Tracer Study Analysis for the Reconstruction of the Mining Vocational Curriculum in the Era of Industrial Revolution 4.0

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Abstract: The Diploma in Mining Engineering Study Program at Padang State University is a vocational education at the diploma three (D3) and has been around since 2001. The graduates have worked in various places, both in mining companies and in government, as civil servants and entrepreneurs. The educational process has always been carried out following developments and market demands in its development to date. Various improvements continue to be made in various ways to meet good accreditation standards. Curriculum reconstruction and adjustments are always carried out by receiving various inputs from graduate users, alumni, students, lecturers, and all existing academicians. Through tracer study activities for graduates, various input data can be collected, which are very useful for improving the standard of services provided. This study reveals the results of implementing a tracer study on graduates, which will be used in reconstructing the curriculum to answer the challenges of changing times in the era of the industrial revolution 4.0.

Keywords: Reconstruction, Mining Vocational Curriculum, Industrial Revolution 4.0, education quality, competitiveness.

1. Introduction

Vocational higher education has a strategic role and is at the forefront of handling the workforce's age and educating them to become skilled, professional, and highly competitive workers who will increase the nation's competitiveness. (Verawardina, et al., 2020), (Arifin, et al., 2020), (Nofranto, et al., 2020), (Vitriani, et al. 2020), (Krismadinata, et al., 2020), (Hendriyani, et al., 2020), (Novaliendry, et al. 2020), (Dony, et al. 2020).

Vocational higher education must produce a skilled and trained workforce needed by the industrial world or the world of work. Vocational higher education also encourages graduates to become independent and robust entrepreneurs who lead them to a prosperous life. Vocational higher education as an integral part of the national education system is one of the driving forces or the leading sector in building a profitable and advanced Indonesia. (Menteri Riset Teknologi Pendidikan Tinggi Republik Indonesia, 2016).

Vocational education is one of the educational channels designed to produce a ready-made workforce. In Indonesia, there are 15 vocational education study programs in the mining sector at Diploma three-level (D3) and are scattered throughout Indonesia (Ketua Forum Komunikasi Program Studi Teknik Pertambangan Seluruh Indonesia, 2019).

Concerning the development of Vocational education, the government has signed an agreement with five ministers, which is a follow-up to Presidential Instruction number 9 of 2016 concerning the revitalization of vocational education to improve the quality and competitiveness of Indonesia's human resources (HR) (Presiden Republik Indonesia, 2016).

However, the overlap in the coordination of vocational education delivery is confusing and a waste of time in realizing President Jokowi’s good intentions. The President's anxiety is quite reasonable, because based on BPS data as of August 2018, for example, he said that Vocational School alumni contributed to the highest unemployment rate, namely 11.24%. This figure is different from high school graduates, who are only around 7.95% (Idris, 2019).

A large number of unemployed vocational schools are clear evidence that there is irregularity or inconsistency between vocational education and the market that is being faced. Referring to this, Presidential Instruction number 9 of 2016 on the revitalization of vocational education was published as one answer to this condition. But unfortunately, related institutions seem slow in responding, even stuttering what to do when the 2020 budget (Indonesian: RABN) for vocational education becomes a priority. The President echoes investment in Human Resources.
Vocational education and training are not new in Indonesia. It's just that the curriculum orientation has not been maximal in responding to demand and supply change. Moreover, shifting labor and types of work in this era of industrial revolution 4.0, where information technology now requires competitive creativity. The mismatch between the availability of majors (link and match) with the fields needed by industry and the skewed view of vocational education needs to be studied more seriously.

Besides, education personnel should be upgraded and in line with the revitalization of the vocational education curriculum based on the business world and the industrial world. For the industry, of course, don't just criticize the difficulty of getting reliable workers. But it must also be balanced with an active role, assisting the improvement of existing vocational education quality. For example, by participating in compiling a joint curriculum, establishing training institutions and work-competent courses and boarding schools or community-based businesses, and providing job apprenticeship opportunities for both students and educators, and business assistance with easy terms and conditions, of course without leaving the aspect quality substantially (Idris, 2019).

In line with the above, in facing the era of industrial revolution 4.0, which involves digital elements in each value chain of the manufacturing process, workers are required to be skilled and able to adapt and be able to adapt to technological developments. To realize skilled vocational higher education graduates who can be accepted in the world of work, support is needed from the business world and the industrial world. Cooperation and support from industry are important factors for implementing vocational education that can adapt to the needs of the world of work. Therefore, once again, the industry is expected to be able to play a role and provide input to the educational curriculum by existing technological developments and provide practical facilities and apprenticeship for students and lecturers so that both students/students and educators/lecturers can keep up with the latest industrial technology developments.

To improve the quality of vocational education in Indonesia, in 2018, the Ministry of Education and Culture has established a vocational education strengthening program, which is carried out with the teaching factory/techno park approach, cooperation with industry, and alignment of vocational with professional certification. The government has also developed several universities to become world-class universities and developed the Science Techno Park (STP). The Science Techno Park itself was developed as a center for innovation and business incubation for students and lecturers based on technological innovation. (Kemendikbud, 2020).

AgusSutarna, et al. (2020), in the title of his book “ManajemenPendidikanVokasi” said that vocational education is higher education that prepares students to have jobs with certain applied skills, held in colleges in the form of academies, polytechnics, colleges, institutes, and universities. Providing vocational education consists of Diploma 1, Diploma 2, Diploma 3, and Diploma Programs. Vocational education adopts an open and multi-meaning system (oriented to culture, empowerment, character building, personality, and various life skills. On work skills by developing applied science and technology and job opportunities demands (AgusSutarna, et al., 2020).

In its operations, vocational education must ensure that the curriculum/education pattern that has been implemented is appropriate and meets the expectations of the community, where graduates have been absorbed in the world of work, and the fields of work carried out by alumni are by what they learned during their time. Be a student. To ensure that this has been achieved, an activity called a tracer study is required. (IlahSailah, 2011).

A tracer study is a study of graduates from higher education providers. (Schomburg, 2014). Another term for a tracer study is often referred to as an alumni survey or a “follow-up” survey or a study of graduates of higher education providers. From the information on the tracer study results, it can provide high feedback for universities (Nugraheni, 2018).

Several other definitions about the tracer study were also raised by several experts; who argued that the purpose of a graduate tracer study is to track graduates' progress after they graduate. This is done to determine graduates' employability and to retrospectively assess graduates' satisfaction with the services provided by the institutions where they studied. This study presents a way to evaluate whether an institution is meeting its primary objective of producing highly qualified and employable graduates. Besides, this study is also used to assess alumni satisfaction with the campus's lecture services before they become employees. From their point of view, it can be seen whether the facilities and infrastructure owned by the campus are good, or if there are any that need repair. From this tracer study, information about the alignment between the curriculum and the needs and expectations of the world of work can also be gathered. (HJBDCS, 2014).
From several understandings about tracer studies as described above, then in this article what is meant by tracer study is as conveyed by Didin Wahidin (DitjenBelwawa) in 2017, that tracer study is understood as an alumni survey carried out by universities to extract information related to the journey of graduates, from the time they finish their education in tertiary institutions to the time of the survey. The information obtained from the tracer study is very useful for various evaluations of higher education outcomes, improvement, and assurance of higher education institutions' quality and the relevance of higher education, information for stakeholders, and completeness of higher education requirements accreditation.

For this reason, universities are expected to carry out the tracer study program appropriately, which aims to determine the absorption, process, and position of graduates in the world of work so that they can prepare graduates according to the competencies needed in the world of work and assist government programs in mapping and aligning world needs. Work with competencies obtained from higher education (Kemenristekdikti, 2016).

2. Methodology

The method used in this research is a survey method with descriptive quantitative analysis. There are two main stages in this research, namely: data collection and data analysis. The most important thing in a tracer study is data collection. Data collection in this study was carried out using the census method/opinion poll through an open survey conducted with the google form format. The census survey involved all graduates of the Diploma 3 Mining Engineering study program, Faculty of Engineering, Padang State University, willing and willing to respond.

The initial inventory was carried out by looking at data on name, year of entry to college, gender, cumulative grade point average, cell phone number and email address, and home address. Next, it is also recorded about how long it takes to complete the study or study on time. If the respondent answers that the study's completion is not on time, then what information is the cause is also explored.

After graduating from college, it is recorded whether they have worked or not, where they work, company address, when to start working and in what position they are placed in the job where they work. Furthermore, information is explored on how long it took them to get a job after graduating from college, where to get information to get a job, and what difficulties they felt when looking for/ applying for a job.

The following data revealed was how the condition was after they had their job. What difficulties and obstacles do they feel, especially those related to the field of work. What types of agencies do they work for, the most important considerations for them in choosing a job, and the nominal range of income they receive.

Furthermore, it was also revealed how several important aspects were related to the conditions when they were educated, which led them to be accepted in the agency or company where they were currently working. And what subjects they get at the lecture and are most relevant to their current job.

Regarding aspects of learning carried out in the study program, the data surveyed included how they responded to the learning model, the learning process, learning services, and teaching facilities. Finally, the respondents' data for improvement in the study program are what aspects need to be improved in the study program. It will help relevance and be useful when graduates are looking for work and when they are working.

3. Results and Discussion

As stated above, a tracer study is understood as a survey of alumni carried out by universities to gather information related to graduates' journey, starting from the time they finish their education in college until the time of the survey. Therefore, in this study, the respondents were all alumni who had completed education regardless of the year of entry and graduation.

Of all the graduates of the mining engineering study program who completed their education, it is recorded that the number of respondents who filled out the survey was 412 respondents, with the number of male respondents as much as 78.2% and 21.8% of female respondents. Regarding study completion on time, 64.8% completed the study on time, and 35.2% exceeded the study time. Of the causes of the study not being on time, 37.8% did not provide reasons. Only 62.2% gave reasons for the reasons in detail (29.5% were late in completing the final/final project, 14.7% repeated failed courses or low scores, 9% financial problems, and the remaining 9% due to health problems and family problems, and 0% or no problems with lecturers).
Of the 412 respondents who responded when asked whether they had worked or not, 96.6% answered that they had worked, and only 3.4% did not work. Regarding the length of time they got a job, and most answers were 70.9% getting jobs between 0 - 6 months after graduating, 17.5% getting jobs between 6 - 12 months after graduating. There are 6.1% of graduates who get jobs before they finish their studies, 2.4% found employment within 12 - 18 months, 0.7% found jobs within 18 - 24 months, and 2.4% found jobs after 24 months they graduated.

The answers to the questions about how they get information to get a job, 44.5% answered getting information from the internet (websites, social media, and/or mailing lists). 24.5% got information from UNP alumni, 14.3% got information from friends/family/parents. 12.4% get information from the study program / faculty. 2.9% of advertisements in newspapers, and 0.7% from various other sources.

When information is extracted about what difficulties alumni have experienced when looking for work, their answers can be patient, as shown in the following diagram in Figure 1:

![Figure 1. Difficulties in finding a job](image)

The most significant difficulty for alumni in getting a job is that many companies require work experience (57.8%), 24.5% think that the salary offered is not in line with expectations. They were followed by the lack of English language skills (29.6%) as well as the lack of communication skills (21.6%), and the required ability to master computers/mining software (21.4%). The next reason is that the field of work is not by the field of knowledge (12.1%), and the field of work is not according to the wishes (8.3%). GPA turned out to be at the bottom of the list with 6.3%.

When extracted information about what difficulties are felt related to the field of work and their relation to their knowledge. The answer is as shown in Figure 2 below.

From the data in Figure 2, the difficulties that alumni encounter when they have worked are; (a) computer skills/mining software (36.2%), (b) English/foreign language skills (32%), (c) communication skills (25.7%), (d) ability to work together in a team (22.6%), (e) skills in making written reports (17.2%), (f) fields of work not by the field of science (mismatch) (16.7%), (g) fields of work not according to education level (15.8%), (h) academic ability (10.7%); and (i) the line of work is not by the wishes (10%), and (j) 1.7% answered others.
Next is the suitability between education and their place of work, the largest being those who work in industrial sectors that are closely related to the field they are studying (66.7%), and those who work in industrial sectors that are not related to their fields are 9.2%, the rest vary working in a variety of fields; continuing studies, working in government agencies and others. As shown in Figure 3.

![Figure 2. Difficulties in the field of work](image)

![Figure 3. Suitability of education with the place of work](image)

Regarding the income that they received, most (86.4%) gave information that they received more than the UMR (> 2 million rupiahs) as shown in Figure 4 below;

![Figure 4. Amount of salary received](image)
When asked about learning activities that most affected their field of work in the field, the most answered were practical activities, as shown in Figure 5 below.

![Figure 5. How important is the existing learning activities](image)

From the information obtained about how they assess aspects of learning, including general conditions of lectures, academic guidance, opportunities for interaction with lecturers outside of lectures, opportunities to involve themselves in scientific/professional activities, and opportunities to participate in research activities, average they give an assessment. Very good and useful, only a few rated it sufficiently, and no one gave a low and abysmal rating.

Likewise, when extracted information about facilities and infrastructure such as; libraries, information and communication technology, study rooms, laboratories, health care facilities, canteen facilities, photocopies, the center of student activity, guidance, and counseling services, most of them said they were very good and good, and only a few gave sufficient assessments. No one gave a poor and abysmal rating.

Finally, regarding which subjects have the most influence and are related to their work in the field, they provide information that in addition to courses related to the mining engineering sector, supporting subjects such as scientific communication, English, computers, and mining software, and field practice courses are things that need attention.

4. Conclusion

Based on data from the results of tracer study research that has been carried out on all graduates of the three diploma study program in Mining Engineering, Faculty of Engineering, Padang State University, from 412 respondents who are willing to respond, it shows that many things can be explored, including in terms of transitions in the world of work, map of activities graduates in the world of work, a map of the horizontal and vertical alignment of graduates, and a map of the competency gap of graduates and the demands of the world of work.

The transition to entering the world of work is indicated by several variables, including GPA, gender, and competence. Salaries earned by alumni exceed, on average, the regional minimum wages. Likewise, how they complete their education, how they get a job, including what difficulties alumni experience when looking for work can strengthen the educational process's improvement in the study program.

Concerning the improvement of the curriculum, it can be seen how the harmony between the fields of study studied and the existing work fields in the field. Learning activities that most influence their field of work in the field, how their assessment of the aspects of learning, conditions of facilities and infrastructure, and which subjects have the most influence and are related to their work in the field, are good input in planning curriculum reconstruction activities in the future.

Information on the suitability between education and their place of work shows that the learning process in the study program is still in the right flow, although there are almost 33.3% who do not work in their respective fields, this should be a concern when carrying out curriculum reconstruction and improvement.
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