Analysis of Instruments for Implementing Intelligent Job Matching Models

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Abstract **– Vocational high schools in Indonesia face challenges in producing graduates who meet the needs of the job market. The link and match policy along with the Job Matching system are proposed to enhance curriculum relevance to the workforce. The intelligent job matching model, which integrates machine learning technology, is expected to provide job recommendations aligned with graduates' competencies. Data analysis techniques used include qualitative and quantitative statistical analysis, encompassing Validity Analysis, Practicality Analysis, and Effectiveness Analysis. The intelligent job matching model has proven effective in assisting in matching vocational high school students' competencies with workforce demands in the industry. In the 2023 job fair, the success ratio of students invited for interviews until the employment process reached 53.13%, exceeding the Ministry of education and culture's target of 40%. This indicates that the model can provide job recommendations accurately enough, aiding in improving the direct employment rate of vocational high school students. Research indicates that the intelligent job matching model is effective in facilitating students' transition to the workforce. The model has been tested for validity, practicality, and effectiveness in enhancing students' employability and strengthening the relationship between education and industry.**

Keywords **– Machine learning, content based filtering, intelligent job matching, vocational high school.**

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1. Introduction

Vocational high schools are significantly impacted by the low quality of education in Indonesia. These schools are essential for improving the quality of human resources. Graduates of vocational high schools have two options: to continue their education at a higher level or to directly enter the workforce. Often, students have not planned their post-graduation paths, while many graduates end up employed in areas unrelated to their skills and competencies. The curriculum of vocational high schools prioritizes assessing student learning results over building their competencies [1].

Students must build their skills throughout their education to effectively set their post-graduation objectives. Mastery of both hard skills and soft skills is crucial in job searching and career planning. Hard skills are the minimum requirements for entering a particular job field, while soft skills determine self-development in a specific job. Integrating these two aspects is a significant challenge in the education sector to prepare human resources capable of working and developing in the future. Enhancing skills will help students in mapping out their career paths [2].

If someone's abilities and interests align with a specific field of work, then that job can be performed well [3]. Job development at various levels of school education encompasses all efforts to guide students in learning various aspects of work, understanding the various demands that must be met in the workforce, and executing plans for future development.

The success and progress in one's work throughout their life is referred to as a career [4]. Career maturity in students reflects their capacity for personal growth, decision-making, and following career paths that match their job categories.

The aim of career development is to support or encourage students' growth so that they can understand themselves [5], familiarize themselves with the work environment, overcome obstacles caused by factors in job hunting, plan for the future, and shape career patterns or directions. Developing skills and career planning in schools enables students to determine the fields of work based on their abilities and interests.

The Central Statistics Agency reported that the Open Unemployment Rate in 2022 reached 5.83%, with the highest figure predominantly in vocational high schools at 10.38%, followed by senior high schools at 8.35%. This indicates that the education standards are still inadequate. Incorporating work practice programs into the curriculum of vocational high schools has been carried out as a form of learning activity between students and the workforce. Work practice programs aim to introduce students to the workforce so that when they enter the actual workforce, they do not feel afraid and can adapt quickly.

The implementation of work practice programs has not yielded optimal results, even the employment challenges among graduates of vocational high school continue to remain significant. In other words, the mismatch between education curriculum and job demands results in students lacking preparation to carry out their field work practice. The school's learning system focuses on teaching materials rather than students' understanding of the workforce [6].

The Indonesian government, through the Ministry of Education and Culture, is currently developing policies aimed at improving the alignment between vocational high school curricula and the workforce demands, industries, and businesses. Link and match initiatives are seen as efforts to identify the competencies required by the future job market [7].

Link and match facilitates mutually beneficial interactions between educational institutions and the job market, enabling the adjustment of educational curricula to meet industry needs [8]. Implementing link and match equips students for participating in field work practices. Consequently, students who previously had limited understanding of the workforce can now learn about the tasks they will undertake and how to execute them.

The impact of link and match also has the potential to address the growing employment challenges faced by vocational high school graduates annually. The Directorate General of Education [9] mentions that the success of the education system in Indonesia can improve the quality of the workforce. Conversely, the workforce also participates in education development, but from the industry's perspective, there are still many vocational high school graduates who cannot meet the requirements of Industry 4.0.

The link and match policy merely serves as a bridge between the education sector and the workforce. Job recommendations are crucial for new graduates seeking employment, especially in addressing the emerging issue of job competency alignment. The link and match policy can address this issue through the implementation of a job matching system, which aims to encourage graduates to explore various job fields [10]. Job matching seeks to improve industry awareness of the skills and competencies that applicants possess [11].

The intelligent job matching model is a system that supports new graduates in job searching. This model will categorize graduates based on their competencies and provide job recommendations suitable for their respective fields. The intelligent job matching model uses the content-cased filtering method, which aims to provide job recommendations based on the suitability of individual profiles [12].

The role of computer technology has evolved from merely a tool for calculating, processing, and presenting information to being capable of replacing humans in handling complex tasks [13]. In the intelligent job matching model, computer technology such as machine learning is used to support the automation of job application filtering processes [14].

The intelligent job matching model not only benefits graduates, but also provides advantages for the workforce. The job recruitment process can be conducted effectively with the implementation of the intelligent job matching model in assisting in matching applicants with job qualifications needed.

2. Methodology

Data analysis techniques aim to obtain information from the data collected using research instruments. Data analysis techniques used include qualitative and quantitative statistical analysis [15]. Data analysis techniques follow the instruments used in research. Therefore, the details of these data analysis techniques are explained as follows.

2.1. Validity Analysis Technique

Validity evaluates how well a test or scale measures what it is supposed to measure [16]. Therefore, validity can be used to determine the accuracy of measurement results or the measurement instrument itself. Validity data are obtained from experts who provide advice for improving instruments, models, media, learning materials, and research products developed.

In the validation analysis of the intelligent job matching model using machine learning, the test data results are considered valid if they meet the goodness of fit criteria, i.e., if the p-value > 0.05 and the loading factor value of each indicator > 0.5.

In the analysis of instrument validity using Aiken's V coefficient, the Aiken's V formula computes the content validity coefficient using experts' evaluations of how well an item represents the construct being measured [17]. The data analysis with Aiken's V formula is as follows:

1. Providing ratings of responses according to the Likert scale.
2. Summing up scores from each validator for all indicators.
3. Providing a percentage assessment of validity using the formula:

$$V = \sum s : (n(c-1))$$
$$s = r - lo$$
$$\sum s = s1 + s2 + s3 + ... + Sn$$

Explanation:

- V = Validity Index
- S = r - lo
- N = Number of validators or assessors
- Lo = Lowest validity rating (= 1)
- C = Highest validity rating (= 5)
- R = Rating given by a validator

4. The Aiken's V range will be obtained between 0 - 1. For results ≥ 0.667, it can be considered sufficiently high and valid. The validity of the test product can be determined from Table 1.

Table 1. Criteria for validity categories

Category	Qualification
0,67 – 1,00	Valid
< 0,66	Invalid

2.2. Practicality Analysis Technique

Practicality data is obtained from product users, including industry stakeholders, educators, and students. Test results serve as the foundation for assessing the practicality level of the product under development [18]. The stages of practicality analysis of the research product can be outlined as follows:

1. Criteria for answer scores are provided according to the Likert scale.
2. Calculating the mean by adding up values derived from different indicators.
3. Assigning practicality scores using the formula:

$$NA = \frac{S}{M} \times 100\%$$

Explanation:

- NA = Final Score
- S = Score Obtained
- M = Total Score

4. The data obtained will be calculated to obtain the average score and multiplied by one hundred percent. The percentage values are subsequently categorized according to practicality levels, as depicted in Table 2.

Table 2. Practicality categories

Achievement Level (%)	Category
86-100	Very Practical
76-85	Practical
60-75	Fairly Practical
55-59	Less Practical
0-54	Not Practical

2.3. Effectiveness Analysis Technique

The technique of effectiveness analysis, employing descriptive analysis, offers a thorough comprehension of how successful the intelligent job matching model is in matching students with companies. Descriptive analysis enables us to depict the characteristics, dimensions, and performance of various aspects involved in the testing [19]. During the job fair organized by the Ministry of Education, the Ministry targets a 40% employment rate for vocational high school graduates through synergy with industries and the enhancement of learning quality in vocational high schools.

This target is essential for reducing unemployment among vocational high school graduates and meeting the skilled workforce needs in the industrial sector. In testing the effectiveness of the intelligent job matching model, an effectiveness analysis technique integrating descriptive analysis is employed to provide a comprehensive overview of the model's performance. Descriptive analysis allows for an in-depth understanding of various aspects, including the number of companies involved, the number of students who successfully passed interviews, the success ratio of students, testing methods utilized, selection criteria, processing time, feedback from companies, job suitability levels, and contributing factors to success or failure. The success ratio of students can be calculated using the formula:

$$\text{Success Ratio} = \frac{\text{Number of Students Passed}}{\text{Total Number of Students}} \times 100\%$$

Descriptive analysis provides an overview of the outcomes of the limited product usage process, with all procedures narrated clearly to ascertain the effectiveness level accurately.

3. Results

Each product and instrument is validated to measure the level of accuracy of each product and instrument that has been developed. The presentation of the validation results is as follows.

3.1. The Results of Validity Analysis

The initial validation of the intelligent job matching model is critical, given that this model constitutes the primary product of the research. This validation process involves both content and construct validation methods. Five experts have validated this model. Expert 1: Y.K., Expert 2: W., Expert 3: S., Expert 4: R.L., and Expert 5: S.R.

Each expert possesses their respective expertise, including expertise in learning model, expertise in computer science, expertise in language, expertise in technology and vocational, and expertise in research and development. Firstly, the results of content validation by experts are presented in Table 3.

Table 3. Syntax validation of the intelligent job matching model

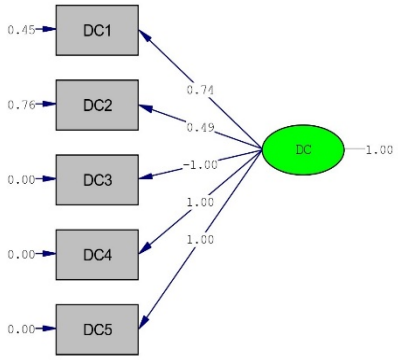
Syntax	Aiken's V	Result
Data Collection	0,88	Valid
Data Training	0,90	Valid
Data Preprocessing	0,89	Valid
Result	0,89	Valid
Total	**0,89**	**Valid**

Based on Table 3, it is obtained that the Model intelligent job matching has 4 syntaxes, namely data collection, data training, data preprocessing, and result. Each syntax, both partially and simultaneously, obtains a value above 0.67, which is interpreted as the model intelligent job matching being valid in terms of content, both partially and simultaneously.

After passing the content validation test, it is followed by the construct validation test. This validation process aims to ensure that the model developed falls into the category of goodness-of-fit models. A goodness-of-fit model must have a chi-square divided by degrees of freedom (X^2/df) < 2 [20]. Other values such as p-value, RMSE, error value, and standardized solutions value are not considered, whether they are positive or negative. This is because in the CFA calculation in this study, only the chi-square test and degree of freedom values are used. Therefore, the following are the results of the construct validity test of the model intelligent job matching.

3.1.1. Construct Validation of Syntax-I (Data Collection)

The data collection syntax serves as the first syntax in the model intelligent job matching. The results of the validation test for the Data Collection syntax are presented in Figure 1.



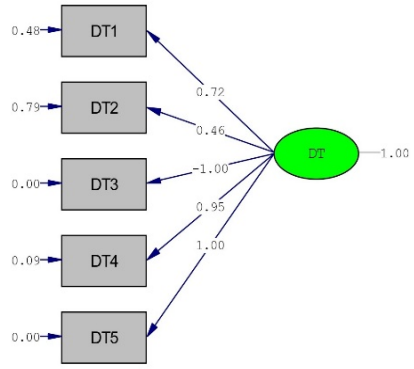
Chi-Square=1.45, df=5, P-value=0.91875, RMSEA=0.000

Figure 1. Validation results of data collection syntax

In Figure 1, it is obtained that the Chi-Square (x^2) value is 1.45 and the df value is 5 out of 5 question items. Based on obtained values, the x^2/df value is calculated as 1.45/5 = 0.29. The value of 0.29 < 2, which indicates that the Orientation syntax is valid.

3.1.2. Construct Validation of Syntax-II (Data Training)

The data training syntax serves as the second syntax in the model intelligent job matching. The validation results of the data training syntax are presented in Figure 2.



Chi-Square=5.93, df=5, P-value=0.31296, RMSEA=0.043

Figure 2. Validation results of data training syntax

In Figure 2, it is obtained that the Chi-Square (x^2) the value is 5.93 and the df value is 5 out of 5 question items. Based on the obtained values, the x^2/df value is calculated as 5.93/5 = 1.18 The value of 1.18 is below 2, indicating that this syntax is valid.

3.1.3. Construct Validation of Syntax-III (Data Preprocessing)

The data preprocessing syntax serves as the third syntax in the model intelligent job matching.

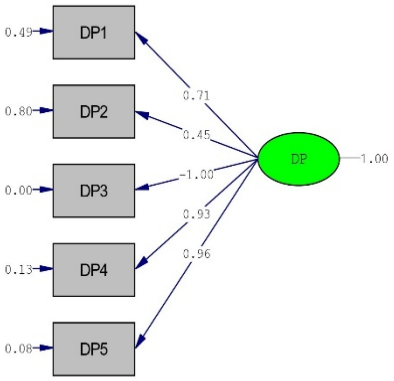


Figure 3. Validation results of data preprocessing syntax

In Figure 3, it is obtained that the Chi-Square (x^2) the value is 3.62 and the df value is 5 out of 5 items. Based on the obtained values, the x^2/df value is calculated as 3.62/5 = 0.72. The value of 0.72 is below 2, indicating that this syntax, Case Base Simulation, is valid.

3.1.4. Construct Validation of Syntax-IV (Result)

The Result syntax serves as the fourth syntax in the model intelligent job matching. The validation results of this syntax are presented in Figure 4.

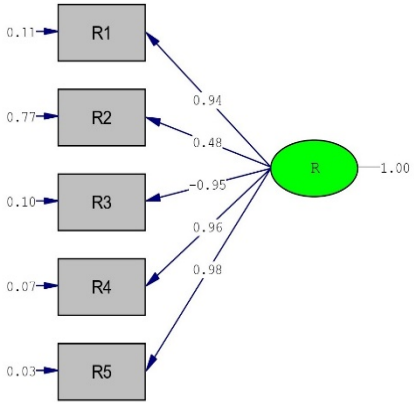


Figure 4. Validation Results of Result Syntax

In Figure 4, it is obtained that the Chi-Square (x^2) the value is 5.59 and the df value is 5 out of 5 items. Based on the obtained values, the x^2/df value is calculated as 5.59/5 = 1.11 The value of 1.11 is below 2, indicating that this syntax, Structured Practice Syntax, is valid.

3.2. The Results of Practicality Analysis

The practicality of a product reflects the level of user preference for using that product.

This preference may arise from factors such as ease of use, aesthetics, speed, and others. In the development research of the intelligent job matching model, three entities are involved: Industry, Educators, and Students. The results of the assessment by each entity are as follows.

3.2.1. The Results of Research Product Practicality: Industry Respondents

The practicality of the research product, the development of the intelligent job matching model, was further evaluated by industry stakeholders who utilize this product. The findings from industry respondents' evaluation of the research product's practicality are displayed in Table 4.

Table 4. Research product practicality assessment by industry respondents

Industry	Total Score	Percentage	Category
AW	Practicality of the Intelligent Job Matching Model		
	28	93%	VP
	Intelligent Job Matching Model Book		
	57	95%	VP
	Application		
	57	95%	VP
	Practicality of the Industry Guidebook		
	18	90%	VP

Based on Table 4, it can be observed that the practicality results of this research product were evaluated by the industry stakeholders who utilized the intelligent job matching model. This indicates that the research product is highly accepted by the industry in its implementation.

3.2.2. Practicality Results of Research Products as Assessed by Educator Respondents

The practicality of the research product development of the intelligent job matching model was further assessed by educators as entities utilizing this product. The results of the practicality of the research product as assessed by educator respondents are presented in Table 5.

Table 5. Practicality of research products as assessed by educator respondents

Educator	Total Score	Percentage	Category
HY	Practicality of the Intelligent Job Matching Model		
	28	93%	VP
	Intelligent Job Matching Model Book		
	57	95%	VP
	Application		
	56	93%	VP
	Practicality of the Industry Guidebook		
	19	95%	VP
WH	Practicality of the Intelligent Job Matching Model		
	27	90%	VP
	Intelligent Job Matching Model Book		
	55	92%	VP
	Application		
	56	93%	VP
	Practicality of the Industry Guidebook		
	18	90	VP

Based on Table 5, it can be observed that the practicality results of this research product were assessed by educators who utilized the intelligent job matching model. This indicates that the research products were highly accepted by educators in their implementation.

3.2.3. Practicality Results of Research Product Trial by Student Respondents

The trial of this product aims to assess the practicality of the research product that has undergone testing by experts. The results of this trial are presented in Figure 5.

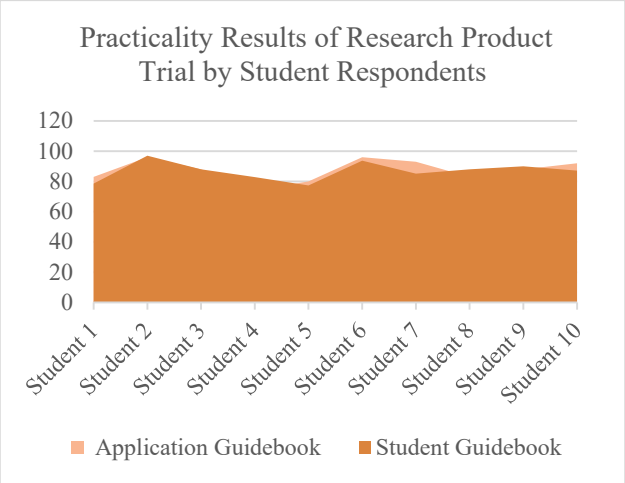


Figure 5. Practicality results of research product trial by student respondents

Figure 5 presents the results of the trial for supporting products in the context of vocational high school students majoring in software engineering. This trial involves two evaluation aspects, namely the application guidebook and the student guidebook. Based on the trial results, the average score for the application guidebook is 87.30%, while the student guidebook obtains an average score of 86.78%. Both scores are categorized as practical, indicating that these supporting products are considered effective and can be used well by vocational high school students majoring in software engineering. Obtaining average scores above 0.8 indicates an adequate level of practicality.

With these results, it can be concluded that the supporting products have successfully passed the trial, receiving positive support from students in their usage. This practical category provides confidence that the application guidebook and student guidebook can be useful and effective tools in supporting the learning process of vocational high school students majoring in software engineering.

3.3. The Effectiveness Analysis

The effectiveness testing of the intelligent job matching model involves several students whose scores are recorded in the table below. This table contains individual student scores that have been tested using the model. The purpose of this boundary test analysis is to provide a general overview of the distribution of student scores, which can serve as a basis for evaluating the model's effectiveness. Through this table, the mean score, quartile distribution, score range, and standard deviation can be assessed to understand the extent of score variation among students as seen in Table 6.

Table 6. Analysis table of upper and lower limits of the intelligent job matching model

Metric	Value
Mean Score	74.21
Median Score	74
Upper Quartile (Q3)	80.75
Lower Quartile (Q1)	63.75
Score Range	60 (94 - 34)
Standard Deviation	13.35

Based on the test results in Table 6, it can be concluded that the student scores in this test have an average of approximately 74.21. The median score reaching 74 indicates that half of the students have scores above 74 and the other half below 74.

The upper quartile (80.75) indicates that 25% of students have scores above 80.75, while the lower quartile (63.75) indicates that 25% of students have scores below 63.75. A score range of 60 indicates a significant variation from the lowest to the highest score. The standard deviation of 13.35 signifies a moderate level of dispersion or variation from the mean. The intelligent job matching model demonstrates good average scores, uniform distribution, and a moderate range of scores and standard deviation, indicating its ability to provide job recommendations accurately.

Furthermore, the intelligent job matching model has been implemented by vocational high school 2 Padang Panjang at the 2023 job fair. The effectiveness of the model can be measured by examining the success ratio of students who pass the interview stage and are accepted to work at the companies collaborating with the school. Based on the provided information, there are 16 companies collaborating with vocational high school 2 Padang Panjang and inviting 17 students for interviews, all of whom pass to the training stage for employment. The success ratio can be calculated using the formula:

$$\text{Success Ratio} = \frac{17}{32} \times 100\%$$

$$\text{Success Ratio} = 53{,}13\%$$

The success ratio of students invited for interviews until the employment process is approximately 53.13%. This means that more than half of the total students participating in the job fair successfully passed the selection through the intelligent job matching model and were invited for interviews by companies. This figure has exceeded the target set by the Ministry of education and culture of 40%, indicating that the implementation of the intelligent job matching model has successfully helped increase the direct employment rate of vocational high school students through job fair activities.

Thus, the model has proven effective in assisting in matching the competencies of vocational high school students with the workforce needs in the industry. This ratio provides positive indications regarding the model's ability to match students with the needs of the companies collaborating with vocational high school 2 Padang Panjang at the job fair. Further evaluation of feedback from companies and students' performance during interviews can provide information to enhance the effectiveness of the model in the future. Here are the results of the intelligent job matching model as seen in Figure 6.

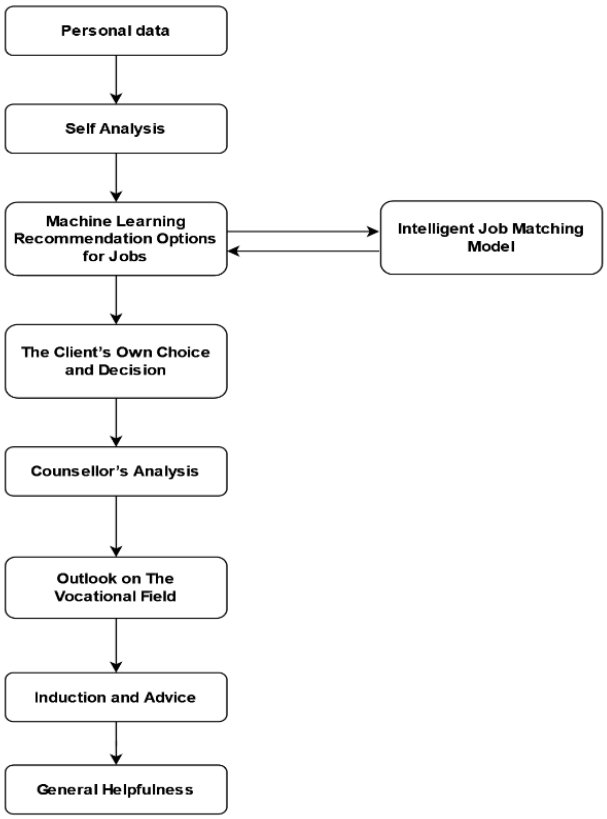


Figure 6. Intelligent job matching model

4. Discussion

The analysis results provide valuable insights into the effectiveness, practicality, and validity of the intelligent job matching model developed in this study. Each aspect contributes to understanding the model's performance and its potential impact on stakeholders, namely, industry, educators, and students.

The validation process, which includes content and construct validation, establishes the credibility of the intelligent job matching model. Content validation, conducted by five experts from various fields, ensures that the model components align with the intended objectives. High ratings obtained from the diverse syntaxes affirm the model's content validity. Additionally, construct validation, performed through chi-square analysis, confirms the model's suitability for practical application.

The practicality assessment measures the usefulness and acceptance of the model among industry stakeholders, educators, and students. Highly positive feedback from industry and educators, indicating high practicality of the model, reaffirms its relevance and effectiveness in real-world scenarios. Similarly, good evaluations from students further validate the model's usefulness, as evidenced by their positive reception of supporting materials such as application guides and participant manuals.

Effectiveness analysis reveals the model's impact in facilitating job placements for students. By observing students' success rates in obtaining job interviews and employment, this study demonstrates the tangible benefits of the model. Impressive success rates surpassing set targets underscore the model's effectiveness in matching students' competencies with industry demands. Furthermore, the positive outcomes achieved during job fairs highlight the model's potential to enhance students' work skills and streamline the recruitment process for participating industries.

These findings have significant implications for both academia and industry. The validated intelligent job matching model offers a systematic approach to aligning students' skills with industry needs, facilitating a smoother transition from education to employment. Looking ahead, continuous monitoring and feedback mechanisms from stakeholders can enhance the model's adaptability and responsiveness to evolving market needs. Additionally, further research can explore the model's long-term impact on students' career trajectories and industry performance metrics.

5. Conclusion

Overall, this research demonstrates the robustness and practicality of the intelligent job matching model in facilitating a smooth transition for students into the workforce. The positive outcomes observed in the dimensions of validity, practicality, and effectiveness confirm the model's effectiveness in bridging the gap between education and industry needs. Leveraging the power of machine learning, this model becomes a promising tool for enhancing workforce readiness and promoting a symbiotic relationship between educational institutions and industries. The developed intelligent job matching model has been validated for its validity, practicality, and effectiveness. The model is deemed valid in terms of content by experts and practical by users. Additionally, the model falls within the goodness-of-fit category based on testing. This study has analyzed occupations for several major fields of work. For future research, it is recommended to add occupation analysis for other fields of work not explored in this study, such as healthcare, education, transportation, and others. By analyzing occupations in a wider range of fields, more comprehensive insights can be gained.

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