIs) to validate these learning experiences effectively. The omission of profiling and formal recognition hampers the bridge between graduates' skill enhancements and industry acknowledgment. The HEIs must highlight micro-credentials and self-learning achievements within a graduate portfolio to empower graduates with a more holistic skill set. It also ensures that industries are well-informed about their diverse capabilities, ultimately promoting a seamless transition from academia to the professional world. Hence, a platform that enables the three entities – graduates/academia/industry must be established.

The mismatch between graduate skills and industry demands is also compounded by the dynamic nature of industries, which continuously adapt to align with customer preferences. Although industries frequently alter their requirements, they often do not communicate these changes explicitly to academia; instead, they anticipate that academic institutions will respond to their evolving needs. It creates a challenge as academic institutions operate within established frameworks that govern curriculum updates, rendering the process slow and cumbersome. Unfortunately, when these updates are implemented, industries might have shifted their demands again, rendering the academic efforts seemingly ineffectual and out of touch.

Industries are progressively adopting data analytics to optimize their talent acquisition strategies. This approach allows companies to efficiently locate and match suitable candidates for their needs. The evidence for this trend is evident in the heightened focus on data-driven processes in talent search (Bongard, 2019). Nonetheless, identifying the perfect talent remains an ongoing challenge for organizations. Campus recruitment through job portals and informal word-of-mouth talent is always preferable. However, the scope of potential talent available through campus recruitment alone is immense, leading to a substantial volume of data that can be harnessed for analysis. This data-driven approach empowers companies to optimize the alignment between job requirements and the available talent pool. However, it remains a challenge for the industry to accurately discern the full extent of graduate capabilities, mainly encompassing intangible attributes like soft skills that often elude explicit coverage in the curriculum.

In a nutshell, a direct correlation between academia, industry, and graduates is notably absent. The academic curriculum often needs help to align with the rapidly evolving demands of the industry. Graduates adhere to outdated syllabi that do not resonate with industry requisites, creating a mismatch between their skills and what employers seek. Despite this disparity, industries require competent talent to fulfill their operational demands. The imperative for a cohesive platform to bridge these three entities becomes evident in response to this disconnection. Such a platform should operate on principles of transparency and mutual support. This collaborative space will facilitate a seamless exchange of insights, ensuring academic programs remain relevant to industry needs. Graduates emerging from this aligned ecosystem will possess skills that match industry expectations, fostering a symbiotic relationship where academia, industry, and graduates each contribute to and benefit from the broader landscape. This paper aims to illustrate the potential of artificial intelligence in establishing a bridge between academia, graduates, and industry. We propose the creation of a platform that extracts data from academic syllabi and job advertisements and maps them with the graduates' skill sets to tailor to the needs of the job. Such an approach can simplify the graduate job-hunting process and allow the companies to select relevant candidates.

2.0 Literature Review

The emergence of the Fourth Industrial Revolution (IR4.0) has triggered a transformative shift in the job landscape, rendering specific roles obsolete due to their diminished relevance in the modern technological context. This technological revolution, characterized by automation, data exchange, and advanced digital technologies, reshapes work and necessitates a profound evolution in skill requirements. Jobs such as manual data entry clerks, telephone operators, and file clerks are replaced by data analysts, AI/machine learning engineers, and cybersecurity analysts due to technological advancement. A report by the World Economic Forum (WEF) estimates that by 2025, automation and AI will have displaced 85 million jobs but will simultaneously create around 97 million new roles, emphasizing the transformative nature of IR4.0 on the job market (World Economic Forum, 2020). In addition, a study by McKinsey & Company emphasizes the rising demand for data-driven roles, predicting that by 2030, nearly 800 million jobs will require significant digital skills (Manyika et al., 2017).

The dynamic changes within industries have compelled graduates to immerse themselves in the latest and relevant technologies to remain competitive and adaptable. Graduates must possess skills and knowledge relevant to the ever-changing landscape. They must rely on more than outdated syllabi to navigate these shifts, which urged the university to revamp its syllabus. Cacciolatti et al. (2017) stated that universities need to find the proper position in the knowledge economy so that the universities, policymakers, and industries

can collaborate and create programs to obtain practical experience and enable students to learn hard and soft skills. This opinion is also echoed by Shrivastava et al. (2022) that a curriculum matrix should be developed with the assistance of the industry.

A symbiotic relationship between the industry and academia hinges on effective communication and collaboration. For this synergy to flourish, industries hold a pivotal role in explicitly conveying their skill and knowledge requirements to academic institutions. Such proactive engagement has yielded fruitful outcomes (Bermejo et al., 2022; Sjöö & Hellström, 2019). When industries communicate their needs, academic institutions can tailor programs to cultivate a pipeline of job-ready graduates. Additionally, industries benefit from a talent pool with the requisite skills, reducing the gap between workforce demands and supply. Through mechanisms such as advisory boards, industry-academic partnerships, and internship programs, industries can provide ongoing feedback and input on the skills and knowledge they consider essential. This two-way interaction nurtures an ecosystem where graduates possess the practical skills and relevant knowledge to contribute effectively to the industry.

While the endeavor to update the syllabus to align with industry needs appears as the optimal solution, a simplified approach that can be swiftly implemented is required. Job recommender sites are a tool that can provide tailored job recommendations, significantly streamlining the job-hunting process and enhancing the overall job-seeking experience. They can help by leveraging artificial intelligence techniques to analyze a user's profile, preferences, skills, and past experiences. Forbes listed the best free job listing sites to help graduates find jobs (Baluch & Main, 2023). From the list, sites like Indeed, LinkedIn, Ladders, and others are presented. Their pros and cons are also discussed in detail. Indeed (Indeed, 2023) is selected as the best all-around option that offers free assessment and job skills tests that can be used to personalize the job. The finding is also supported by Gerencer (2023), who stated that Indeed provides a simple user interface allowing job seekers to enter a designated job title and location, attach a resume document, and complete the registration process in a single-click application submission. Kamaruddin et al. (2019) propose an automated solution that employs text mining and visualization for job recommender systems. Relevant keywords are automatically extracted based on advert word frequency, and graduates' skills are matched through personalized profiles. Then, visualization capabilities are added to facilitate selection. This approach could be integrated into job searching websites, enhancing the efficiency of both job seekers and employers. However, while the approach offers the advantage of streamlining search and filtering tasks, it remains afflicted by a significant limitation – the absence of integration with the university's provided syllabus. The system relies solely on industry demands and prerequisites. If candidates indiscriminately input irrelevant data, the job recommender system will generate nonsensical selections. A link between the university and industry needs to be established.
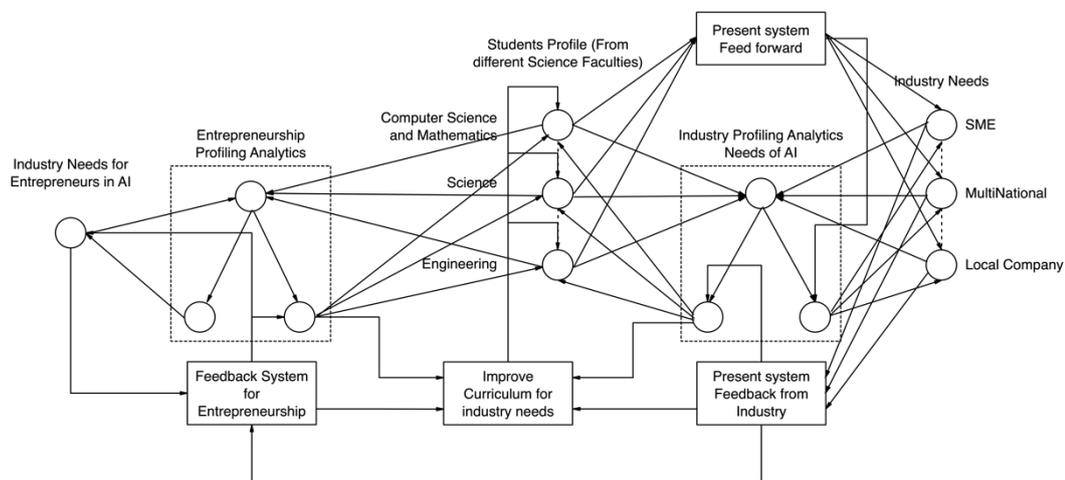

Fig. 1. Profiling for AI job seekers using the talent development ecosystem

The understanding of academic-industry-graduate is encapsulated with a block diagram depicted in Figure 1. The leftmost section of the figure presents the various types of companies that provide input for the system, including SMEs, multinationals, and local companies. This information creates a feedforward system for student profiling that enables HEIs to tailor their programs to meet the demands of the industry. The feedback collected from the industry is essential in enhancing the curriculum to ensure that it meets the current and future demands of the industry. The system also utilizes students' profiles from different science and engineering faculties to provide feedback to the HEIs. By analyzing the students' profiles, industry profiling analytics can identify gaps in the current curriculum and suggest ways to fill those gaps.

The graduates require the appropriate knowledge and skill sets, whether working for an industry or being self-employed. The HEIs provide the knowledge and skills. For self-employed individuals, it is crucial to consider both the industry and community needs, as these factors can determine the direction of their entrepreneurship. Consequently, a mechanism should be in place to support job creators by providing them with information on the industry's needs and facilitating community engagement. Such a mechanism will enable them to make informed decisions that align with the needs of both the industry and the community, thereby enhancing their chances of success. Figure 1 also highlights the importance of higher education institutions in meeting the needs of industries and communities by providing their graduates with the necessary skill sets and knowledge. It is also essential that these institutions develop mechanisms to support the long-term and short-term needs of both industries and communities to ensure their survival. Providing state-of-the-art training for

potential employees in technical and soft skills is essential in this context. The feedback from the industry is essential in ensuring the updates are continuous and relevant.

Rapid results can be achieved by aligning industry requirements, as reflected in job advertisements, with the available university syllabus (Hamiz et al., 2018). The industry will indicate the basic qualifications, skill set, and experience/exposure needed for graduates to work there. In contrast, the university will outline the knowledge and skills that students acquire while studying a specific course. In addition, graduates can augment their profiles with extracurricular pursuits, outside-class involvements, and professional certifications beyond the syllabus. This augmentation fosters a comprehensive and well-rounded profiling of graduates, shifting the emphasis away from purely academic performance to represent a holistic perspective.

3.0 The Comprehensive Talent Development Engine Methodology.

The foundation idea of the comprehensive Talent Development Engine is adopted from the theoretical framework presented by Hamiz et al. (2018). The proposed theoretical framework entails several sequential processes. Initially, student results will be retrieved from the Student database. Subsequently, an automated knowledge extraction will be performed using the compiled curriculum structure document to obtain skill sets. At the same time, the skill sets needed from the industry are extracted from the advertisements. Then, a matching algorithm will be used to map the relevant index and the weight to the list of indexed matching skill sets. Once the alignment between student and industry skill sets is established, a ranking mechanism will be employed to identify the job that highly matches the graduates to the least matched.

Data collection in this work focuses on the syllabus and job advertisement data. The job advertisement data was meticulously gathered from JobStreet (Jobstreet, 2023), employing the web scraping technique with Python. This technique effectively extracted crucial details from job postings, encompassing elements such as job position, company name, job type, salary, location, job description, and the corresponding URL to the job posting. A manual data cleaning process was meticulously administered in this project to ensure precision. There are 2124 job postings for Computer Science-related fields from January 2023 to June 2023. This dataset was meticulously scrutinized to categorize the diverse skill requisites associated with these job postings. For instance, positions necessitating programming languages such as HTML, CSS, and PHP, along with supplementary skills like Laravel, are systematically assigned relevant labels.

Moreover, the collected syllabi from the university have been compiled as well. For the scope of this study, the syllabi extracted from computer science courses, specifically CS230 and CS253 from the College of Computing, Informatics, and Mathematics at Universiti Teknologi MARA, were utilized. The rationale behind this selection is to focus on job advertisements related to computer science. The syllabi underwent processing by applying the Natural Language Processing (NLP) technique.

Subsequently, a string-matching phase is conducted. The employed fuzzy matching algorithm, facilitated by the FuzzyWuzzy PHP library, encompasses a comprehensive evaluation of parameters, including character similarity, transpositions, and word sequence. These factors collectively contribute to the computation of a similarity index between two given strings. In the present context, this algorithm establishes the extent of similarity between syllabus details and the requisite skills outlined in job postings. The FuzzyWuzzy effectively measures the correspondence between the academic content and industry-specific skills by quantifying the similarity scores between syllabus elements and job skills prerequisites. This approach is instrumental in gauging the potential relevance of the acquired knowledge to the practical demands of the job market.

4.0 Findings and Discussion

A web-based application was developed to demonstrate the concept by employing the PHP implementation of FuzzyWuzzy for performing approximate string matching. FuzzyWuzzy calculates similarity scores and identifies the nearest matching strings within a provided set of options. Then, the SQL query is utilized to retrieve information from the 'course_desc' column, containing syllabus descriptions, and the 'job_skill' column, encompassing details about job skill prerequisites, including programming languages. The execution of SQL queries was conducted using the 'mysqli_query()' function, leading to the storage of results in respective variables labeled as '$result1' and '$result2'.

The subsequent steps encompassed matching and ranking job descriptions against course descriptions based on similarity metrics. An array was initially created to store the matches and their corresponding similarity scores. Through iterative loops, each string from the SYLLABUS table was systematically compared with all strings from the JOB table. The calculation of similarity scores determined the optimal match, which was then stored in the '$matches' array.

Initial findings were obtained by analyzing input data from job listings on Jobstreet, focusing on the availability of computer science positions in January 2023. The participants in this study encompassed final-year students enrolled in a computer science program. As presented in Table 1, the summarized findings provide an overview of the outcomes of the alignment between student profiles and computer science job opportunities. These outcomes elucidate distinct prerequisites, discerned from the detailed listings on Jobstreet. Table 1 shows an example of the result that shows the job title and its requirements. The user can observe that the higher the similarity, the more relevant their syllabus and additional information to the job. This is important because the jobs in computer science have very distinct requirements and sometimes overlap, although they may have different titles.

Upon successfully aligning a user's enrolled courses with the requisite job skills, the system will generate a compilation of matched job opportunities and their respective similarity metrics. The resulting list will be accessible on the dedicated "Job Matched" page. The system will arrange this list based on ascending similarity values as a default presentation. Nonetheless, users can alter the display

arrangement by selecting the 'Sort' option at the upper left corner of the body section. This functionality enables users to switch the list's presentation in descending order. This adaptive feature empowers users to identify skills gaps by identifying jobs with lower degrees of matching, thus aiding them in recognizing areas for potential skill enhancement.

Table 1. Job matching of students applying for potential computer science jobs as advertised on Jobstreet

Jobs	Similarity
Java Developer Java	87%
System Developer MySQL, HTML, CSS, Javascript, JQUERY, PHP, C#	87%
Java Developer (Junior) Java	86%
Software Developer PHP, Larave, React JS, API, MySQL, MS SQL	85%
Software Developer API, MySQL, PHP, CSS, JavaScript, Angular, VueJS, JSON, Cordova, React JS	79%
Software Developer HTML, SASS, and Typescript	74%
Software Developer SQL, JavaScript, C#	65%
Software Development Engineer C	63%

6.0 Conclusions and Recommendations.

This paper substantiates a proof of concept that entails the aggregation of information from both university syllabi and industry requisites extracted from job advertisements. The employed methodology entails using straightforward techniques such as web scraping to procure data from job recommender websites, alongside Natural Language Processing for identifying pertinent terms within the syllabi. Despite using rudimentary matching methodologies, the proposed solution exhibits noteworthy potential, signifying its viability and serving as a foundation for future enhancements and implementations. However, challenges like labor-intensive manual job advertisement extraction, difficulty in obtaining syllabi due to restricted documents, and the students are not keen to provide their information are some that need to be addressed for future work.

The holistic endeavor of talent development constitutes a collaborative and synergistic engagement involving all stakeholders. This collective effort strives to nurture a proficient workforce, adept at adapting to the dynamic work landscape and actively contributing to the socioeconomic advancement of the nation. The underlying vision entails a framework where Higher Education Institutions (HEIs), industries, and communities converge in a collaborative synergy. This concerted approach ensures the comprehensive articulation of necessities and aspirations, a unified effort that transcends mere identification and transcends into action.

Central to this framework's potency is the strategic utilization of Artificial Intelligence (AI). AI operates as an instrumental tool, dissecting and comprehending the intricate dimensions of evolving market needs. By harnessing AI's analytical prowess, the framework endeavors to decipher genuine future prerequisites concerning skillsets integral to the impending economic milieu. The envisaged outcome aspires to be an incisive depiction of the skillsets requisite to propel the future economy, fostering a symbiotic relationship between HEIs, industries, and communities.

Acknowledgement

Paper Contribution to Related Field of Study

This study enhances the established concept by demonstrating the viability of integrating university syllabus content with industry requisites extracted from job advertisements. Although the findings remain preliminary, they exhibit promise for further refinement and development. Remarkably, the novel approach of harmonizing academic and industry inputs to optimize job matching has yet to be explored. This paper fills this gap by showcasing the initial steps in realizing this synergy, paving the way for future enhancements in the job recommendation process.

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