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Mapping the Career Pathways of Electrical Engineering Education Graduates Using Tracer Study

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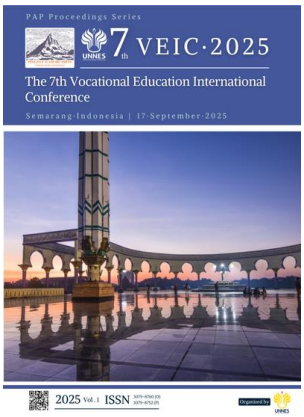

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Abstract: Alumni tracer activities are initiatives conducted by higher education institutions to collect data on graduates' career paths and professional development after completing their studies. This information serves as a crucial basis for assessing the alignment between the curriculum and labor market demands, while also contributing to the enhancement of educational quality. This study aims to describe the career development of alumni in the labor market, focusing on several indicators, including the percentage of alumni entering the workforce, currently employed, pursuing further studies, and engaged in entrepreneurship. The study employed a descriptive method by distributing surveys to all alumni of the Electrical Engineering Education Study Program at State University of Surabaya who graduated in 2024. The sampling technique applied was saturated sampling, in which the entire population was included as research participants. This approach provides evaluative insights for the university in curriculum development, measuring the relevance of graduates' competencies to the needs of industry, and fulfilling a key component of the university accreditation process. One of the benchmarks used was the gold standard, referring to the proportion of alumni who are employed, pursuing higher education, or running a business. Based on the tracer study results, the gold standard for alumni of the Electrical Engineering Education Study Program in 2024 was recorded at 85.19%. Data analysis was conducted using descriptive statistics to map graduates' profiles, distribution across employment sectors, and the relevance of acquired skills to labor market requirements.

Keywords: alumni; curriculum; electrical engineering education; gold standard; tracer study

1. Introduction

The rapid changes of the modern era, coupled with advancements in information technology, have significantly impacted various aspects of life, including education. The focus of education, which was once primarily directed toward the pursuit of knowledge for personal purposes, has now shifted toward the development of knowledge that delivers direct benefits to society. This transformation is further reinforced by the swift progress in science and technology, as well as the growing demands of the labor market for skilled and high-quality professionals. As a result, society is increasingly motivated to enhance individual capabilities through access to quality education to remain competitive at the global level [1]. The growing number of higher education graduates in Indonesia each year is an inevitable phenomenon. Therefore, it is crucial to have a well-organized

system to monitor and track the career trajectories of alumni in line with the increasing graduate population.

A tracer study is an alumnus tracking method designed to obtain feedback from graduates regarding the extent to which the education they received aligns with the needs of the labor market [2,3]. In addition, tracer studies serve to assess curriculum effectiveness, act as a tool for measuring educational quality, and strengthen collaboration between higher education institutions and the industrial sector [4,5]. Furthermore, tracer studies function as a critical source of information for all stakeholders, provide a reference for curriculum development evaluation, and play a vital role as an integral component of the higher education accreditation process [6,7].

Each year, universities produce graduates who are ready to enter the workforce [8]. Tracer studies are conducted to evaluate the outcomes of higher education after graduates have completed their studies, encompassing alumni engagement in industry, employment conditions, as well as the relevance and application of skills acquired during their education within professional contexts [9,10]. The findings from tracer studies not only indicate the proportion of alumni successfully absorbed into the labor market but also reflect the quality of the academic programs offered

At State University of Surabaya, the implementation of tracer studies within the bachelor's Program in Electrical Engineering Education is overseen by a designated individual at the program level. This reflects the program's dedication to delivering high-quality educational processes, its commitment to the prospects of its graduates, and its accountability to society for the trust entrusted to the institution. Accordingly, tracer studies are not merely an administrative requirement for accreditation but also serve as a strategic tool for building public trust and ensuring the alignment of educational delivery with labor market demands [11].

This study specifically aims to identify the gold standard of graduates from the bachelor's Program in Electrical Engineering Education. The gold standard refers to the proportion and number of alumni who, after graduation, successfully secure employment, pursue further education, or engage in entrepreneurial activities.

2. Literature Review

2.1. Tracer Studies

A tracer study is a strategic form of research designed to gather essential data that supports the advancement of higher education institutions. Through this activity, universities can obtain relevant information on the career pathways, achievements, and professional progress of their graduates after completing their studies. This data not only serves as an evaluation tool but also functions as a key component of the quality assurance system, ensuring that educational institutions can continuously enhance their quality [12].

In addition to its role in maintaining and improving educational quality, a tracer study makes a significant contribution to curriculum development within each academic program [13]. The information obtained provides an objective understanding of the strengths and weaknesses of an educational program, enabling curriculum adjustments in accordance with labor market demands, technological advancements, and professional requirements. In this way, graduates are expected to acquire relevant competencies and strong competitiveness at both national and international levels.

Within the bachelor's Program in Electrical Engineering Education, the tracer study is conducted one year after graduation—when alumni have received their official diploma numbers and are likely to have entered the workforce, pursued further education, or initiated entrepreneurial activities. This time frame is considered ideal, as it allows for the collection of more accurate information concerning the graduates' transition from academic life to professional engagement.

Data collection is carried out online through State University of Surabaya's integrated Tracer Study System, which is accessible directly to alumni via the official

platform (http://tracerstudy.unesa.ac.id) [14]. Alumni of the bachelor's Program in Electrical Engineering Education complete a self-administered questionnaire designed to capture information on employment status, the relevance of their job to the competencies acquired during study, involvement in entrepreneurship, and participation in further education. The collected data are then utilized as a basis for evaluating the effectiveness of the Outcome-Based Education (OBE) curriculum in place, as an instrument for public accountability, and as a key component in the accreditation process of the program at both national and international levels (As shown in Figure 1).

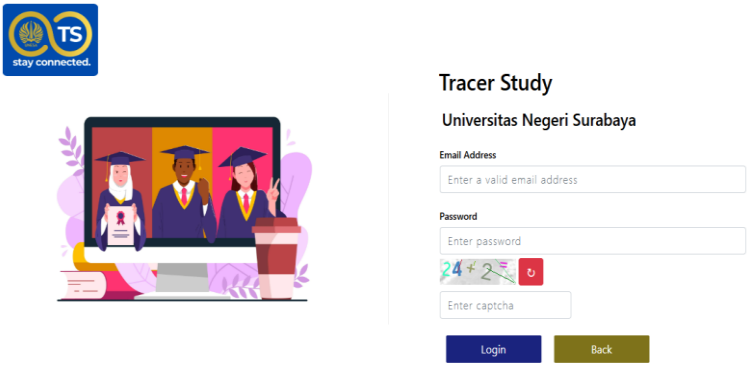

Figure 1. Tracer Study Website Interface.

Through this mechanism, the program can assess the extent to which its graduates achieve the gold standard of success, defined as the percentage and number of alumni who are sustainably employed, enrolled in further studies, or engaged in entrepreneurial ventures.

2.2. Alumni Profile

The graduate profile of the bachelor's Program in Electrical Engineering Education at State University of Surabaya is designed to produce graduates who possess expertise in electrical and electronic engineering, along with the competencies required to serve as professional educators in vocational secondary education. Graduates are equipped with pedagogical, professional, personal, and social competencies, mastery of advanced scientific and technological knowledge, analytical skills, and the application of scientific methods for problem-solving. They are also trained in the design and development of products, as well as the transfer of knowledge in the field of electrical engineering.

In addition to technical capabilities, soft skills such as communication, collaboration, problem-solving, and critical thinking are highly sought after by employers [15,16]. Graduates must adequately prepare themselves before entering the professional environment, as without the appropriate skills they will be unable to meet industry demands [17]. Higher education institutions play a vital role in preparing qualified experts, making feedback from alumni, the community, and stakeholders essential for evaluating and improving learning activities [18].

2.3. Gold Standard

In this study, the term gold standard refers to the target benchmark percentage and the number of alumni who successfully achieved one of three primary post-graduation outcomes: employment, further study, or entrepreneurship. This benchmark serves as a reference for evaluating the effectiveness of the program in preparing graduates for their professional or academic pathways, in accordance with Decree of the Minister of Education, Culture, Research, and Technology No. 210/M/2023 and Decree of the Director General of Higher Education, Research, and Technology No. 173/E/KPT/2023 concerning the key performance indicators of higher education institutions [19,20].

The gold standard percentage is determined by comparing the number of graduates who achieve one of the specified outcomes with the total number of surveyed graduates. While the calculation is expressed in Equation (1).

Gold Standard = (Total Points) / (Total Alumni) x 100% (1)

A higher percentage reflects a stronger alignment between the educational curriculum and labor market needs, opportunities for further study, or readiness to start a business. These findings are utilized to evaluate the quality of the program and serve as a basis for formulating sustainable improvement strategies

3. Methodology

3.1. Population and Research Subjects

This study employed a descriptive approach with the objective of gaining a comprehensive understanding of the background of alumni from the bachelor's degree Program in Electrical Engineering Education at State University of Surabaya [21]. The research subjects encompassed all graduates from the year 2024, with a total population of 54 individuals, all of whom also served as respondents. By applying a full population sampling technique, the researchers were able to collect extensive data on the condition of the graduates, thereby ensuring that the research findings accurately represent the alumni profile for the specified period (As shown in Table 1).

Table 1. Questionnaire Instrument.

No	Instrument
1	Alumni Entering the Workforce
1.1	Alumni Not Yet Eligible for Employment
1.2	Unemployed but Actively Seeking Employment
2	Alumni Pursuing Further Studies
2.1	Continuing Studies (≤ 12 Months After Graduation Date)
3	Alumni Employed
3.1	Employed (≤ 6 Months and Salary ≥ 1.2× Minimum Regional Wage)
3.2	Employed (≤ 6 Months and Salary < 1.2× Minimum Regional Wage)
3.3	Employed (6 < Waiting Period ≤ 12 Months and Salary ≥ 1.2× Minimum Regional Wage)
3.4	Employed (6 < Waiting Period ≤ 12 Months and Salary < 1.2× Minimum Regional Wage)
4	Entrepreneurial Alumni
4.1	Entrepreneur (≤ 6 Months and Income ≥ 1.2× Minimum Regional Wage)
4.2	Entrepreneur (≤ 6 Months and Income < 1.2× Minimum Regional Wage)
4.3	Entrepreneur (6 < Waiting Period ≤ 12 Months and Income ≥ 1.2× Minimum Regional Wage)
4.4	Entrepreneur (6 < Waiting Period ≤ 12 Months and Income < 1.2× Minimum Regional Wage)

3.2. Data Collection

The research data were obtained through a survey method using a questionnaire accessible via the official tracer study website of State University of Surabaya (tracerstudy.unesa.ac.id). Alumni were contacted through a mass email distribution containing access information, including a username and password, enabling them to log into the tracer study system. Subsequently, the tracer study PIC monitored the progress of questionnaire completion and conducted follow-ups via personal messages to alumni who had not yet participated, ensuring that all required data were fully collected.

3.3. Questionnaire Instrument

This study employed a survey approach using a tracer study questionnaire instrument developed based on the guidelines of State University of Surabaya. The questionnaire instrument included key indicators, primarily the respondents' employment status, categorized as: unemployed but seeking employment, employed, entrepreneur, and pursuing further studies. The details of the indicators and the questionnaire items are presented in Table 1.

3.4. Data Collection

This study began with the formulation of objectives and the identification of tracer study variables, namely the employment status of graduates. Subsequently, a questionnaire instrument was developed based on the guidelines of the Directorate General of Higher Education (Ditjen Dikti) and adapted to the specific needs of the study program (As shown in Figure 2)

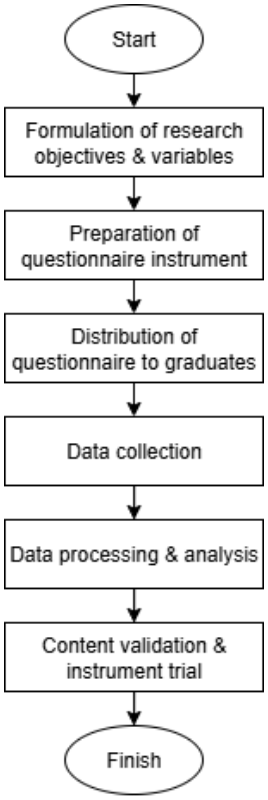

Figure 2. Research Flow

4. Results And Discussion

4.1. Gold Standard Achievement

The tracer study results for the 2024 alumni of the Bachelor of Electrical Engineering Education program at State University of Surabaya indicate that most graduates were able to enter the workforce or start a business within a relatively short period after graduation (As shown in Table 2).

Table 2. Tracer Study Data Results.

No	Instrument	Alumni Total	Constant Point	Total Point
1	Alumni Entering the Workforce			
1.1	Alumni Not Yet Eligible for Employment	0	0	0

1.2	Unemployed but Actively Seeking Employment	6	0	0
2	Alumni Pursuing Further Studies			
2.1	Continuing Studies (≤ 12 Months After Graduation Date)	1	1	1
3	Alumni Employed			
3.1	Employed (≤ 6 Months and Salary ≥ 1.2× Minimum Regional Wage)	29	1	29
3.2	Employed (≤ 6 Months and Salary < 1.2× Minimum Regional Wage)	10	0.7	7
3.3	Employed (6 < Waiting Period ≤ 12 Months and Salary ≥ 1.2× Minimum Regional Wage)	0	0.8	0
3.4	Employed (6 < Waiting Period ≤ 12 Months and Salary < 1.2× Minimum Regional Wage)	0	0.5	0
4	Entrepreneurial Alumni			
4.1	Entrepreneur (≤ 6 Months and Income ≥ 1.2× Minimum Regional Wage)	5	1.2	6
4.2	Entrepreneur (≤ 6 Months and Income < 1.2× Minimum Regional Wage)	3	1	3
4.3	Entrepreneur (6 < Waiting Period ≤ 12 Months and Income ≥ 1.2× Minimum Regional Wage)	0	1	0
4.4	Entrepreneur (6 < Waiting Period ≤ 12 Months and Income < 1.2× Minimum Regional Wage)	0	0.8	0
	Total	54		46

According to the data, 53.7% of alumni (29 individuals) secured employment within ≤ 6 months with an income level ≥ 1.2 times the Provincial Minimum Wage (UMP). Meanwhile, 18.5% of alumni (10 individuals) were also employed within ≤ 6 months, but with an income < 1.2 times the UMP. In addition, 14.8% of alumni (8 individuals) chose the entrepreneurial path, with most starting their businesses within ≤ 6 months after graduation. Only 1.85% of alumni (1 individual) pursued further studies within ≤ 12 months post-graduation. Moreover, 11.1% of alumni (6 individuals) were still in the process of seeking employment (As shown in Figure 3).

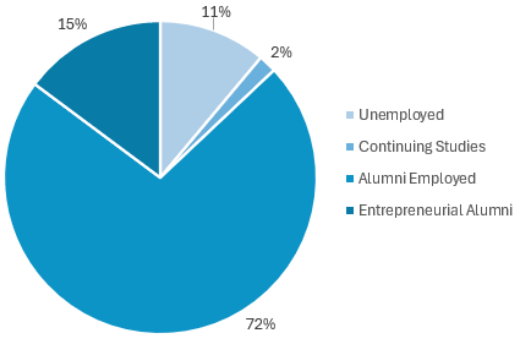

Figure 3. Alumni Career Status Distribution.

The high percentage of graduates who immediately entered the workforce or started a business indicates a strong alignment between the study program's curriculum and labor market demands. This also reflects the graduates' ability to compete professionally and create entrepreneurial opportunities independently. Nevertheless, the presence of several alumni still seeking employment signals the need for additional efforts by the study program. Strategic measures that can be undertaken include providing soft skills training, entrepreneurship preparation, and strengthening networks with the industry to expand employment opportunities for graduates.

Gold Standard = 46/54 x 100%
Gold Standard = 85.19%

Overall, the gold standard achievement of 85.19% is considered high and can serve as a positive indicator in accreditation processes and curriculum evaluation. This figure demonstrates the study program's success in preparing competent graduates, although there remains room for improvement to approach a 100% success rate.

4.2. Type of Institution Where Alumni Work

Based on the tracer study results, most alumni from the Bachelor of Electrical Engineering Education program at State University of Surabaya are employed in the private sector (64.10%), indicating a strong alignment between graduates' competencies and industry needs. The "Other" category accounts for 15.38%, followed by alumni working in government institutions (7.69%) and non-profit organizations (7.69%). Meanwhile, alumni employed in multilateral institutions and entrepreneurship each represent 2.56%, with no graduates working in state-owned enterprises (BUMN/BUMD). These data highlight the dominance of the private sector as the primary employer of graduates, with relatively smaller opportunities in the public, social, and entrepreneurial sectors (As shown in Figure 4).

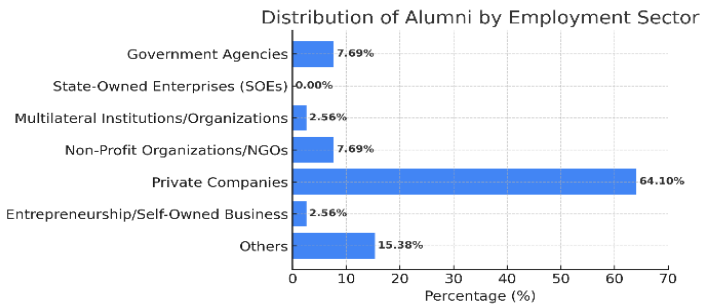

Figure 4. Alumni Career Status Distribution.

4.3. Alignment Between Alumni Job Fields and Field of Study

Based on the data presented in Figure 5, the degree of alignment between alumni job fields and their field of study shows considerable variation. Most alumni (35.90%) rated their jobs as "Moderately Aligned" with the field of study pursued in the Bachelor of Electrical Engineering Education program. A total of 20.51% of alumni considered their jobs "Highly Aligned," while 17.95% rated them as "Aligned" and another 17.95% as "Slightly Aligned." Meanwhile, only 7.69% of alumni perceived their job fields as "Not at All" related to their field of study.

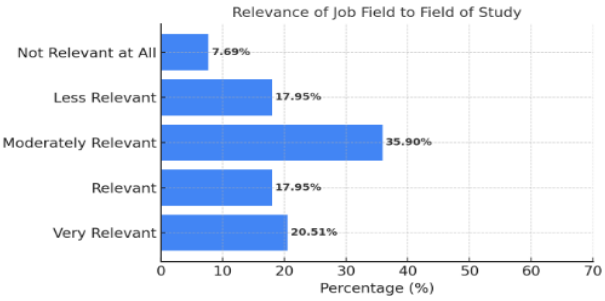

Figure 5. Relevance of job to field study

These findings indicate that most graduates work in areas still relevant to the academic competencies acquired during their studies, although some pursue careers

outside their field of study. This may be influenced by factors such as employment opportunities, personal interests, or dynamic career developments.

5. Conclusions

The 2024 tracer study of alumni from the Bachelor of Electrical Engineering Education program at State University of Surabaya indicates positive outcomes, with 85.19% of graduates employed, pursuing entrepreneurship, or continuing their studies. Most alumni work in the private sector (64.10%), followed by "Other" (15.38%), government institutions (7.69%), and non-profit organizations (7.69%), while multilateral institutions and entrepreneurship each account for 2.56%, with no graduates in state-owned enterprises. Regarding job-field alignment, most alumni work in areas relevant to their academic competencies: 20.51% "Highly Aligned," 17.95% "Aligned," and 35.90% "Moderately Aligned." However, 17.95% and 7.69% of graduates' work in fields "Slightly Aligned" or "Not at All" related to their studies, likely influenced by job opportunities, personal interests, or career dynamics.

Overall, these results serve as a positive indicator of the study program's effectiveness, though there remains room for improvement through enhanced competency training, stronger industry partnerships, and guidance for alumni not yet employed. To further improve graduate quality, strategic measures should include strengthening soft skills and technical competencies, fostering entrepreneurial mindset, expanding industry collaboration, and optimizing career support for unemployed alumni. These steps are expected to better prepare graduates for the workforce and entrepreneurial opportunities.

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