Profile matching for students specialization in industrial engineering major

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Abstract. Nowadays, various specific skills are needed in the global work environment. Because of that, many university majors provide specializations within majors. The Industrial Engineering major at Telkom University has eleven specializations that can be selected by the fourth-year students. Every academic year, some specializations have registrants more than the class maximum capacity. Therefore, this study aims to create a selection procedure. The methodology used in the selection procedure is profile matching. The matching is done between the students’ capacity and the requirements of the specializations. The capacity and the requirements are measured by using seven previous first to third-year courses as the criteria. The value of the criteria is measured by the grade index of the seven courses. The gap is identified between the students’ grade achievement and the highest grade. This study is limited to two specializations that have 55 and 47 registrants in the academic year of 2019/2020. The profile matching calculation is simulated using the data of three students for each specialization. The highest and the lowest match score from the six students are 4.9 and 3.6 (on a scale of 5).

1. Introduction

A rapid change in society and the work environment requires universities to be able to prepare graduates with the appropriate skills for future work [1]. Expertise in certain fields is important to be mastered by students when graduating from university. Therefore, universities must have teaching programs that can construct student competencies under the major. In addition to general competencies related to the major, students also need to have special competencies in more specific fields. Special competencies can be formed through the choice of specializations.

The Industrial Engineering major at Telkom University has eleven specializations that can be selected by the fourth-year students. Each specialization opens at least three elective courses that can be chosen by the fourth-year students. The eleven specializations are Production System and Automation, Product Design and Ergonomics, Quality System Engineering, Supply Chain Management, Enterprise Support System, Maintenance Management, Human Capital Management, Entrepreneurship, Marketing Management, Business Analyst, and Project Management.

The class maximum capacity for each specialization is 45 students. Every academic year, some specializations have registrants more than the class maximum capacity. Because of that, the head of the Industrial Engineering department must determine which students are enrolled in the specialization they choose and which students are redistributed to another specialization. In the existing condition, students with higher Grade Point Average (GPA) will have a higher probability to be enrolled in the
specialization they choose. The disadvantage of this method is that the students may be assigned to a specialization that is not the most suitable according to their potential capacity.

On the other hand, the choice of specialization is also a problem for students. This is caused by the lack of students' understanding of their interests and abilities [2]. If the student’s interests and abilities can be identified, the student can choose the most suitable specialization according to their interests and potential capacity. Based on that, the head of the Industrial Engineering department can prioritize students with a high match between their capacity and the requirements of the specializations, rather than relying only on GPA. Therefore, this study aims to create a selection procedure in specialization enrollment, which considering the students’ capacity and the requirements of the specializations.

The match between the students’ capacity with the requirements of the specializations can be measured using the profile matching method. This method has already widely used in human resource management, especially for identifying the gap between individual competencies and job competency [3]. Some previous studies apply the profile matching method for employee placement in a manufacturing company [4], an insurance company [5], and a navy organization [6]. In the higher education context, the profile matching method is implemented to select scholarship grantees [7], recruit laboratory assistants [8], and determine students’ specialization. The determination of students’ specialization in the previous studies are for the students of informatics [9], management [2], animal husbandry [10], and information and communication technology major [11]. These previous studies show that profile matching is suitable to be implemented in this study.

This paper consists of four parts. The introduction section is followed by the methodology section. The method section explains the data and the profile matching stages used in this study. The third section represents the result and discussion. In this section, the description of aspects, the gap calculation result, and the proposed selection procedure in specialization enrollment are explained. The fourth section summarizes the conclusion of this study.

2. Method
This study aims to create a selection procedure in specialization enrollment based on the match between the students’ capacity with the requirements of the specializations. The match can be measured by following the profile matching methodology. Profile matching is a decision-making mechanism that assumes that there is an ideal level of predictor variables that must be possessed by candidates. The actual profile data values of the candidates will be compared with the ideal data values. Based on this comparison, differences in values between actual and ideal conditions will be identified. The smaller the value difference, the better, because this shows that the actual profile is approaching the ideal profile [12].

The profile matching stages are aspect and criteria identification, scoring formulation, gap value calculation, core factor and secondary factor determination, weight determination, final score calculation [3]. In the aspect and criteria identification, the student’s capacity is selected to be the aspect in the specialization selection. The student’s capacity is measured using some previous first to third-year courses as the criteria. Those are the courses with high relevance to the specializations. The courses used as the criteria are determined by the head of each specialization.

After the aspect and criteria are identified, the scoring for the criteria is formulated. The value of the criteria is measured by the grade-index of the courses. The grade-index implemented in Telkom University consists of A, AB, B, BC, C, D, and E, which are equal to 4, 3.5, 3, 2.5, 2, 1, and 0 consecutively.

The gap is identified between the students’ grade achievement and the highest grade. The gap rule used in this study is the match value will be equal to 5, 4.5, 4, 3.5, 3, 2.5, 2, 1, and 0 when the gap is equal to 0, -0.5, -1, -1.5, -2, -3, and -4.

In this study, there is no core factor and secondary factor. All of the courses used as the criteria are considered to be equal. Therefore, there is no weight determination between the core factor and the secondary factor. The final score is calculated by determining the average of the match value.
The profile matching stages discussed above are simulated using the data of three students for each specialization. The three students are randomly selected. This study is limited to two specializations that are Business Analyst and Maintenance Management. In the academic year of 2019/2020, the Business Analyst has 55 registrants, while Maintenance Management has 47 registrants. Both are exceeding the class maximum capacity.

Based on the result of the profile matching stages, a new selection procedure in specialization enrollment is design. The selection procedure will prioritize students with a high match between their capacity and the requirements of the specializations.

3. Results and discussion

The results of this study are presented and discussed in the following two subsections. The first subsection presents the profile matching stages simulated using the data of six students. The second subsection explains the proposed selection procedure in specialization enrollment.

3.1. Profile matching stages

The student’s capacity is selected to be the aspect of the specialization selection. The criteria for this aspect are some previous first to third-year courses. For Business Analyst specialization, the criteria are Facility Layout Design (Fac), Business Feasibility Study (Bus), Entrepreneurship (Ent), Practicum for Business Design and Industrial Facilities (Pra), and System Modeling and Computer Simulation (Sys). For Maintenance Management specialization, the criteria are Facility Layout Design (Fac), Supply Chain Management (Sup), Quality Control and Assurance (Qua), Practicum for Business Design and Industrial Facilities (Pra), and System Modeling and Computer Simulation (Sys).

The score data of Student A, Student B, and Student C who register to Business Analyst specialization is shown in Table 1. The score data of Student D, Student E, and Student F who register to Maintenance Management specialization is shown in Table 2.

| No. | Name    | Fac | Bus | Ent | Pra  | Sys |
|-----|---------|-----|-----|-----|------|-----|
| 1.  | Student A | 2   | 4   | 4   | 3.5  | 2   |
| 2.  | Student B | 2   | 3.5 | 4   | 0    | 3.5 |
| 3.  | Student C | 2.5 | 3.5 | 4   | 3.5  | 3.5 |

| No. | Name    | Fac | Sup | Qua | Pra  | Sys |
|-----|---------|-----|-----|-----|------|-----|
| 1.  | Student D | 2.5 | 3.5 | 3.5 | 4    | 3.5 |
| 2.  | Student E | 3   | 4   | 4   | 4    | 3.5 |
| 3.  | Student F | 4   | 3.5 | 4   | 4    | 4   |

The target value for all criteria is the highest grade that is 4. The gap is calculated by identifying the difference between the score data and the target value. The gap value of Student A, Student B, and Student C who register to Business Analyst specialization is shown in Table 3. The gap value of Student D, Student E, and Student F who register to Maintenance Management specialization is shown in Table 4.

| No. | Name    | Fac | Bus | Ent | Pra  | Sys |
|-----|---------|-----|-----|-----|------|-----|
| 1.  | Student A | -2  | 0   | 0   | -0.5 | -2  |
| 2.  | Student B | -2  | -0.5| 0   | 4    | -0.5|
| 3.  | Student C | -1.5| -0.5| 0   | -0.5 | -0.5|
Table 4. Gap value (maintenance management).

| No. | Name   | Fac | Sup | Qua | Pra | Sys |
|-----|--------|-----|-----|-----|-----|-----|
| 1.  | Student D | -1.5 | -0.5 | -0.5 | 0   | -0.5 |
| 2.  | Student E | -1  | 0   | 0   | 0   | -0.5 |
| 3.  | Student F | 0   | -0.5 | 0   | 0   | 0   |

This gap is then converted into match values ranging from 0 to 5. The lower the gap, the higher the match value. The match value of Student A, Student B, and Student C who register to Business Analyst specialization is shown in Table 5. The match value of Student D, Student E, and Student F who register to Maintenance Management specialization is shown in Table 6.

Table 5. Match value (business analyst).

| No. | Name   | Fac | Bus | Ent | Pra | Sys | Final |
|-----|--------|-----|-----|-----|-----|-----|-------|
| 1.  | Student A | 3   | 5   | 5   | 4.5 | 3   | 4.1   |
| 2.  | Student B | 3   | 4.5 | 5   | 5   | 4.5 | 3.6   |
| 3.  | Student C | 3.5 | 4.5 | 4.5 | 5   | 4.5 | 4.4   |

Table 6. Match value (maintenance management).

| No. | Name   | Fac | Sup | Qua | Pra | Sys | Final |
|-----|--------|-----|-----|-----|-----|-----|-------|
| 1.  | Student D | 3.5 | 4.5 | 4.5 | 5   | 4.5 | 4.4   |
| 2.  | Student E | 4   | 5   | 5   | 5   | 4.5 | 4.7   |
| 3.  | Student F | 5   | 4.5 | 5   | 5   | 5   | 4.9   |

Since there is no core factor and secondary factor in this study, the final score is calculated by determining the average of the match value. The final score for each student is shown in Table 5 and Table 6.

Table 7. Student ranking (business analyst).

| No. | Name   | Profile Matching Score | Profile Matching Ranking | GPA   | GPA Ranking |
|-----|--------|------------------------|--------------------------|-------|-------------|
| 1.  | Student A | 4.1         | 2                        | 2.93  | 3           |
| 2.  | Student B | 3.6         | 3                        | 3.05  | 2           |
| 3.  | Student C | 4.4         | 1                        | 3.41  | 1           |

Table 8. Student ranking (maintenance management).

| No. | Name   | Profile Matching Score | Profile Matching Ranking | GPA   | GPA Ranking |
|-----|--------|------------------------|--------------------------|-------|-------------|
| 1.  | Student D | 4.4       | 3                        | 3.45  | 2           |
| 2.  | Student E | 4.7       | 2                        | 3.78  | 1           |
| 3.  | Student F | 4.9       | 1                        | 3.78  | 1           |

The ranking comparison between profile matching score and GPA of Business Analyst specialization registrants can be seen in Table 7. Based on the profile matching final score, the ranking order of Business Analyst specialization registrants from the highest is Student C, Student A, and Student B in sequence. If the ranking is conducted based on GPA, as used in the existing procedure, the sequence is Student C, Student B, and Student A. The order is different for Student A and Student B. This situation implies that high GPA does not guarantee high profile match.

The ranking comparison between profile matching score and GPA of Maintenance Management specialization registrants can be seen in Table 8. Based on the profile matching final score, the ranking order of Maintenance Management specialization registrants from the highest is Student F, Student E,
and Student D in sequence. If the ranking is conducted based on GPA, as used in the existing procedure, the sequence is Student F and Student E, and then Student D. The order is the same for the three students.

3.2. Proposed selection procedure
The proportion of specialization registrants is varied from an academic year to another academic year. Some specializations have registrants more than the class maximum capacity. Therefore, some registrants must be reallocated to another specialization. The registrants are ranked based on their GPA. Students with a lower-ranking will be reallocated. Usually, the student is reallocated to his or her second choice of specialization. If the second choice is also full, then the student is placed in the specialization with the least member.

The profile matching stages as discussed in the previous subsection can be implemented in the selection procedure. The profile matching score can replace GPA as the main ranking determinant. The proposed selection procedure is explained as follows.

- Sort the specializations by the number of registrants.
- Check if there are specializations that have more than 45 registrants. If no, the selection procedure is finished. If yes, choose a specialization with the highest number of registrants.
- Sort the registrants by the profile matching score. If there are students with the same profile matching score, the student which has a higher GPA will have a higher ranking.
- Allocate the first 45 students to this first specialization, then this specialization is closed.
- For the students who are at 46th ranking to the last, calculate the profile matching score for the rest unclosed specializations.
- Put the students in the registrant list of the specialization with the highest match with those students.
- Sort the unclosed specializations by the number of registrants. Back to step 2.

4. Conclusion
This study aims to create a selection procedure in specialization enrollment based on the match between the students’ capacity with the requirements of the specializations. The match is measured by the profile matching methodology. The criteria used are seven previous first to third-year courses which are related to the two specializations simulated. The value of the criteria is measured by the grade index of the seven courses. The gap is identified between the students’ grade achievement and the highest grade. The profile matching calculation is simulated using the data of three students for each specialization. The highest and the lowest profile matching score from the six students are 4.9 and 3.6 (on a scale of 5). This simulation shows that the profile matching is applicable for determining the ranking of students in the specialization selection.

The profile matching stages simulated in this study can be implemented in the selection procedure. The profile matching score can replace GPA as the main ranking determinant. The proposed selection procedure consists of seven steps, starting from sorting the specializations by the number of registrants. The procedure is to stop when there is no specialization with more than 45 registrants.

The limitation of this study is that the match is simulated only between the students’ capacity with the requirements of the specializations chosen by the students. Therefore, the specialization which has the highest match with a student can not be identified. For future study, the implementation result of the proposed and the existing selection procedure can be compared, for example using an agent-based simulation approach [13]. A decision support system can also be developed to make the selection procedure easier. Additional aspects and criteria, such as students’ interest in future final project and work position, can be applied. The weighting approach such as Simple Additive Weighting (SAW) [9] or Weighted Sum Model (WSM) can be embedded into the decision support system [14].
References

[1] Keinänen M, Ursin J and Nissinen K 2018 How to measure students’ innovation competences in higher education: Evaluation of an assessment tool in authentic learning environments *Studies in Educational Evaluation* **58** pp 30-36

[2] Mutiara S and Aziz R Z A 2018 Sistem pendukung keputusan pemilihan konsentrasi Bidang Ilmu Ekonomi pada Program Magister Manajemen IIB Darmajaya menggunakan Fuzzy FIS Tsukamoto *Proceedings of the Seminar Nasional Teknologi dan Bisnis* pp 303-313

[3] Hasibuan H A, Purba R B and Siahaan A P U 2016 Productivity assessment (performance, motivation, and job training) using profile matching *SSRG International Journal of Economics and Management Studies* **3** 6 pp 73-77

[4] Nasriyah R, Arham Z and Aini Q 2016 Profile matching and competency based human resources management approaches for employee placement decision support system (case study) *Asian Journal of Applied Sciences* **9** 2 pp 75-86

[5] Sunarti S, Yuliendi R R and Marlim Y N 2017 Application profile matching method for employees online recruitment *IOP Conference Series: Earth and Environmental Science* **97** 1 pp 012035

[6] Sahureka A O P 2017 Decision support systems in the placement of Electronic Officers of Indonesian Navy with profile matching method *International Journal of Engineering Research & Technology* **6** 1 pp 458-465

[7] Jayadi P, Yazid A S and Mustakim M 2016 Bidikmisi scholarship Sselection in UIN Sunan Kalijaga using profile matching method *International Journal on Informatics for Development* **5** 2 pp 6-11

[8] Astari S R, Umar R and Sunardi S 2019 Penerapan profile matching untuk seleksi asisten laboratorium *Telematika* **16** 1 pp 1-10

[9] Elizabeth T and Tinaliah T 2019 Sistem pendukung keputusan pemilihan peminatan Program Studi Teknik Informatika menggunakan metode SAW *Jurnal Teknik Informatika dan Sistem Informasi* **5** 2 pp 210-218

[10] Ariebowo B and Widayanti R 2017 Sistem penunjang keputusan pemilihan bidang peminatan mahasiswa Fakultas Peternakan Universitas Brawijaya menggunakan metode Weighted Product *Proceedings of the Seminar Nasional Sistem Informasi* (Malang: Universitas Merdeka Malang) pp 655-664

[11] Petra Y and Hansun S 2016 Rancang Bangun Sistem Rekomendasi Peminatan Fakultas Teknologi Informasi dan Komunikasi dengan Metode Analytical Hierarchy Process *Jurnal Buana Informatika* **7** 2 pp 151-158

[12] Sopianti L and Bahtiar N 2015 Students major determination decision support systems using profile matching method with SMS gateway implementation *Jurnal Sains dan Matematika* **23** 1 pp 14-24

[13] Ramadhun F, Soesanto R P, Rizana A F, Kurniawati A and Wiratmadja I 2017 Mechanisms for effective tacit knowledge transfer in university laboratory: An agent-based approach *Proceedings of the 017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* 1138-1142

[14] Naufal A, Kurniawati A and Hasibuan M A 2016 Decision support system of SMB telkom university roadshow location prioritization with weighted sum model method *Proceedings of the 2016 2nd International Conference of Industrial, Mechanical, Electrical, and Chemical Engineering (ICIMECE)* 107-111