Unravelling the Dynamics of Generic Graduate Attributes and Employability in Higher Education for Sustainable Development

David Abejide
110128576
University of Windsor
Windsor, Canada
abejided@uwindsor.ca

Ayesha Siddiqua
110122759
University of Windsor
Windsor, Canada
ayeshas@uwindsor.ca

Fajuko Odunayo Micheal
110130116
University of Windsor
Windsor, Canada
fajuko@uwindsor.ca

Juanita Melosha Kingsly Vijay
110128207
University of Windsor
Windsor, Canada
kingslyj@uwindsor.ca

***Abstract*—The research delves into comprehensively analysing the soft skills required within the software industry, aiming to bridge the gap between academia and industry by offering insights into the soft skills landscape within this sector and their implications for graduates' readiness for employment. Using a qualitative research approach, job advertisements from a prominent technology-related job portal were manually analysed, without a predefined set of soft skills. The analysis identified soft skills, with communication-related skills being consistently emphasized across different positions. Notably, explicit references to soft skills were found in adverts, indicating their significant demand in the industry. The findings suggest that soft skills are universally sought after, irrespective of company size or core business focus. Additionally, the study explores graduates' employability status, utilizing logistic regression analysis on data we collected using google forms and referring to few job descriptions. The predictive model, highlights various factors influencing graduate employability, including communication skills, analytical skills, teamwork, and general knowledge. This research contributes to a deeper understanding of the soft skills landscape within the software industry and their role in shaping graduates' readiness for employment.**

***Index Terms*—Soft skills, Employability, Job adverts, Education**

I. Introduction

The concern over graduate employability, stemming from mismatches in skills and job expectations, prompts a need for understanding and addressing these discrepancies. Employability, defined as a blend of skills, attributes, and understandings aiding graduates in securing and succeeding in employment, highlights the growing significance of soft skills in today's service-oriented economy. In the context of software development, where soft skills like communication and teamwork are crucial for project success, empirical insights into specific soft skills demanded by the industry are lacking. This study aims to fill this gap by analysing job advertisements to identify and contextualize the soft skills sought by employers. By exploring correlations between soft skills, software engineering positions, and organizational characteristics, this research seeks to provide valuable insights for both academia and industry, aiding in curriculum design and professional development initiatives. By providing a more nuanced knowledge of the skills and competences sought for by employers and the impact of sustainability-focused coursework on graduates' preparedness for the profession, research aims to close the gap between education and employability results.

Similarly, the research project aims to investigate the impact of Sustainable Development Goal 4 (SDG 4) related curricula on graduates' employability, salary, and skill mismatches at the University of Windsor [1]. It seeks to explore the relationship between generic graduate attributes, specific knowledge, and sustainability in courses, emphasizing emotional engagement, diverse teaching methodologies, and interdisciplinary approaches. The study addresses the gap in understanding the influence of sustainability-focused coursework on graduates' skills and competencies desired by employers. The motivation for the research lies in influencing the quality of instruction, addressing the needs of the 21st century, and providing evidence-based ideas for policymakers to impact economic stability and workforce development [1]. The proposed solution involves employing a Machine Learning Logistic Regression Model to comprehensively analyze the impact of SDG-4 on the curricula of the University of Windsor, aiming to provide meaningful insights for researchers and policymakers.

II. Literature Review

The background study encompasses two main areas of research. This approach aims to understand the actual demand

for soft skills in the industry, as opposed to relying solely on individual perceptions.

The proposed solution involves employing a Machine Learning Logistic Regression Model to comprehensively analyze the impact of SDG-4 on the curricula of the Universities around the world, aiming to provide meaningful insights for researchers and policymakers[2].

A. Integration of SDGs into Educational Curricula:

Graduate employability is a multifaceted concern, necessitating a nuanced understanding of the factors influencing job acquisition, skills matching, and income expectations. Previous research has predominantly focused on integrating Sustainable Development Goals (SDGs) into educational curricula, emphasizing sustainability literacy and awareness among students. However, there's been a gap in understanding how SDG-related coursework directly impacts graduates' employability [3]. This study uniquely contributes by investigating this relationship quantitatively, utilizing data from the University of Bologna to provide robust statistical insights into the associations between SDG-related curricula and graduates' employability outcomes. Unlike prior qualitative studies, our approach offers precision in delineating the complex dynamics between sustainability education and career prospects.

B. Employability Skills and Soft Skills Development:

Furthermore, the literature underscores the significance of employability skills beyond academic knowledge. Studies have shown that soft skills, such as communication, teamwork, problem-solving, and leadership, play a crucial role in enhancing graduates' job readiness and employability [4]. Despite the recognition of the importance of soft skills, many graduates still lack adequate proficiency in these areas, hindering their transition into the labor market. Addressing this gap requires universities to incorporate soft skills development into their curricula, ensuring that graduates possess the necessary competencies desired by employers.

C. Context-Specific Factors Influencing Employability:

Regarding specific contexts, research in Malaysia has highlighted the importance of English proficiency, entrepreneurial orientation, and work experience in enhancing graduate employability. Factors such as gender, professional qualifications, and socio-economic backgrounds also influence graduates' job prospects. However, challenges persist, including the mismatch between industry demands and higher education offerings, as well as the prevalence of overqualification among graduates [5].

TABLE I. OLD AND NEW TALENT ASSESSMENT METHODS AND TOOLS

Old Methods	New Tools	Dimension Assessed
Interviews	Digital Interviews Voice Profiling	Expertise, Social Skills, Motivation and Intelligence
Biodata Supervisory Ratings IQ	Big Data	Past Performance, Current Performance, Intelligence, Job Related Knowledge and Big Five Personality Traits or Minor Traits
Situational Judgment Test Self-Reports	Gamification	
Self-Reports	Social Media Analytics	Big Five Personality Traits and Values (Identity claims)
Resume	Professional Social Networks	Experience, Past Performance and Technical Skills and Qualifications
360	Crowdsourced Reputation/Peer Ratings	Any personality Trait, Competencies and reputation

III. PROPOSED MODEL

A. Methodology: Logistic Regression

A Machine Learning Logistic Regression Model is implemented as part of the model, with the goal of giving academics and policymakers valuable information. The model emphasises emotional engagement, different teaching strategies, and multidisciplinary approaches in order to investigate the relationship between specialised knowledge, general graduate qualities, and sustainability in courses. Furthermore, the model attempts to close the knowledge gap about how graduates' abilities and competencies—which employers value—are affected by coursework with a sustainability focus. Along with addressing 21st-century requirements, it also aims to improve instruction quality and offer evidence-based recommendations to policymakers about workforce development and economic stability. The suggested remedy is using a Machine Learning Logistic Regression Model to thoroughly examine how SDG-4 has affected the curricula of the universities aiming to provide valuable insights for researchers and policymakers.

In logistic regression, the probability (P) of the outcome and the odds are key concepts. Probability ranges between 0 and 1, while odds can range from 0 to infinity. The relationship between probability and odds is given by the formulas:

$$P = \frac{\text{Number of outcomes}}{\text{Total number of possible outcomes}},$$

$$0 \le P \le 1$$

$$Odds = \frac{P(x)}{1 - P(x)}, 0 \le \text{Odd} \le \infty$$

Logit is the natural logarithm of odds and is linear in terms of the independent variables and parameters. The logit model is expressed as:

$$ln\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = \beta_o + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \hat{\beta}_3 x_3 + \cdots + \hat{\beta}_n x_n$$

where the probability of Y is

$$P(Y=1) = \frac{e^x}{1+e^x}$$

where $P(Y=1)$ is the probability of a graduate being employed, $\beta 0$ is the intercept, $\beta 1, \beta 2, \ldots, \beta k$ are the coefficients of the independent variables $X1, X2, \ldots, Xk$, which include factors such as general appearance, manner of speaking, communication skills, and various soft skills.

B. Flowchart:

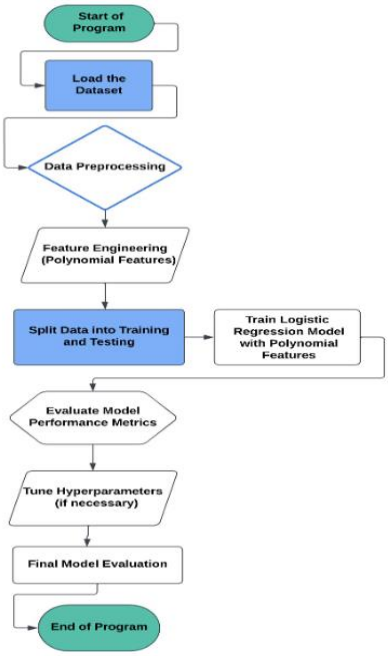

Fig 1

Fig 2

	Name of Student	GENERAL APPEARANCE	MANNER OF SPEAKING	PHYSICAL CONDITION	MENTAL ALERTNESS	SELF-CONFIDENCE	ABILITY TO PRESENT IDEAS	COMMUNICATION SKILLS	Student Performance Rating	CLASS	Average Score
741	Student 742	3	3	3	3	3	2	2	4	0	2.555556
2725	Student 2744	3	3	3	3	3	2	2	4	0	2.555556
1105	Student 1106	3	3	3	3	3	2	2	4	0	2.555556
195	Student 196	3	3	3	3	3	2	2	4	0	2.555556
923	Student 924	3	3	3	3	3	2	2	4	0	2.555556
...	...	...	...	...	...	...	...	...	...	...	...
297	Student 298	5	5	5	5	5	5	5	5	1	4.555556
1207	Student 1208	5	5	5	5	5	5	5	5	1	4.555556
661	Student 662	5	5	5	5	5	5	5	5	1	4.555556
1025	Student 1026	5	5	5	5	5	5	5	5	1	4.555556
843	Student 844	5	5	5	5	5	5	5	5	1	4.555556

2982 rows × 11 columns

Fig 3

IV. RESULTS

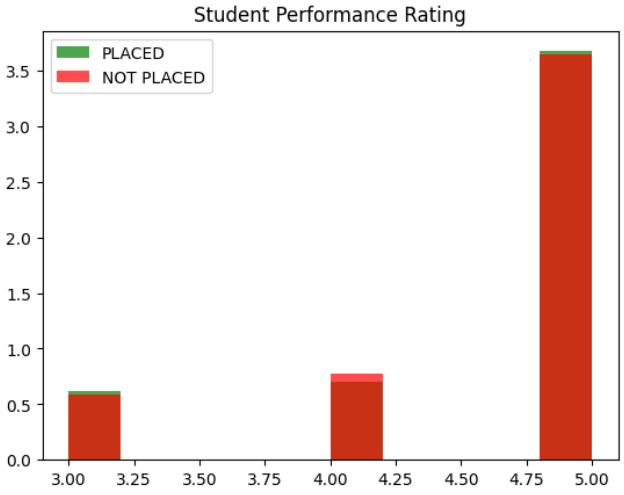

Fig 4

Student Performance Rating (Bar Chart): Based on their placement status, the students' performance ratings are shown in this bar chart. The number of students is shown on the y-axis, while the rating scale is represented on the x-axis. Students who were placed had an average rating higher than those who were not, indicating a substantial difference in performance ratings.

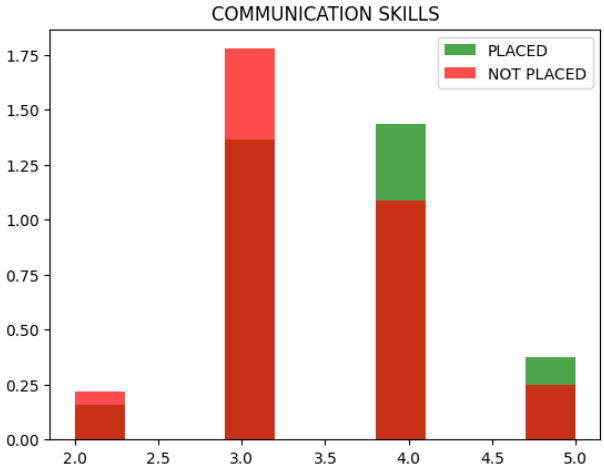

Fig 5

Communication Skills (Bar Chart): Using a placement and non-placement division, this bar chart shows the number of pupils with varying communication skill levels. The data suggests that pupils who possess superior communication abilities are typically placed more frequently than those who have lower scores.

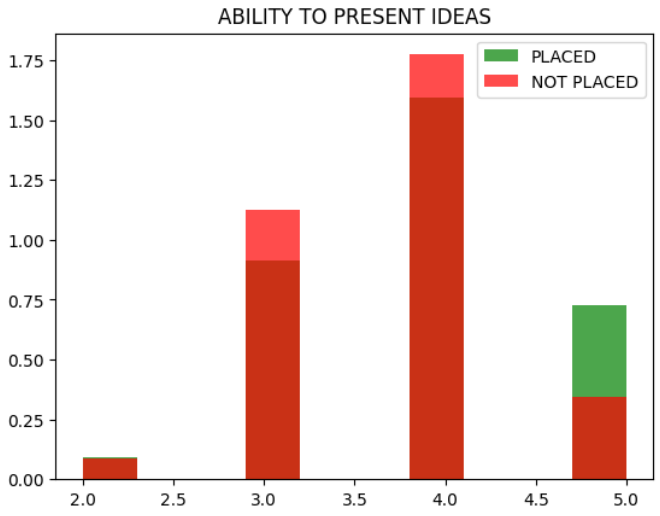

Fig 6

Proficiency in Idea Presentation (Bar Chart): This diagram illustrates how frequently students are able to share their ideas when compared to students who did not receive placement. It indicates that the placement rate is better for those who are skilled at communicating concepts.

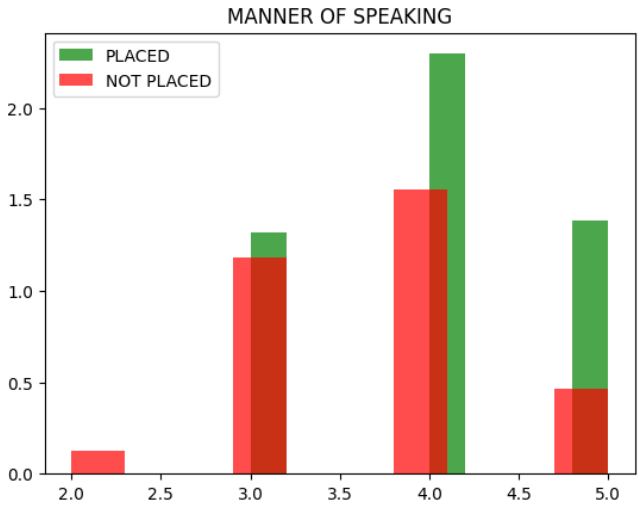

Fig 7

Speaking Manner (Bar Chart): This graphic shows how students' placement results are correlated with the way they communicate. It suggests communicating with greater confidence and clarity could have a favourable impact on placement success.

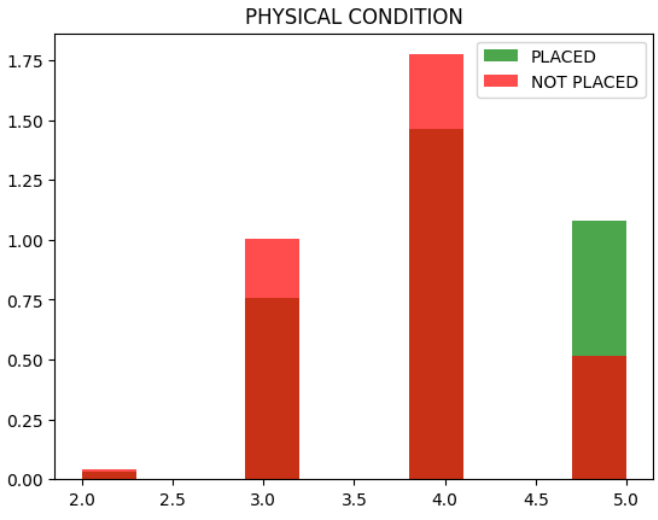

Fig 8

Physical Status (Bar Chart): Looking at students' placement status side by side with their physical condition, this bar chart illustrates a trend where higher placement rates are tangentially linked to better physical conditions.

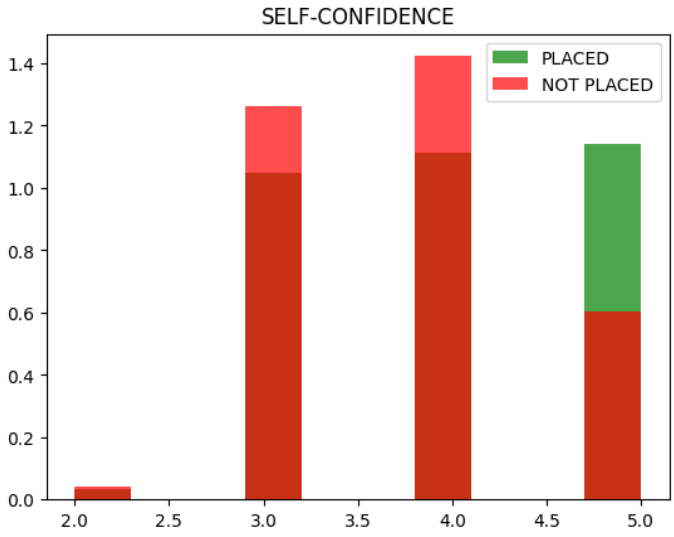

Fig 9

Self-Confidence (Bar Chart): This chart shows how pupils' degrees of self-confidence are distributed, contrasting those who are placed with those who are not. There seems to be a correlation between increased self-confidence and a higher chance of placement.

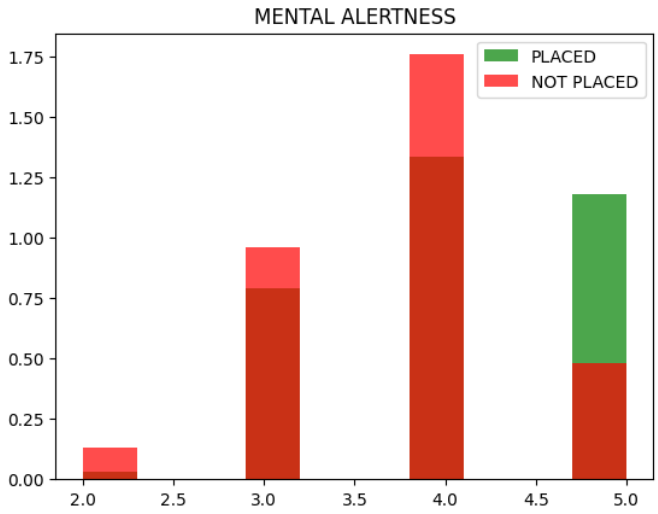

Fig 10

Mental Alertness (Bar Chart): Students that exhibit a higher degree of mental alertness are more likely to be placed; this seems to be the general pattern.

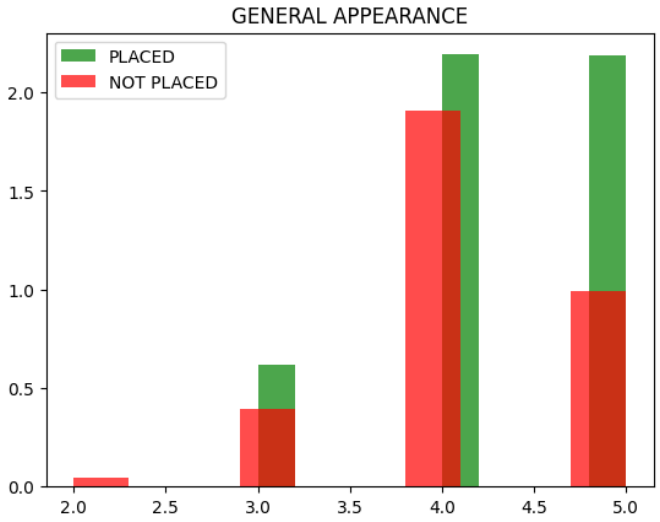

Fig 11

General Appearance (Bar Chart): This chart contrasts pupils' outward appearance with their placement. It implies a tendency where people who look more put together can have an advantage when it comes to placement.

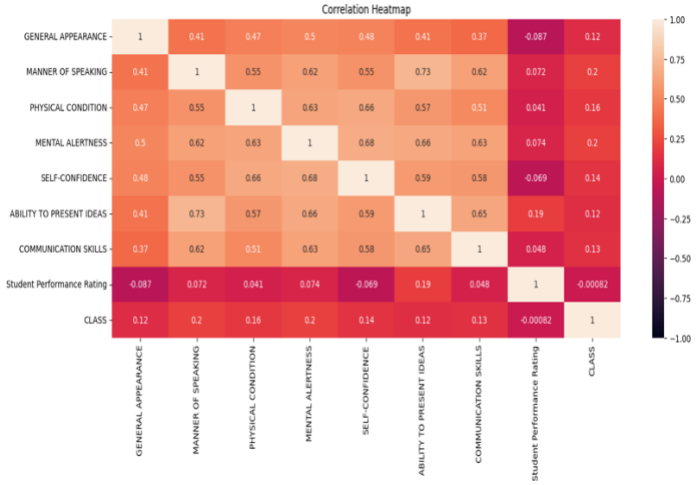

Fig 12

Correlation Heatmap: A heatmap displaying the correlation coefficients between several parameters such as physical condition, speech pattern, appearance, and so on. Lighter reds or whites suggest a weaker correlation, while darker reds indicate a larger positive connection. The correlation values are referenced to the scale on the right.

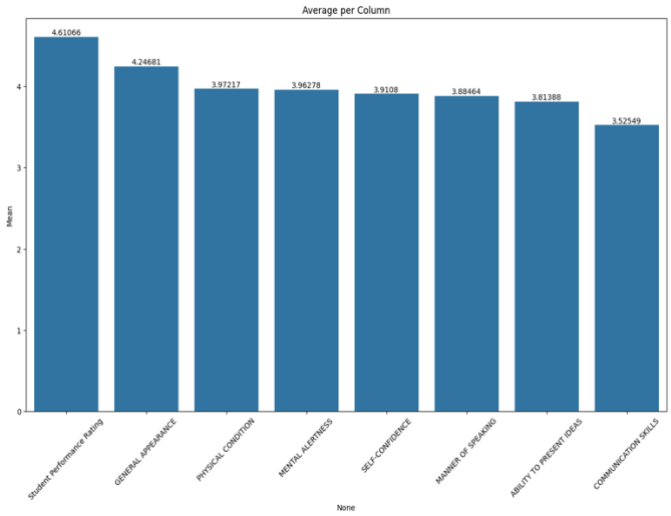

Fig 13

Average per Column (Bar Chart): The overall student performance rating and average scores for the various assessed attributes are displayed in the final bar chart. It makes it possible to compare qualities quickly and determine which traits have the greatest average ratings among the assessed students.

The result from our analysis based on our dataset shows that the Logistics Regression Model has 60% accuracy in employment classification, this can be explained by the correlations observed in the heatmap between different attributes relevant to employability. Strong positive correlations, such as between "Manner of Speaking" and "Ability to Present Ideas," indicate that individuals excelling in

one area tend to excel in the other, contributing to accurate classification. Moderate positive correlations, like those between "Physical Condition" and "Mental Alertness," suggest that certain attributes, when present together, indicate readiness for employment. Additionally, negative correlations, although weak, offer insights into inverse relationships between attributes. Leveraging these correlations allows the model to capture nuances in employability factors, contributing to its predictive accuracy. Overall, the correlations observed in the heatmap provide valuable insights into the interplay between different attributes, aiding in the accurate classification of employment status.

V. Limitations

The research grapples with various limitations, particularly owing to the constraints of the dataset employed. Firstly, the integrity of the findings may be compromised due to potential errors or biases within the limited dataset, thereby affecting the overall accuracy of the analysis. Furthermore, the study's reliance on a restricted set of variables may overlook crucial aspects that influence employability, potentially resulting in incomplete insights. Although correlations between variables were observed, caution must be exercised as the dataset's scope may not capture the full range of factors at play.

Moreover, the utilization of a simplified logistic regression model might fail to capture the nuanced relationships within the dataset, thereby limiting the depth of the analysis. Additionally, the generalizability of the findings beyond the confines of the specific dataset and context is called into question. The presence of imbalances and biases within the dataset further exacerbates these limitations, potentially skewing the results and compromising their validity. Ethical considerations regarding fairness and discrimination should be diligently addressed, given the dataset's inherent limitations. Finally, external factors unaccounted for in the limited dataset, such as broader economic trends or societal dynamics, may introduce confounding variables and necessitate further exploration and refinement of the research methodology.

VI. Future works

Future research in employability classification should focus on overcoming the limitations identified in the current study. This includes expanding the dataset to encompass a wider range of variables and samples, as well as exploring more sophisticated modeling techniques beyond logistic regression. Longitudinal studies can provide insights into the dynamic nature of employability factors over time. Cross-validation and external validation techniques are essential for assessing the robustness and generalizability of findings. Incorporating qualitative research methods and addressing data bias and imbalance are crucial steps. Ethical considerations regarding fairness and transparency should be prioritized. Additionally, investigating the influence of external factors and fostering interdisciplinary collaboration can enrich the understanding of employability. Practical applications and interventions aimed at enhancing employability outcomes are also recommended. Overall, future research endeavors should strive to advance knowledge in employability classification and contribute to the development of effective strategies for workforce participation and economic empowerment.

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