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Designing Recruitment Automation System to Reduce Gender, Age, Race, and Educational Background Bias in Indonesia

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Abstract

***Research aim**: This research aims to design a fair, technology-based recruitment system by eliminating bias and assessing candidates solely based on their competence.*
***Design/Method/Approach**: This research utilizes the ADDIE model to develop a bias-free recruitment system.*
***Research Finding**: The system effectively identifies and minimizes bias in candidate selection by prioritizing relevant qualifications and competencies, while excluding non-work-related factors.*
***Theoretical contribution/Originality**: This research enhances the understanding of automation in employee recruitment in developing countries, particularly Indonesia, by introducing innovative recruitment algorithms that promote diversity and inclusivity across various companies.*
***Practical/Policy Implication**: This research suggests that companies adopt a more equitable automation system to foster a diverse and innovative work environment.*
***Research limitation**: This study requires further validation with large-scale, real-world data. Future research should utilize more diverse datasets and explore the system's impact in a broader context.*
***Keywords:** Recruitment, Fairness in Recruitment, Recruitment Automation System, Recruitment Bias, Workplace Diversity.*

1. Introduction

Automation in the employee recruitment process is an important issue that needs to be discussed, especially in the context of creating a fair and unbiased recruitment system. Traditional recruitment processes are often affected by human biases, such as gender, age, race, and educational background, which can hinder the creation of diversity in the workplace [1]. This phenomenon is not only detrimental to qualified candidates but also negatively impacts the company, as biased recruitment decisions can overlook the best talent that is needed. With the increasing use of technology in recruitment, automation offers the potential to reduce this bias through a more objective and transparent approach. However, without careful design, automation systems can reinforce existing biases if the data used reflects historical inequities [2]. Therefore, research on fair and unbiased automation of recruitment processes is highly relevant to ensure that technology is used responsibly to support diversity and inclusivity in the workplace.

Previous research has shown that while automation can reduce human bias, many systems still retain bias because the data used reflects historical inequities. For example, a study revealed that Amazon's recruitment algorithms tend to discriminate against female

candidates because the data is dominated by male applicants for technical positions [3]. Another study also found that algorithms often reinforce biases related to race and ethnicity if the data used is not properly verified [4]. In addition, another study showed that age bias is still a significant problem in automation systems, where younger or older candidates are often overlooked despite having sufficient qualifications [5]. These findings indicate that automation does not automatically guarantee fairness in recruitment, but rather requires a more in-depth approach in designing and evaluating algorithms.

Although many studies have addressed bias in automation systems, most studies have focused on the context of developed countries, with little attention to the challenges faced in developing countries such as Indonesia. In Indonesia, discrimination in the recruitment process is still a serious problem, especially regarding gender bias, age, race, ethnicity, and educational background [6]. For example, female candidates are often considered less suitable for technical or leadership positions, while candidates of certain ethnicities are prioritized due to cultural preferences [7] or many companies include an age limit as a requirement in job vacancy information and it is even considered normal, including by the Ministry of Manpower. However, for women, the impact of age discrimination in employment can be more significant. Women who stop working to get married and take care of children often find it difficult to get re-employed because they have exceeded the age limit set by many companies. In addition, education bias is also common, where candidates from reputable universities are favored even though candidates from other universities are equally competent. Some of these phenomena related to non-work factors are factors that cause many candidates not to pass in the early stages of the recruitment process, even though they may have more advantages when compared to candidates who pass to the next stage of recruitment. Research on automation that can overcome these biases in Indonesia is still very limited, creating a research gap that needs to be filled.

In contrast to previous studies that mostly focus on gender and race bias in developed countries, this research offers novelty by focusing on the Indonesian context, where age, race, ethnicity, and education bias are still significant issues in the recruitment process. This research proposes the development of an automation algorithm that not only eliminates gender and race biases but also addresses age and educational background biases, which are often overlooked in previous studies. Thus, this research makes a new contribution to the literature by integrating a more holistic approach to reducing bias in employee recruitment.

The main objective of this article is to design an automated recruitment system model that can reduce gender, age, race, ethnicity, and education bias in the recruitment process in Indonesia. With this research, it is hoped that companies in Indonesia can adopt a more equitable and inclusive automation system, thus supporting the creation of diversity in the workplace.

1.1. Statement of Problem

Traditional recruitment processes are often affected by human biases, such as gender, age, race, ethnicity, and educational background biases that can hinder the creation of diversity in the workplace and overlook quality candidates. While using automation systems often reinforces biases related to gender, race, ethnicity, and age, especially if the data used is not properly verified, distorted or unrepresentative data can lead to unfair recruitment decisions. Most of the literature and research on recruitment automation focuses more on the context of developed countries, so there are not many practical solutions that are relevant for

the context of developing countries such as Indonesia. Therefore, research on the automation of fair and unbiased recruitment processes is highly relevant to ensure that technology is used responsibly to support diversity and inclusiveness in the workplace.

1.2. Research Objectives

This research aims to identify and analyze various types of bias in traditional recruitment processes in Indonesia, including gender, age, race, ethnicity, and educational background bias, and design an employee recruitment information system that can reduce or eliminate bias by focusing on relevant candidate qualifications and competencies in a technology-based recruitment system that can be implemented in companies in Indonesia.

2. Method

This research is a qualitative study, using the Research and Development (R&D) method to design and develop an employee recruitment information system design. The data used is primary data collected through literature study techniques and interviews with HRD. The development model used is ADDIE which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage is used systematically to ensure the system developed is following the needs of the company.

3. Results and Discussion

The ADDIE instructional model is a dynamic learning process, consisting of five main stages namely analysis, design, development, implementation, and assessment [8]. The stages in the ADDIE model are applied in the designed system as follows:

3.1. Analysis

3.1.1.Identification of Bias in the Traditional Recruitment Process in Indonesia

Referring to various literature studies and previous research that address the issue of bias in the recruitment process, here are some relevant literature studies and research results to identify bias in traditional recruitment:

1) Gender Bias

   Gender bias is the commonly found bias in job recruitment. A study shows that gender bias persists in the recruitment process even though more and more companies are trying to create inclusive recruitment policies. This research found that women are more often overlooked in dominant positions in the technology sector, despite having equal qualifications to men [9]. In addition, women still often experience injustice in the work environment, especially in obtaining a better career path and equal pay. Societal assumptions about gender roles that are still inherent contribute to the unequal treatment of female workers [10]. Gender bias can be rooted in cultural perceptions that associate technical or leadership skills with the male gender.

2) Age Bias

   Age bias often occurs in employee recruitment, especially against older or younger applicants. Research reveals that older applicants tend to experience discrimination due to stereotypes that they are less flexible or unable to adapt to new technologies. In contrast, younger applicants are often perceived as less experienced and not ready for bigger roles [11]. In addition, age restrictions in employment also impact those who are still in their

productive years and need a job to make a living and support a family [12]. These biases often overlook the competence and experience of candidates.

3) Racial and Ethnic Bias
   Racial and ethnic bias in job recruitment is a significant issue, especially in multicultural societies. This is based on a study that showed that although companies try to implement algorithms to reduce racial bias, bias against candidates from ethnic minority groups still exists in technology-based recruitment systems. They found that applicants with names associated with a particular race or ethnicity were called for interviews less often, despite having equivalent qualifications to other candidates [13].
4) Educational Bias
   Educational bias often occurs when companies prioritize candidates with certain educational backgrounds, such as graduates from well-known universities, even though other candidates may have experience or skills that are more relevant to the position offered. One study found that job recruitment in large companies often prioritizes formal education from reputable universities, which can disadvantage candidates with solid work experience but from lesser-known universities [14]. Discrimination based on university reputation in the recruitment process creates inequality of employment opportunities. Studies show that graduates from less reputable universities are often excluded from the initial selection stage, despite having sufficient competence, due to the bias of recruiters who prioritize candidates from prestigious institutions. This practice not only reduces the career opportunities of graduates from non-elite universities but also has the potential to hinder social mobility and create inefficiencies in the labor market [15].
   The results of this bias analysis will be the main basis for system design so that the system designed is free from biases that are often encountered in its application.

3.1.2. Identify Company Needs

1) Assessment and Data Analysis: The need to collect and analyze data on candidates from different backgrounds to understand existing patterns of bias as well as the use of representative data to avoid repeating historical discrimination.
2) Inclusive Algorithm Design: The need to develop algorithms designed to identify and eliminate bias, including gender, age, race, ethnicity, and education bias.
3) Staff Training and Education: The need to educate human resources (HR) and management teams about bias in recruitment and the importance of diversity in the workplace. In addition, training in the use of automation systems and understanding how to read algorithm-generated results.
4) Transparency of The Recruitment Process: The need to ensure transparency in the recruitment process that provides candidates with a detailed explanation of the selection criteria.
5) System monitoring and evaluation: The need to have an ongoing oversight mechanism in the evaluation of algorithm performance and its impact on diversity.
6) Compliance with Regulations and Ethics: The need to ensure that the recruitment system in place complies with labor-related regulations and ethics in the recruitment process and adopts policies that support diversity and tackle discrimination in the workplace.

3.1.3. Analysis of Parties Involved in the System

1) Managers: Assessing and identifying team needs related to the position to be filled, drafting inclusive job descriptions, ensuring objective selection criteria, and being responsible for the final decision in the recruitment process.
2) HR Team: Develop the recruitment plan, coordinate the candidate selection process, and ensure that the candidates accepted match the company's needs.
3) IT Support: Ensure the recruitment system runs smoothly, prepare selection tools, and provide technical support as well as maintain candidate data to make the process transparent and fair.
4) Candidates: Responsible for presenting honest and relevant information about their competencies, as well as actively participating in each stage of the selection without manipulating data.

3.2. System Process Design

The processes in this system are:

a. Managers analyze HR recruitment needs and create job descriptions and candidate specifications needed, then report them to the HR team.
b. The HR team then promotes job vacancies either through the company website or other job portals with a wider reach.
c. Candidates complete the required documents requested in the job vacancy and then submit a job application.
d. The IT Support team screens the candidate's CV where in this process the application of the employee recruitment automation algorithm model is carried out, namely:
   1) Input
      The design of this algorithm aims to ensure a fair and bias-free candidate recruitment process, focusing on selecting candidates based on relevant qualifications. The data inputted are name, age, gender, race, education, work experience, skills, and certifications and training. This data will be used as the basis for the selection process.
   2) Pre-Processing
      The steps in this stage include:
      a) Data Cleaning: Removing missing or invalid data (for example, incomplete or duplicate data).
      b) Data Formatting: Changing the data to be in an appropriate format (e.g., normalization of age, work experience).
      c) Removal of Bias Attributes: Attributes that may cause bias (gender, age, race) will be hidden or ignored in the selection algorithm.
   3) Weighting of Qualifications
      Weighting of candidate qualifications based on relevance factors to the job applied for i.e. Skills 40%, Work Experience 30%, Educational Suitability 20%, Certification and Training: 10%.
   4) Screening Based on Qualification
      At this stage, the algorithm will perform an initial screening based on the relevant qualifications for the position applied for, then determine the candidate's score based on the qualification weights that have been given. Example: Score = (Skills x 0.4) +

(Work Experience x 0.3) + (Education Suitability x 0.2) + (Certification and Training x 0.1).

5) Recruitment Based on Classification
   At this stage, the candidate with the highest score is selected for the next stage. At this stage, it must be ensured that attributes such as gender, age, and race are not used in the selection or do not affect the selection decision.
6) Fairness Evaluation
   The system will evaluate the diversity and inclusiveness of the selected candidates. The algorithm will be evaluated based on the level of diversity of the selected candidates. Diversity is calculated based on factors such as age, gender, ethnic background, and work experience. The system will calculate based on fairness metrics, such as equal opportunity and demographic parity, to ensure that no group is discriminated against in the recruitment process.
7) Output
   The process will produce a list of shortlisted candidates showing the names and scores of candidates based on qualifications. It also generates a diversity report that provides information on the diversity of the selected groups (gender, age, race, etc.) that will be stored in the company database. After that, the candidates will be processed to the next selection stage.

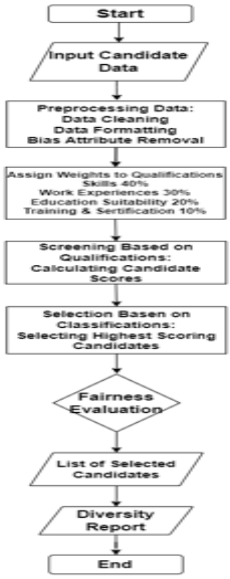

Figure 1. CV Screening Process

The design of this algorithm aims to ensure that the recruitment process is more fair, transparent, and unbiased. The system will use machine learning algorithms focused on job-relevant candidate qualifications and competencies while eliminating non-job factors such as gender, age, race, and educational background.

e. After the CV screening process, the candidate selection process is carried out where initial tests are carried out, namely basic ability tests, psychometric tests, and field of expertise tests by the HR Team.

f. The next process is at the initial interview stage where the HR Team conducts a process of verifying candidate information, motivation and interest, cultural suitability, salary expectations, and candidate availability.
g. After the initial interview process is carried out, proceed to the user interview stage regarding the candidate's specific skills, relevant experience, problem-solving, and collaboration skills possessed by the candidate.
h. The next stage is a reference check where the HR Team verifies the candidate's work history, performance, attitude, and reasons for resignation to the candidate's previous place of work.
i. After that, the HR Team submits the recruitment results to the Manager for candidate assessment and final assessment.
j. After that, a job offer is made regarding the job position. After that, a job offer is made regarding the job position, salary, benefits, and work requirements of the HR Team to the candidate.
k. The next stage is negotiation by the candidate and afterward the signing of the employment contract.
l. The next process is an introduction to the work environment where on the first day of work an office tour, a team introduction, an explanation of company policies, company culture, and provision of work tools.
m. The next stage is the initial training where employees are given technical training, product/service training, procedure training, and also software training.
n. After a few months, employees are given continued support where regular evaluations, further training, career development programs, and emotional support are carried out according to the needs of the company.

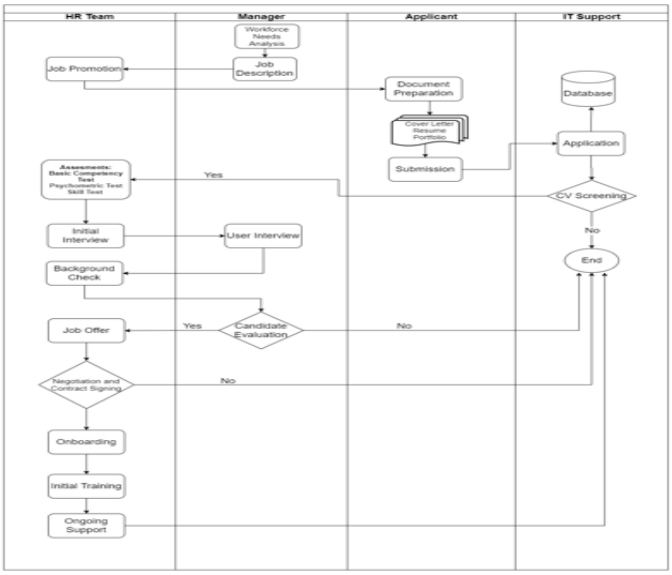

Figure 2 System Process Design

3.3 Development

a. System Prototype
   1) Prototype Development

Design and build a prototype of the algorithm-based recruitment system, describing the user interface and basic functionality. This prototype will be used for demonstration and testing of the concept.

2) Interface Design
Create user interface wireframes and mockups using design tools to visualize data presentation and workflow for users (HR and management).

3) Screening Simulation
Develop a screening model with fictitious data covering various candidate scenarios, without saving real data, to test the selection logic based on predefined qualifications and weights.

b. Documentation and Training Modules

1) System Documentation
Build a system manual that covers the data structure, algorithm functionality, and directions for prototype usage. This document will be the primary source for any relevant parties when the system is implemented.

2) Staff Training Materials.
Develop training materials for the HR team which will include:
a) A detailed presentation of the system and the recruitment process was built.
b) Video tutorials demonstrating its use in recruitment scenarios.

3) Training Simulation.
Design a training scenario that can be used by HR staff to understand the application of the system in an actual recruitment scenario.

c. Database Design

1) Database Schema Design
Develop a database schema to support the system, including tables for candidates, qualifications, and scoring results.

2) Data Security and Privacy
Design policies and procedures on candidate data security and protection, ensuring that sensitive data will not be disclosed in the research phase.

3.4 Implementation

a. Implementation Plan
A system implementation plan was developed to coordinate the steps and resources required for full implementation in the future. Meetings with management and the HR team were conducted to gain support for this plan.

b. Algorithm Testing
To ensure the algorithm works properly, several tests need to be conducted:

1) Data Validity Testing
This test aims to ensure that the data received is valid and does not contain duplication or missing data. The method used for testing is to check whether the applicant data has missing or duplicate values. The algorithm must be able to handle missing data and ignore duplicates or irrelevant data.

2) Unbiased Testing

This test is conducted to ensure that the algorithm does not consider biased attributes (gender, race, age, etc). The algorithm should not differentiate between candidates based on these attributes. For example, despite differences in age or gender, candidates with higher qualifications are still selected.

3) Testing Effectiveness in Reducing Bias
After ensuring the algorithm does not consider biased attributes, the next test is to see if the algorithm is successful in reducing bias in candidate selection. Candidates from different backgrounds (race, age, gender) should be selected in proportion to their qualifications, without any discrimination based on these factors.

4) Candidate Diversity
This test aims to evaluate how diverse the candidates selected by the algorithm are. The algorithm should produce selected candidates that reflect a more balanced diversity in terms of gender, age, race, and educational background.

5) Fairness Metric Testing
This test measures whether the algorithm meets fairness metrics such as equal opportunity or demographic parity. The algorithm should ensure that recruitment rates do not show significant differences between groups based on demographic attributes that are not relevant to job competencies.

6) System Testing
After the algorithm is tested through the stages above, the system will be tested with larger and more diverse real data to assess its effectiveness in real conditions. This pilot test aims to ensure the system functions well in a real-world context, identify possible improvements needed based on feedback from users (HR or hiring managers), and measure the effectiveness of the system in increasing diversity and reducing bias in the recruitment process. The system must work well in a corporate environment and produce fair, transparent, and bias-free results.

A pilot test was conducted involving key users from the HR and management teams. The feedback collected from these sessions was used to evaluate the interface, functionality, and effectiveness of the prototype in meeting user needs.

3.5 Evaluation

a. Concept Evaluation
An analysis of the pilot test results was conducted to assess the extent to which the system prototype meets user needs and reduces bias in the recruitment process. The assessment also includes the algorithm's performance in filtering candidates based on set qualifications.

b. Documentation of Evaluation Results
The evaluation results report presents findings from the analysis of feedback and piloting, as well as recommendations for improvement. Important notes identified during the evaluation are also recorded for future development.

c. Continuous Development
A plan for ongoing monitoring and evaluation of the system post-implementation was developed, including a performance monitoring mechanism to ensure the system remained bias-free. Ongoing education for the HR team was designed so that they could consistently use the system effectively.

4. Conclusion

This research identifies various forms of bias in the traditional recruitment process in Indonesia, including gender, age, race, ethnicity, and educational background bias, and designs an algorithm-based recruitment system aimed at reducing these biases. The main findings show that an automated system designed with a qualifications- and competency-based approach and eliminating non-relevant attributes such as gender, age, and ethnicity can improve fairness and diversity in candidate selection. Algorithm testing proved its effectiveness in selecting candidates based on objective scores, while diversity evaluations showed an increased representation of groups that are often affected by bias.

This research makes significant contributions both academically and practically. Academically, the study fills a gap in the literature by focusing on the Indonesian context, where age and education biases are often overlooked in previous research. The novelty of the research lies in the holistic approach that incorporates multi-bias removal in one system. Practically, this model can be adopted by companies in Indonesia to create a more inclusive recruitment process, support diversity policies, and comply with fair labor regulations. In addition, the prototype system developed can serve as a reference for future HR technology development.

Nonetheless, this study has some limitations. First, it needs further validation using real data on a large scale. Second, implementation challenges in companies such as cultural resistance or IT infrastructure limitations have not been fully explored. Future research agenda could include longitudinal experiments to measure the impact of the system on firm performance, as well as comparative studies with other developing countries to test the adaptability of the model. Integrating technologies such as explainable AI (XAI) to improve algorithm transparency could also be a focus of future research.

References

[1] Binns, R. (2018). Fairness in Machine Learning: Lessons from Political Philosophy. *Proceedings of the 2018 Conference on Fairness, Accountability, and Transparency*, 149-159. https://arxiv.org/abs/1712.03586

[2] Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2021). A Survey on Bias and Fairness in Machine Learning. *ACM Computing Surveys*, 54(6), 1-35. https://doi.org/10.1145/3457607

[3] Dastin, J. (2018). Amazon Scraps Secret AI Recruiting Tool That Showed Bias against Women. Reuters. https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G

[4] Raghavan, M., Barocas, S., Kleinberg, J., & Levy, K. (2020). Mitigating Bias in Algorithmic Hiring: Evaluating Claims and Practices. *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency*, 469-481. https://doi.org/10.1145/3351095.3372828

[5] Cowgill, B. (2019). Bias and Productivity in People Analytics: Evidence from a Field Experiment. *Management Science*, 65(7), 2961-2979. http://dx.doi.org/10.2139/ssrn.3584916

[6] Kurniawati, S., Suryadarma, D., Bima, L., & Yusrina, A. (2018). Education in Indonesia: A white elephant? Journal of Southeast Asian Economies, 35(2), 185–199. https://doi.org/10.1355/ae35-2e

[7] Ngadi, N., Asiati, D., Latifa, A., & Nawawi, N. (2021). Gender Inequality in the Indonesian Labor Market. In S. Dixit & S. Moid (Eds.), Women Empowerment and Well-Being for Inclusive Economic Growth (pp. 24-44). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-7998-3737-4.ch002

[8] Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis Addie Model. *Halaqa: Islamic Education Journal*, *3*(1), 35-42. https://doi.org/10.21070/halaqa.v3i1.2124

[9] Magnus Carlsson, Henning Finseraas, Arnfinn H Midtbøen, Guðbjörg Linda Rafnsdóttir, Gender Bias in Academic Recruitment? Evidence from a Survey Experiment in the Nordic Region, European Sociological Review, Volume 37, Issue 3, June 2021, Pages 399–410, https://doi.org/10.1093/esr/jcaa050

[10] Loker.id. Mengapa Sistem Perekrutan Kerja di Indonesia Disebut Diskriminatif? [Internet]. 2024 [cited 2025 Mar 24]. Available from: https://www.loker.id/artikel/mengapa-sistem-perekrutan-kerja-di-indonesia-disebut-diskriminatif

[11] Cavanagh TM, Kraiger K, L. Henry K. Age-Related Changes on the Effects of Job Characteristics on Job Satisfaction: A Longitudinal Analysis. The International Journal of Aging and Human Development. 2019;91(1):60-84. https://doi.org/10.1016/s0742-7301(08)27002-7

[12] Green Network Asia. Menghapus Diskriminasi Usia Kerja [Internet]. 2024 [cited 2025 Mar 24]. Available from: https://greennetwork.id/ikhtisar/menghapus-diskriminasi-usia-kerja/

[13] Alessandro Fabris, Nina Baranowska, Matthew J. Dennis, David Graus, Philipp Hacker, Jorge Saldivar, Frederik Zuiderveen Borgesius, and Asia J. Biega. 2025. Fairness and Bias in Algorithmic Hiring: A Multidisciplinary Survey. ACM Trans. Intell. Syst. Technol. 16, 1, Article 16 (February 2025), 54 pages. https://doi.org/10.1145/3696457

[14] Merluzzi, J. (2016). Lauren A. Rivera: Pedigree: How Elite Students Get Elite Jobs. Administrative Science Quarterly, 61(2), NP13-NP16. https://doi.org/10.1177/0001839216631490 (Original work published 2016)

[15] Liputan6.com. Lulus dari Kampus Tak Ternama Bisa Bikin Susah Dapat Kerja [Internet]. 2024 [cited 2025 Mar 24]. Available from: https://www.liputan6.com/bisnis/read/2123495/lulus-dari-kampus-tak-ternama-bisa-bikin-susah-dapat-kerja