

1. INTRODUCTION

Universities play a critical role in equipping students with the tools they need to thrive in the dynamic job market. Traditionally, a university's success has been measured by its graduates' ability to secure employment after graduation. However, recent trends indicate a troubling rise in the number of graduates struggling to find jobs that align with their educational backgrounds. The mismatch between graduates' skills and job market demands has become increasingly pronounced. This discrepancy often leads to underemployment, where graduates take positions that do not require their level of education or expertise, resulting in wasted potential and dissatisfaction. Factors contributing to this issue include the rapid pace of technological change, shifting economic conditions, and evolving employer expectations that outpace the current curricula. Additionally, the saturation of certain job markets with too many qualified candidates exacerbates the problem, making it harder for graduates to stand out. The urgency of this research lies in addressing this concerning phenomenon, aiming to understand and mitigate the factors hindering graduate competitiveness. Without timely intervention, universities risk producing graduates who are ill-prepared for the job market, thereby undermining the value of higher education and contributing to broader economic inefficiencies.

To address this challenge, universities have increasingly relied on tracer studies. These studies systematically assess graduates' employment status, job search experiences, and the application of competencies acquired during their university education [1], [2]. Tracer studies provide invaluable insights that enable universities to adapt to societal changes, meet employer expectations, and continuously evaluate and revise curricula [2]. The job market is constantly evolving due to technological advancements, globalization, and economic shifts. Tracer studies help universities identify emerging skill gaps and adapt their programs accordingly. Employers are constantly seeking graduates with specific skillsets and experiences. Tracer studies provide valuable data on employer needs, allowing universities to tailor their programs to meet those expectations. By analyzing graduate outcomes, universities can identify areas where their programs may fall short and make informed decisions about curriculum revisions.

However, the effectiveness of traditional methods for analyzing tracer study data can be limited. This is where machine learning (ML) models come into play. This research employs ML algorithms, specifically Naïve Bayes and KNN, to analyze tracer study data and identify factors contributing to low job competitiveness among university graduates. ML algorithms can efficiently manage and analyze large datasets collected through tracer studies. This allows universities to identify patterns and trends within the data, revealing factors that might otherwise be overlooked. This deeper understanding can inform the development of targeted interventions to improve graduate competitiveness [3]. By analyzing historical data, ML models can be trained to predict future trends in graduate employment. This allows universities to proactively address potential challenges and prepare students for the job market accordingly. Universities can leverage ML insights to make informed decisions about resource allocation, program development, and career counseling services.

Several recent studies have demonstrated the effectiveness of machine learning algorithms in analyzing tracer study data. For instance, a study at STIKOM Bali used the Naïve Bayes algorithm to predict alumni employment waiting times, achieving an accuracy of 48.629% [4]. This highlights the potential of Naïve Bayes, although there is room for improvement. Other studies utilizing Naïve Bayes achieved accuracy rates of 75.33% [5], 87.50% [6], and another study confirmed its effectiveness in predicting alumni employment timelines [7], further solidifying its potential. K-Nearest Neighbors (KNN) is another algorithm that has proven effective. Research has shown its accuracy in predicting on-time graduation status (accuracy: 93.2%) [8]. While comparisons with Naïve Bayes suggest a slight edge for Naïve Bayes in some cases (accuracy: 83.83% vs. 82.34% for KNN) [9], both algorithms demonstrate significant potential.

Building upon the success of previous studies, this research aims to utilize both Naïve Bayes and KNN algorithms to analyze tracer study data and identify the factors contributing to low job competitiveness among university graduates. By analyzing the specific competencies provided by universities, this study seeks to generate valuable insights that can be used to enhance educational and career development strategies.

This research offers a two-pronged approach. First, by employing machine learning algorithms, this study delves deeper into the factors hindering graduate competitiveness. This knowledge is crucial for developing targeted interventions to address these specific challenges. Second, the insights gained from this research can be used to inform the development of more effective programs and services that better prepare students for the job market. This includes potentially revising curricula to ensure graduates possess the in-demand skills and experiences sought by employers.

As universities have a vital role to play in ensuring graduate success in the job market, tracer studies, coupled with machine learning analysis, provide a powerful tool for identifying the challenges faced by graduates and developing effective solutions. This research, by utilizing Naïve Bayes and KNN algorithms, aims to contribute to this critical endeavor by shedding light on the factors hindering graduate competitiveness and paving the way for improved educational and career development strategies. The objective of this study is to identify the factors contributing to low job competitiveness among university graduates by analyzing tracer study data using Naïve Bayes and KNN machine learning algorithms. The findings from this research will be used to inform the development of more effective educational and career development strategies for graduates.