

Measuring Signal of Skill Mismatch from Online Job Advertisements and HR Roles: A conceptual paper

Zuria Akmal Saad^{1*}, Muhammad Ashraf Fauzi², Naliza Solat¹, Azmi Salim¹

*Corresponding Author

¹ Faculty Business Management, Universiti Teknologi MARA Pahang Branch, Jengka Campus, Bandar Tun Abdul Razak, Jengka Pahang, Malaysia

² Faculty of Industrial Management, Universiti Malaysia Pahang Al-Sultan Abdullah, Gambang, Kuantan Pahang, Malaysia

zuria@uitm.edu.my, ashrafauzi@ump.edu.my, nalizas@uitm.edu.my, azmisalim@uitm.edu.my
Tel: 0199002800

Abstract

Skill mismatch remains an ongoing issue due to differences in qualitative interpretation and quantitative measurement. Scholars and practitioners have yet to reach a consensus on a definitive method for measurement, making it challenging to diagnose and solve the problem. This conceptual paper focuses on measuring skill mismatch signals through online job advertisements and the roles of HR in addressing this issue. It reviews relevant literature from journals, articles, and dissertations from previous studies. By enhancing online job advertisements and refining HR roles, this study aims to improve future labour market conditions.

Keywords: skill mismatch; online job advertisement; HR roles; signaling theory

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1.0 Introduction

The rapid growth of technology in the era of Industry 4.0 has caused the labour market to evolve unprecedentedly, leading to a significant disparity between the jobs available and the skills required. Consequently, long-term unemployment can render skills and knowledge obsolete, making it challenging for individuals to meet the current demands of the job market. In Malaysia, it has been reported that nearly half of all unemployment cases stem from this skills mismatch issue. This finding is substantiated by a study conducted by Said et al. (2021), which reveals that unemployment in Malaysia increased by 40%-50% from 2003 to 2017, primarily due to skill mismatch. The study identified five key indicators signalling a mismatch in the Malaysian labour market.

Firstly, there is an imbalance between job supply and demand, as evidenced by the Beveridge curve. Secondly, unemployment among tertiary education graduates increased by 35% in 2017, according to the Department of Statistics Malaysia, while youth unemployment rose by 10%, as reported by Bank Negara Malaysia. Additionally, there has been a surge in low-skilled job opportunities, which contradicts the number of graduates produced. Out of 1,473,376 available jobs, only 5% are suitable for high-skill workers, while 19% fall into the middle-skill category, leaving the majority as low-skill jobs. Furthermore, Malaysia offers lower wages for educated workers compared to countries such as Singapore and Australia. Lastly, it takes approximately four weeks to fill a job vacancy in Malaysia, whereas countries like Indonesia and India achieve this in about two weeks (Said et al., 2021).

This review aims to elucidate the method of measuring a signal of skills mismatch by analysing online job advertisements and assessing HR roles. This paper begins with an overview of skills mismatch measurement and the emergence of online job advertisements as a new trend in measuring skills mismatch. Lastly, it explores HR's roles in addressing hiring and recruitment issues. The final section of this review will highlight the contributions of this research, including its theoretical and conceptual implications for future studies.

2.0 Literature Review

2.1 Measurement of Skill Mismatch

The broad definition of skill mismatch has left this issue unresolved. Terms such as skill shortage, skills gap, obsolete skills, vertical mismatch, and horizontal mismatch have been used to study this problem. There are numerous perspectives and factors to consider, and there is always more to discover to understand the future labour market better. Another intriguing aspect is the ongoing blame game between educational institutions and industries in addressing this issue. However, both parties play crucial roles in finding solutions. Qualification mismatch in the labour market arises from an imbalance between labour supply and industry demand. When discussing skill mismatch, the measurement method becomes a central concern. As noted by Maltseva (2019), there is no consensus among scholars or practitioners regarding the optimal method for measuring skill supply and demand. This lack of consensus hampers efforts to diagnose and solve the issue.

The failure to develop and upgrade the labour force by industries has resulted in inefficiencies in human capital utilisation. This, in turn, has led to the misallocation of labour, unemployment, and redundancies, driven by an overemphasis on academic degrees. This issue has been a long-standing debate among scholars, approached from various perspectives. However, there is no one-size-fits-all solution, as skill demand is influenced by several factors, including technology, the economy, and other variables that necessitate adaptation and change.

As supported by the OECD (2017a), rapid technological advancements, demographic shifts, globalisation, and changes in labour market institutions are four megatrends reshaping the nature of work and contributing to skills mismatches. Consequently, emerging technologies associated with the Fourth Industrial Revolution (4IR), such as robotics, big data analytics, and artificial intelligence, require organisations to adopt different approaches to making business decisions.

While skills mismatches are a global issue, data collection on skill mismatches is particularly critical in low- and middle-income countries. Many approaches have been explored to address the challenge of skills mismatches and unemployment. However, this problem remains a global concern without a definitive solution. The studies listed below predominantly focus on developed countries.

Table 1.0: International Organization and Relevant Study of Skill Mismatch

Organization	Study
European Center for the Development of Vocational Training (CEDEFOP)	European Skills and Jobs (ESJ): A study of EU28 member states of skills mismatch and education.
European Foundation for the Improvement of Living and Working Conditions provides research findings for the development of social and work-related policies (Eurofound)	European Company Survey: A study among 32 EU countries which includes management and employees related to occupational matters
Organization for Economic Cooperation and Development (OECD)	Programmed for the International Assessment of Adult Competencies (PIACC): A study to measure numeracy, literacy, and problem-solving skills among developed countries.
International Labor Organization (ILO)	Global Product on Jobs and Skills Mismatch School-to-Work Transition Survey (SWTS): A study of the labor market among 34 low- and middle-income countries

Source: Maram Taweel, 2018

To assess labour market conditions, especially regarding skill mismatches, the primary issue raised by previous studies is how it is measured. Several popular approaches have been employed, including the subjective method (self-assessment), which is commonly applied in many developing countries due to the limitation of objective data, and the objective approach (self-report, job requirement approach, and realised approach) that relies on available data on skill proficiency and skill utilisation (Senkrúa, 2021). However, each method has its biases and drawbacks (Senkrúa, 2021). Challenges in accurately classifying jobs and skills, determining appropriate skill measurement scales, obtaining representative study samples, dealing with time lag between data publication and collection, and addressing limitations in scaling for standardised job measurement contribute to the unsolved nature of this issue (see Figure 2.0: Summary of Skills Mismatch Measurement). Thus, further exploration of various facets and perspectives is necessary to uncover its root causes.

Table 2.0: Measurement of Skill Mismatch

Method	Advantages	Disadvantages
Subjective/ Directive Subjective Measurement Employee Survey (Allen & van der Velden, 2001)	Measure directly employee's skill in performing the job and training provided (Allen et al., 2001)	Measurement error in which employees tend to exaggerate or overestimate their abilities (Hartog, 2000)
Employer Survey/ Linked Employer-Employee survey/Self-reported approach (Maltseva, 2019)	Ease of data collection (Senkrúa, 2021; Maltseva, 2019)	Bias towards specific answers, small scale (specific industry and occupations) (Senkrúa, 2021; Maltseva, 2019)
Objective / Direct objective measurement Realized Method Approach (Maltseva, 2019)	The comparison of cognitive skills (literacy, numeracy, and problem-solving) with attainment value of occupation. Level of education required for the job (Flisi, et al., 2017)	Sensitive to a cohort effect, misleading education mismatch, less sensitive to outlier and technological change, allow only one education level to be appropriate for each occupation, and too broad occupation grouping and self-report data from PIACC (OECD, 2013)

	Use International Standard Classification of Occupations.	Uses only 1 digit of ISCO (to achieve enough good matches) (Pellizzari & Fichen, 2013)
	Measured with competency bandwidth (under-skilled and well match (Senkrua, 2021)	
	More objective description of skills (OECD, 2013b:5)	
Job Requirement Approach / Direct Measurement (Senkrua, 2021; Maltseva, 2019)	Divided into four categories of skills (Quintini, 2011)	Biased as the respondent tends to overstate the skills used at work (Perry et al., 2014)
	Measured by the standard deviation (Allen et al., 2013)	Skill used is not a necessary proxy for skill requirement, average skills are considered well-matched (Van der Velden & Bijlsma, 2017)
Job Analysis / Job Evaluation Method (Nedelkoska et al., 2019)	Analysis of education and skills reported by expertise (Nedelkoska et al., 2019)	No information about an individual job, only average skills, and education that has been grouped and become a fixed requirement for an occupation, overrated level of education compares to self-reported (van der Velden and Van Smoorenburg, 1997)
		Time-consuming (Pérez Rodríguez, 2022)
		Expensive and not available at the national level and need recurring updates. (McGuinness et al., 2017)

Source: Authors' compilation

2.2 Online Job Advertisement

Considering the limitations of previous studies in measuring skills mismatches, analysing online advertisements has emerged as a new method for assessing skills mismatches, supported by a previous study by CEDEFOP (2018). This method is deemed more valid and capable of overcoming the shortcomings of previous approaches used to measure skills mismatches. Additionally, it provides timely information about skill changes in the labour market. It is essential for various stakeholders, including businesses, educational institutions, policymakers, and governments, to plan for the labour market effectively. As a result, the adoption of this method has been on the rise. Figure 1.0 below illustrates the trend in papers published using online data from the Scopus database. An advanced search of the Scopus online database, using filters such as "online job advertisement," "online job vacancies," and "online job portal," revealed that 117 papers were published from 2007 to 2022, with a significant increase in publications observed from 2019 to 2021. Most of these publications originated from developed countries, with the United States (11), Italy (8), Germany (7), and Australia (6) leading the way. In contrast, Malaysia had only one publication that utilised online job advertisements in 2012 and employed SPSS to analyse the data for measuring graduates' employability.

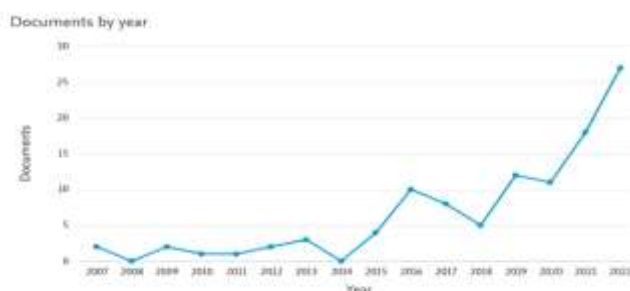


Figure 1.0: The number of papers published using an analysis of online sources (portal, advertisement, and vacancy)
Source: Scopus

The shift towards online analysis has arisen in response to the shortcomings of traditional methods for measuring skills mismatches. The traditional approach is often costly, involves a complex process to gather complete information, and suffers from a time lag in comprehending and taking action. This delay, especially in providing relevant information to stakeholders such as policymakers, educational institutions, training providers, and job seekers, makes it challenging to align with the requirements of the labour market. This shift to online data analysis is supported by a report from CEDEFOP (2019), which emphasises the importance of providing timely and accurate information on the right skills to educational institutions, training centres, and career guidance services. Such information is crucial for all sectors, regions, and countries to plan their actions effectively, respond promptly to labour market demands, and facilitate the upskilling and reskilling of adults and the development of younger individuals in the TVET system.

As a result, the analysis of online job portals has emerged as a valuable source for measuring the matching conditions between employees and employers. This is due to the extensive range of jobs offered across various occupations and the specific skills required. A study conducted by Cárdenas Rubio (2020) underscores the challenges of obtaining detailed information regarding required skills, occupational demands, employer-specific requirements, and overall labour market insights. The limitations of existing surveys, such as those conducted by the Columbia Office for National Statistics (DANE), have hindered a comprehensive understanding of these

dynamics. Consequently, utilising Big Data for labour market analysis has been recognised as a practical approach to address these challenges and provide valuable insights.

This method is considered relevant due to its numerous advantages. It helps in understanding the dynamic skill demands in the labour market, particularly for labour market actors, and aids individuals in making better career and skill development choices. For employers and HR professionals, this analysis provides valuable insights for adjusting and developing policies. It also supports policymakers in making better-informed decisions and assists training providers, guidance services, and employment services in improving their targeting for the future job market.

Combining conventional methods with online job analysis (OJV) has become increasingly valuable. It offers a more comprehensive, detailed, and timely approach to measuring labour market conditions. This method allows for the early identification of new and emerging jobs and their required skills (CEDEFOP, 2019). However, like previous methods of measuring labour market conditions, the analysis of online job portals has its limitations:

- i. over-represented vacancies in some sectors and occupations in OJV portals
- ii. digital divide and different employment structures will lead to a different result of measurement as the use of OJV portals differs across and within the countries
- iii. the limitation of some information, such as critical skills and qualifications, due to unlisted skills in the job profile.
- iv. vacancy notices have to be machine-readable and use a standardised vocabulary, and given the quantity of data, some simplifying assumptions have to be made
- v. the same vacancy notice may be published on several websites and not necessarily correspond to an actual job opening

2.3 HR Roles

There needs to be more than analysing online data to give a comprehensive view of the skill mismatch issue. As stated by CEDEFOP (2018), the difficulty of recruitment among Europeans not only happened due to a shortage of skills for a fulfilled job vacancy, but it is also multifaceted from the HR side, such as poor quality of job offers or other HRM inefficiencies. Thus, the growing size of the private sector, changes in remuneration, and work organisation practices are factors that cause difficulty in recruitment among selected EU countries. Supporting the issue of unemployment from the demand side, Malaysia also reported the exact causes as EU countries are unable to meet requested salaries, lack of job opportunities, lack of required skill/soft skills, and unready work among graduates (Jamaluddin et al, 2021)

A competency of HR roles as another measurement for skills mismatch is supported by the CEDEFOP (2018) report, which found that 40%–60% of issues of difficulty in recruitment cannot be considered "genuine" as firms' inability to offer a competitive salary or adopt a competitive recruitment strategy also contributes to the skills mismatch. Below are the types of bottlenecks in recruiting as listed by CEDEFOP (quoted from page 42):

Table 3.0: Bottlenecks in recruiting

Genuine skill shortage	lack of applicants with the right skills and ability to offer a competitive starting salary.
Apparent skill shortage	lack of right skills and inability to offer a competitive starting salary by the company and lack of right skills and HRM inefficiency.
Uncompetitive wage offer	the inability to offer a competitive starting salary
HRM inefficiency	lack of offer of competitive graduate training and development programs and a slow hiring process or limited resources to market vacancies.

Source: CEDEFOP (2018)

The study revealed the possibility that the recruitment process created mismatch skills issues. Several studies on the HR side mentioned certain elements such as job design (Fine & Nevo, 2011), HR involvement (Kohnová et al., 2020), job descriptions, unavailable positions (Bian et al., 2020), informal recruitment such as referral through friends and relatives (Meliciani & Radicchia, 2016), strictness and regulations in hiring (Assirelli, 2005) are related with the mismatch issue. However, figuring out the natural causes from the HR perspective is inconclusive.

CEDEFOP mentioned this report in 2012, and it continues to be referenced in current studies examining the functions of organisations and HR in addressing skills mismatch issues. The report highlights that firms play roles in mitigating skills mismatch by paying lower wages to educated talent, cutting training costs, and preparing for talent shortages during economic crises through their human resources practices. The report also emphasises the need to explore skill mismatches from the firm's perspective, identifying essential functions to overcome them, including recruitment, training, performance evaluation, wage policies, career development, job design, and employee representation. To address these challenges, Puckett et al. (2020), in the article on addressing global skills mismatches, list seven key challenges that must be overcome.

- i. Lack of training provided for upcoming jobs in the labour market, with an estimated 27% of roles not being filled in 2022.
- ii. lack of lifelong learning and continuous retraining for the active labour force. Reskilling and upskilling are needed as the fast rate of advanced technology will obsolete technical skills in between two and five years.
- iii. Lack of motivation and self-accountability for self-improvement. The survey from the BCG report mentioned that only 28% of respondents learned through self-service content.
- iv. Limited access to labour market opportunities due to lack of internet access, with an estimated 3 billion people from Asia and Africa. The rest, only 41%, use the online platform, and 14% are through social networks.
- v. Uneven redistribution of human capital. As in the US, 90% of job distribution offered is within 100km of the job seeker's location, and the job search has increased by 20% because of the expansion of job offered locations.
- vi. limited potential for labour force categories. In the US, only one-third of working-age disabilities have worked out of 7% of the population.

- vii. Shifting of value and need from the labour force. Only 36% of Generation Z consider career growth as a priority. Meanwhile, 10% of them already accept lower earnings and work fewer hours.

2.4 Signaling Theory in Recruitment

While signalling theory and skill mismatch are closely related, criticism arises when job seeker qualifications are presented to employers during recruitment. This competition among job seekers sometimes results in job mismatches, where less qualified candidates accept any available job for a salary. Critics argue that this theory primarily focuses on the supply side, unlike the Human Capital Theory (Capsada-Munsech & Valiente, 2020). Therefore, this study focuses on the demand side, investigating how firms' strategies and conditions lead to skill shortages and job mismatches.

Besides Signaling Theory, the Theory of Planned Behavior (TPB) and the Technology Acceptance Model (TAM) are commonly used to study applicant perceptions and behaviours in e-recruitment. These three theories have significant relationships with e-recruitment (Mooney, 2020). McCarthy et al. (2018) suggest improving the candidate experience through transparency, respect, and reassurance signals. Silva et al. (2018) also support using Signaling Theory for employers to attract suitable candidates. Social identity and expectancy theory are also relevant as they correlate with a firm's attractiveness in attracting employees. Positive signals from employers serve as indicators for employees when choosing which company to work with.

In the context of Signaling Theory, a crucial concept is 'asymmetric information.' It refers to the signaler's lack of information, leading the receiver to make incorrect decisions. Cárdenas Rubio (2020) highlights how imperfect information contributes to skill mismatches. In a balanced labour market, as envisioned in the perfect competition model, relevant parties such as employees and employers participate because there is complete information about supply and demand. In such an environment, people make informed decisions based on available information. Job seekers understand employer requirements, employers know the skills they need, and training centres adapt to meet labour market demands. However, disequilibrium arises when employers, employees, and training centres lack essential information to respond to shifts in labour demand (Stiglitz et al., 2013).

A study by Chang and Chin (2018) emphasises the pivotal role of HR in the labour market. The interaction between the signaler (HR) and the receiver (job seeker) initiates early in the recruitment process (Suazo et al., 2009). This phase can be likened to a scenario of information scarcity for job seekers who grapple with an incomplete understanding of an organisation's practices. Job seekers often rely on cues from the organisation's superior management practices to differentiate it from others. Consequently, the limited available information aids job seekers in choosing the right organisation, given their limited details for evaluating potential employers.

2.5 Mix Method of Measuring Skill Mismatch

Using online job portal data alone, measurement of skill mismatch might be less significant. This is because the demand for specific jobs/employment could be increased due to the search process for the occupation, and it does not mean a "real" increase for occupations (Cárdenas Rubio, 2020). The issue of bilateral information asymmetry has caused incorrect information about the labour market. The matching problems occur as the skills required do not fit the vacancy, not the job vacancy itself. Thus, the situation of duplication and a different number of vacancies in the different portals makes the number of jobs offered unknown to the employers. Thus, this affects the effective matching where the information needed is not clear to them. Cleared information needed to be explored and only can be gathered by using big data analysis.

Most of the previous surveys, such as GEIH (DANE) and STEP (World Bank) are more focused on labour supply and less explored employer requirements, which can be the source to reduce mismatch. Flaws of the DANE survey need to be more comprehensive to measure human capital (skill needed for each position and occupation structure) but only state the number of employed people for specific sectors (production, marketing, sales, investigation, and development, among others). However, in 2012, DANE came out with a survey from across the industry exploring job training and productivity, but data of the results still cannot figure out the employer requirements (Cárdenas Rubio, 2020).

However, The National Training Center for Columbia, known as SENA, has run two surveys to figure out the employer requirements. The first survey used a semi-structured questionnaire. Lack of standard procedures, unclear objectives, and incentives for the company to participate make the survey less effective. Meanwhile, the second survey conducted between employers and employees measures the employability performance of TVET and failed to explore the employer requirements. The interview result from the employer is limited, and only 13% of TVET programs have been evaluated. The survey focuses on the content of TVET programs with the skill for the job; hence skill requirements from employers remain unexplored (Cárdenas Rubio, 2020).

The studies above clearly show the need for studies covering employer requirements and vacancy information, especially among developing countries such as Columbia. Labour demand information is unavailable due to resource constraints such as time and costs in gathering the information. Thus, this study has adopted the suggestion from Cárdenas Rubio's (2020) literature to explore both sides' demands from the labour market, which online job portals and employer requirements focus on the HR perspectives. This study extends Saad et al. (2023) review of skill mismatch. The study systematically reviews the literature on skill mismatch measurement from 2017 to 2021, which suggests that online job advertisements could be a source of identifying signals of skill mismatch. However, using quantitative methods alone has limitations that need to be addressed, as indicated by previous studies (refer to Table 2.0). Therefore, it is suggested to employ a mixed-method approach that combines HR roles such as interviews or distributing a survey with HR representatives, applies various variables and features, and utilises deep learning to comprehensively explore the issue of skill mismatch.

3.0 Methodology

The proposed framework has been developed by reviewing current theoretical and empirical literature. For the variable of online job advertisement, a systematic literature review was conducted to understand previous methods of measuring skill mismatch, as seen in a study by Saad et al. (2023). The list of all the measurements used has been provided in Figure 2.0 above. From this review, the researcher concluded that analysing online job advertisements is an effective way to overcome the flaws of previous measurement methods.

However, to enhance the effectiveness of this measurement, it is suggested to complement it with another method by exploring HR roles. This second variable, defining HR roles, has also been constructed through the review of numerous journal articles, company reports, dissertations, seminar papers, term papers, and professional papers and views. Therefore, to propose the framework, the Signalling Theory has been used to support the variables used in measuring the signal of skill mismatch. The details of the proposed approaches are explained below:

The first approach is to scrutinise labour market conditions through online job advertisements. The measurement of labour demand for this study will be conducted by analysing information from online job portals. The top online job portals will be selected based on three criteria: traffic, type of job, and web quality. These three criteria are essential for determining the granularity of the data. The details and steps of this approach are explained in Tables 4.0 and 5.0.

Table 4.0: Selection steps for online job portals

1.	Select the most important vacancy websites in the country
2.	Scrap the vacancy websites selected
3.	Apply text and data mining techniques to organize the information

Source: Cárdenas Rubio, 2020

Table 5.0: Steps of Analysis of Online Job Advertisement

Step 1	Manual coding
Step 2	Cleaning
Step 3	Cascot
Step 4	Machine Learning

Source: Cárdenas Rubio, 2020

Secondly, this study also aims to explore HR roles to determine whether these conditions could lead to a mismatch. To investigate HR roles in the strategy of recruiting and hiring, a set of interview questions will be developed based on the identified problem. It is estimated that ten interviewees will be selected for the study until the saturation level is achieved, at which point the researcher will be able to define the research aim. The respondents for this study will be managers, executives, or staff members related to recruitment and hiring by the HR manager. The selected industries are manufacturing and services, as these two sectors create the most jobs in Malaysia (Department of Statistics Malaysia Official Portal).

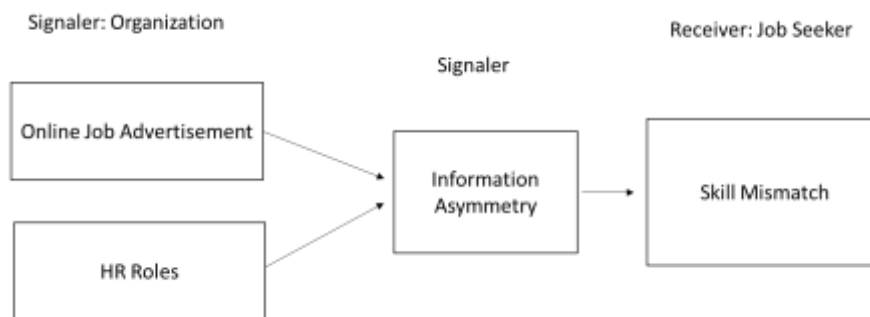


Figure 6.0: Proposed Conceptual Framework

4.0 Conclusion & Recommendations

The problem of skill mismatches arises from a gap between employee skills and the company's requirements. Generally, many companies have higher expectations and requirements when hiring talents, which makes it harder for their HR recruiters to find candidates with the necessary abilities to complete the tasks. Earlier studies on skill mismatches have emphasised how these problems affect the business and its personnel due to job dissatisfaction, leading to increased training costs, higher staff turnover, and, ultimately, failure to meet company objectives. Ineffective hiring also results in underutilising employees' potential for optimal productivity. In addition, employees who have mismatched skills often need help in completing their assigned jobs.

Prior research on this issue mainly focuses on how it is measured in developing countries. However, low-and middle-income countries are still lacking the data. As a result, more findings on skill mismatches are needed, notably for Malaysian industries. More open and consistent strategies must be outlined to solve the skill mismatch issues. Therefore, the authors emphasised using both subjective and objective approaches to measuring skill mismatches. The proposed conceptual framework for this study involves using a qualitative measurement to address the previous shortcomings in measuring skill mismatch. The measurement of online job advertisements aims to assess the balance between job supply and demand in the labour market. To complement the understanding of

skill mismatch obtained from online job advertisements, interviews with HR professionals responsible for job design and job characteristics in the recruitment process will be conducted.

This paper highlights the need to use signalling theory to analyse online job advertisements and assess HR roles. In this review paper, the authors stressed improving online job advertisements and refining the roles of HR recruiters in the hiring process. To avoid any skills mismatches, companies, particularly HR recruiters, should develop better hiring policies and provide accurate job descriptions detailing all open positions' requirements. The online job advertisement should not only be designed carefully, but a further analysis should be made so that it can be directed to the suitable qualified candidates. The company should also work on and improve its online job posting strategy to attract talented candidates.

Additionally, in finding the best candidates for the position, the company should also consider sending its recruiters to have the training to sharpen their skill assessment. The HR recruiters need to play their role wisely so that they will not be allured and misinterpreted by interviewees' abilities during the selection session. It is believed that the information gathered would increase the level of awareness among all respective parties regarding the issue.

To validate and test this framework, empirical research is required. Since this study focuses on the manufacturing and services industries, it is recommended that future research consider using a mixed-method approach to enhance the generalizability of the findings to other relevant industries.

Paper Contribution to Related Field of Study

The study of skill mismatches can benefit the academic community and the industry. The significant contribution of this paper would be to assist companies and HR recruiters in formulating a better strategy for their recruitment policy. The findings could help HR practitioners make better decisions and increase the likelihood of finding the ideal talent that fits the position.

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