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Design of Vocational High School Students' Skills Test Instrument Based on Construction Services Needs

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Abstract. Student skills test instruments, based on industry needs, help measure and ensure that students have the practical skills needed in the workplace. This study evaluated the performance criteria of students in concrete structure work, which was used as the basis for designing a work skills test instrument for vocational high school students based on construction service needs. This study involved vocational high school teachers, construction service providers, and vocational education experts as participants. The research data from the responses of the research participants were analyzed in terms of practicality and effectiveness index values, while the essence of the instrument was analyzed with the Lawshe index value. The instruments designed in this study were adjusted to types of concrete structure work. The results showed a practicality index of 4.83 and an effectiveness index of 4.93, while the Lawshe index value was 0.64. This study has found the vocational high school student skills test instrument very practical, effective, and essential as a tool for measuring the level of vocational student skills. This student skills test instrument can be integrated with a

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competency certification program for students before entering the workforce. The results of this study serve to recommend that related educational institutions implement the student work skills testing process.

Keywords: Vocational education; vocational high school; skills test instruments; construction service needs

1. Introduction

The implementation of vocational high schools (VHS) is important in facilitate students gaining practical work skills so that they can work in certain jobs according to their fields of expertise. The education pattern in VHS can be an association between education and the world of work. The implementation of VHS is an effort to meet the needs of the industrial world, such as the construction services sector.

In Indonesia, when students at VHS complete their learning process, they are required to take a skills competency test (UKK) with the format and assessment criteria prepared by the school. However, the assessment process is carried out by business stakeholders, such as the construction services industry. The UKK mechanism has an impact on the discrepancy of skills matching the needs of the construction services sector because the assessment process seems to ignore the work competency needs of this sector. This issue has caused many VHS graduates from not being absorbed by construction services because their work skills competencies are still low in terms of suitability to the needs of the workforce (BPS RI, 2024). Such negative impacts can be reduced by VHS and construction service stakeholders collaborating on the implementation of vocational education (Hiim, 2017).

Research findings show that the open unemployment rate for VHS graduates is still the highest among other levels of education, which is 8.62% (BPS RI, 2024). The data prove that VHS graduates are still the largest contributor to the number of unemployed at productive ages. According to existing data, the number of construction workers is still dominated by VHS graduates at 70% (Kementerian PUPR, 2021). This should lead to great opportunities for VHS graduates to be more easily absorbed in the construction services sector but, in reality, VHS graduates still lack the work skills competencies that the construction services need.

The incongruity between student competencies and the needs of the work field has become a problem in vocational education in Indonesia in recent years. Students' expertise specialization does not fully meet industry needs. The lack of relevance between the needs of the world of work and the quality of VHS graduates is one of the factors that drives the low absorption of VHS graduates in the world of work (BPS RI, 2024; Oroh et al., 2018). A solution that can overcome this discrepancy is greater collaboration between schools and construction service actors (Oroh et al., 2024), such as collaborating in assessing the achievement of

students' work skills competency learning, so that the format and assessment criteria have a high level of relevance.
Thus, this study aimed to evaluate the performance criteria of students in concrete structure work, which will later be used as the basis for designing a work skills test instrument for VHS students based on construction service needs. It is hoped that, through this study, a student skills test instrument that is relevant to industry needs may be formulated. Furthermore, this study can provide positive implications for stakeholders related to the process of implementing student skills tests to be more effective and efficient and will have an impact on increasing the productivity of collaboration between schools and the industrial world (Hiim, 2023). Although several VHS have implemented work skills competency certification tests, they are considered suboptimal and their independence is still questionable (Rosyid, 2020).

Relevant student skills test instruments will help measure and ensure that students have the practical skills needed in the workplace. This not only prepares students to enter the workforce directly but also increases their chances of being employed in roles that match their competencies and ensures that graduates are equipped to meet the demands of the labor market (Setiyawami et al., 2020; Tsai et al., 2020). Relevant skills test instruments help ensure that VHS students not only learn basic skills but are also able to adapt to labor market developments in a rapidly-changing economic landscape (Hampf & Woessmann, 2017). Skills test instruments that are in line with industry needs can be used as feedback to develop and update the VHS curriculum so that it is always in line with industry (Nkwanyane, 2023). Thus, vocational education can remain relevant and responsive to labor market needs, thereby producing competent graduates who are ready to contribute to the construction services industry.

Construction services in Indonesia, from small, medium to large classifications, continue to increase every year. For example, in the province of North Sulawesi, Indonesia, in 2020, the number of construction service business actors recorded was 1,995 (with details small businesses totaling 1,750 business entities, 207 medium businesses, eight large businesses, and as many as 30 others business entities) (BPS RI, 2021). Nationally (including the North Sulawesi region), the number of construction service actors continues to increase.

The role of the construction service industry in the development of infrastructure in a region is very important so it needs to be supported by the availability of competent workers in the construction work sector. The VHS is one of the sources of workers who have construction work competencies because it is a type of school that has a building construction expertise program. Therefore, VHS needs to prepare its students to have quality and certified work skills competencies. The Law of the Republic of Indonesia No. 2 of 2017 requires all construction workers working on construction projects to have certificates, especially for expert, technician/analyst and operator positions (Kementerian PUPR, 2021).

2. Method

2.1 Research Design

The design of the VHS student work skills test instrument in this study used the analyze, design, develop, implement, and evaluate model approach. According to its stages, at the analysis stage, which is the initial stage, an in-depth study of literature, needs analysis, curriculum analysis, syllabus and student characteristics is carried out. Additionally, an analysis of the Indonesian national work competency standards (Kepmenaker RI, 2021) and the Indonesian national qualification framework (Perpres RI, 2012) is conducted, which are in accordance with the secondary education level (VHS). At the design stage, a conceptual instrument product design is carried out as a reference in the instrument development process. Furthermore, the development of an instrument is adjusted to the results of the analysis of student performance criteria by referring to the needs standards, characteristics of VHS students, and Indonesian national work standards. The specific requirements for construction services are that students must have concrete structure work skills, with work indicators, namely scaffolding, formwork, reinforcement and casting work.

This study evaluated the performance criteria of students in concrete structure work, which was then later used as the basis for designing a work skills test instrument for VHS students based on construction service needs. This stage involved research participants from VHS teachers, construction service actors, and vocational education experts.

2.2 Participants

This study involved 10 VHS teachers of building construction expertise and six construction service providers in North Sulawesi province, Indonesia. The involvement VHS teachers and construction service providers was intended to test the practicality and effectiveness of the instrument product. Participants from the VHS teacher element were chosen using a simple random sampling technique. The sample was made up of two teachers for each VHS, from five vocational schools, which organize building construction expertise programs, in the province of North Sulawesi, Indonesia.

The participants from the construction service business actor element were taken using a purposive sampling technique with the consideration that construction service businesses use VHS graduates. This study also involved five vocational education experts to test the essence of the instrument product. The involvement of these participants is based on the consideration that VHS teachers understand the practice of work skills provided to students. Construction service actors understand what work skills are needed in the industry. Vocational education experts understand the core competencies of VHS students' work skills that are relevant to industry needs. The characteristics of the participants in this study are described in Table 1 for VHS teacher participants, Table 2 for construction service providers, and Table 3 for vocational education expert participants.

Table 1: Characteristics of VHS teachers as participants

Expertise	Teaching program at VHS	Gender	Number
Building construction	Building modeling and information design	Male	4
		Female	4
	Construction and property business	Male	1
		Female	1
Total			10

Table 2: Characteristics of construction service business actors as participants

Business classification	Business area	Business fields	Gender	Number
Large	Indonesia	Consultants and contractors	Male	1
			Female	-
Medium	North Sulawesi Province and Surrounding Areas	Consultants and contractors	Male	1
			Female	-
Small	North Sulawesi Province	contractors	Male	4
			Female	-
Total				6

Table 3: Characteristics of vocational education experts as participants

Interest expertise	Gender	Number
Educational research and evaluation	Male	1
	Female	-
Building construction	Male	2
	Female	-
VHS learning	Male	1
	Female	1
Total		5

2.3 Research Instruments

Data on participant assessment responses to the design of the VHS student work skills test instrument developed in this study were obtained through a questionnaire. The VHS student work skills test instrument that was been designed was adjusted to the description of reinforced concrete beam structure work (Mehta et al., 2013), with performance criteria that meet the needs of construction services (Oroh et al., 2023). Furthermore, participant assessments were conducted through a questionnaire with the assessment indicators provided, in which teacher participants assessed the practicality dimension of the instrument with assessment indicators of ease of use, flexibility, and user suitability, so that the instrument can be more easily understood by students and more flexible with the development of vocational education needs and various environmental conditions (Ambiyar, 2024; Churiyah, 2023; Hass, 2019).

The construction service participants assessed the effectiveness dimension of the instrument with the assessment indicators of clarity of instructions, suitability to needs, and level of difficulty of tasks, so that students can articulate clearly and relevantly to the needs of the world of work (Munawar et al., 2019; Ohle-Peters et al., 2023). Vocational education expert participants assessed the essence

dimension of the instrument with assessment indicators on the content of the instrument. The questionnaire used in this study was tested for validity and reliability and the results deemed it suitable for use. The validity test of the questionnaire used the Pearson product moment correlation technique to correlate the score of each item with the total score, and for the reliability test used the alpha Cronbach method.

2.4 Data Collection

The research data were in the form of responses from the research participants regarding the design of the VHS student skills test instrument on concrete structure work expertise based on the needs of construction services. The response data from participants to the VHS student skills test instrument were obtained through a questionnaire with response options 'not necessary', 'less necessary', 'quite necessary', 'necessary', and 'very necessary', which were each given a value scale from 1 to 5. The value scale was given to measure the attitudes, opinions or perceptions of participants regarding the instruments developed in this study. Specifically, the vocational education experts were given two response options, namely 'important' or 'not important'. Furthermore, the results of the participant assessments were collected and tabulated for analysis.

2.5 Research Data Analysis

The data obtained in this study were then collected and tabulated according to the assessment indicators in each assessment dimension. Data were analyzed using quantitative descriptive analysis techniques. The analysis technique on the practicality and effectiveness dimensions of the instrument was analyzed by measuring the frequency of responses of research participants according to each item. The measure of the level of practicality of the instrument was determined by calculating the practicality index (P) and adjusted to the value criteria, as shown in Table 4, where the practicality index value was the ratio between the total score and the number of participants.

The measure of the level of effectiveness of the instrument was determined by calculating the effectiveness index (E) and adjusted to the value criteria, as shown in Table 5, where the value of the instrument effectiveness index was the ratio between the total score and the number of participants.

The essence dimension of the instrument was analyzed using the Lawshe index (L) against the responses of the participants. Determination of the level of essence of the instrument was obtained by looking at the Lawshe index value in the range of index numbers from -1 (perfectly disagree) to +1 (perfectly agree) (Ayre & Scally, 2014; Ponto, 2019). The Lawshe index value was obtained using the formula: $L = \{[n_e - (N/2)] / (N/2)\}$, where n_e is the number of expert participants who stated it was important, and N is the number of expert participants (Ayre & Scally, 2014; Ponto, 2019).

Table 4: Criteria for testing the instrument practicality

Range of index	Information
P > 4.50	very practical
3.50 < P ≤ 4.50	Practical
3,00 < P ≤ 3.50	Quite practical
2.50 < P ≤ 3.00	Less practical
P ≤ 2.50	Not practical

Table 5: Criteria for testing the instrument effectivity

Range of index	Information
E > 4.50	Very effective
3.50 < E ≤ 4.50	Effective
3.00 < E ≤ 3.50	Effective enough
2.50 < E ≤ 3.00	Less effective
E ≤ 250	Ineffective

3. Results and Discussion

The responses from all participants in this research provided assessment results for the instrument design that were in accordance with the dimensions of the instrument assessment. Table 6 shows the results of VHS teacher responses to the practical dimensions of the VHS student work skills test instrument.

Based on the results or responses of the practicality level assessment of the VHS student skills test instrument from vocational teacher participants, varying values for each work indicator item were evident. Each dimension showed a different index but, in general, it was not much different. For example, the dimension of the ease of use (EU) gave an average practicality index of 4.80; the dimension of flexibility (F) gave an average index value of 4.83; and the dimension of user suitability (US) gave an average index value of 4.85. The practicality index (P) generally gave an average value of 4.83 and if adjusted to the criteria, as seen in Table 4, then the VHS student skills test instrument is included in the "very practical" category to be used as a tool for measuring the skill level of VHS students.

Based on the responses of the construction service participants to the level of effectiveness of the VHS student skills test instrument (Table 7), varying values for each job indicator item were provided. Each dimension showed a different index but, in general, it was not much different. For example, the dimension of the clarity of instructions (CI) gave an average practicality index of 4.65; the dimension of the suitability to needs (SN) gave an average index value of 4.38; and the dimension of the task difficulty level (TDL) gave an average index value of 4.15. The effectiveness index (E) generally gave an average value of 4.39 and if adjusted to the criteria shown in Table 5, it means that the VHS student skills test instrument was included in the "effective" category to be used as a tool for measuring the level of VHS student skills.

Table 6: Response from VHS teacher

VHS student work skills test instrument design			**Participant responses**		
Type of work	Work indicators	Performance criteria	Practical		
			Average index		
			EU	F	US
Concrete structure	Scaffolding work	▪ Scaffolding construction according to work methods, and ▪ Selection of scaffolding materials must be in accordance with technical specifications.	4.80	4.80	4.75
	Formwork making	▪ How to make formwork according to the working method to make it strong, ▪ Equipment for making formwork according to the working method, and ▪ How to install formwork according to the working method.	4.73	4.80	4.90
	Reinforcement work	▪ Concrete reinforcement process according to the work method, ▪ Binding of transverse reinforcement must be in accordance with the work method, and ▪ Requirements for installing concrete reinforcement that has been assembled according to the work drawing.	4.87	4.90	4.87
	Casting work	▪ The reinforcement model is in accordance with technical specifications so that it does not shift during casting, ▪ The leveling of the concrete after casting is carried out according to the working drawings, and ▪ The method of compacting the concrete during casting is carried out in accordance with the working method.	4.80	4.83	4.90

Note: EU= ease of use; F= flexibility; US= user suitability

Table 7: Response from construction service actors

VHS student work skills test instrument design			**Participant responses**		
Type of work	Work indicators	Performance criteria	Mean in terms of Effectiveness dimension		
			CI	SN	TDL
Concrete structure	Scaffolding work	▪ Scaffolding construction according to work methods, and ▪ Selection of scaffolding materials must be in accordance with technical specifications.	4.80	4.30	4.20
	Formwork making	▪ How to make formwork according to the working method to make it strong, ▪ Equipment for making formwork according to the working method, and ▪ How to install formwork according to the working method.	4.80	4.40	4.13

	Reinforcement work	▪ Concrete reinforcement process according to the work method, ▪ Binding of transverse reinforcement must be in accordance with the work method, and ▪ Requirements for installing concrete reinforcement that has been assembled according to the work drawing.	4.60	4.60	4.40
	Casting work	▪ The reinforcement model is in accordance with technical specifications so that it does not shift during casting, ▪ The leveling of the concrete after casting is carried out according to the working drawings, and ▪ The method of compacting the concrete during casting is carried out in accordance with the working method.	4.40	4.20	3.87

Note: CI= clarity of instructions; SN= suitability to needs; TDL= task difficulty level

Table 8: Response from vocational education experts

VHS student work skills test instrument design			**Responses from each participant**				
Type of work	Work indicators	Performance criteria	A	B	C	D	E
Concrete structure	Scaffolding work	1. Scaffolding construction according to work methods.	√	√	√	√	√
		2. Selection of scaffolding materials must be in accordance with technical specifications.	√	√	√	-	√
	Formwork making	3. How to make formwork according to the working method to make it strong.	√	√	√	√	-
		4. Equipment for making formwork according to the working method.	√	-	√	√	√
		5. How to install formwork according to the working method.	√	√	√	√	-
	Reinfor-cement work	6. Concrete reinforcement process according to the work method.	√	√	√	√	√
		7. Binding of transverse reinforcement must be in accordance with the work method.	√	√	-	√	√
		8. Requirements for installing concrete reinforcement that has been assembled according to the work drawing.	√	√	√	-	√
	Casting work	9. The reinforcement model is in accordance with technical specifications so that it does not shift during casting.	-	√	√	√	-
		10. The leveling of the concrete after casting is carried out according to the working drawings.	-	√	√	√	-
		11. The method of compacting the concrete during casting is carried out in accordance with the working method.	√	√	√	√	√

Note: √ = important; - = not important; A, B, C, D, E = participants

The results of the assessment of vocational education expert participants on the design of the VHS student skills test instrument was determined by the five vocational education experts who tested the essence of the instrument product.

Table 8 presents the relatively varied values according to the indicators and criteria of student performance. If the Lawshe index value (L) was calculated for each item of performance criteria, it gave the highest value of L = 1.00 and the lowest L = 0.20, but if the average value was calculated for all items of performance criteria, it gave a value of L = 0.64. Therefore, with this average value, it can be said that the VHS student skills test instrument designed through this study was "very essential" as a tool or instrument for measuring VHS student skills.

This study has produced a valid, reliable, practical, effective, and essential VHS student work skills test instrument. The skill test instrument is in the field of concrete structure work expertise with four work indicators, namely scaffolding work, formwork work, reinforcement work and casting work. Each work indicator is equipped with performance criteria that can guide or direct the performance of VHS students in showing their performance to demonstrate their work skills in concrete structure work expertise.

The scaffolding work indicator is equipped with two work criteria, namely the manufacture of scaffolding according to the work method and the selection of scaffolding materials must be in accordance with technical specifications. The formwork work indicator is equipped with three work criteria, namely how to make formwork according to the work method to make it strong, formwork making equipment according to the work method, and how to install formwork according to the work method. The reinforcement work indicator is equipped with three work criteria, namely the concrete reinforcement process according to the work method, the binding of transverse reinforcement must be in accordance with the work method, and the requirements for installing concrete reinforcement that has been assembled according to the work drawing. The casting work indicators are equipped with three work criteria, namely the binding reinforcement model according to technical specifications so that it does not shift during casting, the leveling of concrete after casting is carried out according to the working drawings, and the method of compacting concrete when casting is carried out according to the work method.

This research is very important in efforts to improve the competency of VHS graduates. Fundamentally, vocational schools can maximally produce graduates who are ready to work with good competency ownership, relevant to the needs of the employment industry. This is in line with the Indonesian National Standards Agency issuing regulations that vocational schools must always assess the achievement of students' work skills competencies by involving industry parties to ensure that students' competencies are in accordance with the needs of the world of work (Misbah et al., 2020). One way that this may be done is to use an assessment instrument based on industry needs that can assess students' work skills achievements.

Competency-based education patterns, such as learning at VHS, require assessments to determine whether students are competent or not (Wesselink et al., 2017; Misbah et al., 2020). Competency-based learning models at VHS always

focus on achieving students' work competencies (Oroh et al., 2018; Misbah et al., 2020; Ralf et al., 2020). This shows the importance of organizing VHS in an effort to provide work skills competency for students and providing a guarantee of the relevance of students' work skills to the real needs of workers (Khampirat et al., 2019) so that students are ready to enter the real world of work (Hansen et al., 2022; Mentele & Heinzer, 2021). However, it must also always be noted that vocational education will be effective if a student learning environment is provided that is appropriate to the environment in which they will work in the future (Ferm, 2020; Oroh et al., 2020; De Vos et al., 2022).

Student skills test instruments must be able to assess the achievement of the results of the student's learning process and determine whether the students being assessed are skilled or not, because the assessment action functions to test the expected learning outcomes (Mulder, 2017; Tentama et al., 2019). The instrument must be well-designed so that the data obtained when assessing student learning outcomes do not provide measurement errors (Blömeke, 2017). The learning outcome assessment instrument developed in this study is important because it is more focused on vocational learning assessment that reflects the actual workplace environment (Deutscher & Winther, 2019). Vocational learning assessment instruments must be developed and designed based on industry needs; the instruments designed in this study have gone through processes and stages accommodating the needs of the construction services industry so that the VHS student skills test instrument is appropriate for use when assessing VHS student learning outcomes.

The form of assessment that can be carried out to assess the achievement of VHS students' work skills is the student performance assessment approach. Student performance can be assessed through a skills test instrument with performance criteria as developed from the results of this study. To find out whether the competencies achieved by students are in accordance with the needs of the industrial world or not, it is necessary to equip them with performance criteria that are in accordance with the needs of the industrial world (Misbah et al., 2020; Preston, 2017). Thus, the student work skills test instrument equipped with the performance criteria obtained in this study can be a VHS student work skills test instrument that can be used in the vocational learning assessment process.

The student skills test instrument developed through this research was carried out as an effort to provide assurance of adjusting student skills to industry standards. Skills test instruments that are in accordance with the needs of the construction services industry ensure that students have competencies that are relevant to industry standards, provide opportunities for increasing graduate employability (Aliu & Aigbavboa, 2020), and graduates who are ready to work (Subiyantoro, 2023). This can be met through an assessment instrument with assessment criteria that accommodate basic vocational competencies in carrying out work tasks (Hiim, 2023). This assessment is also a form of competency-based assessment, which can help and motivate students in future vocational tasks (Gulikers et al., 2017) and also reduces the skills gap between education and the world of work. Vocational education students who are considered to have work

skills competencies obtained through their learning process should be able to demonstrate their abilities (Ewing, 2017) when doing their jobs.

Furthermore, VHS student skill test instruments that are relevant to the needs of the construction services industry are very important because they can increase industry confidence in vocational education graduates because vocational education graduates are more ready to work (Wahyudi, 2023). By using relevant skill test instruments, the construction services industry will have greater confidence in the abilities of VHS graduates. This can increase the level of trust and acceptance of the industry towards graduates, which in turn can increase the absorption rate of workers from VHS to the construction services sector. The construction industry's trust is imperative because with skilled and trained workers, a construction project will be successful in its implementation (Elfaki & Alatawi, 2015). The results of this study can provide a guarantee of trust to the construction services industry because the skill test instruments produced in this study have been developed based on the needs of the construction services industry.

This research was to ensure the relevance of VHS graduates to industry needs. Furthermore, an important contribution of this study is that the results of this study can facilitate competency certification of VHS graduates, because relevant skill test instruments can be integrated with competency certification programs. Certification is an added value for students when entering the workforce. This certification is often a requirement for workers in the construction industry (Kementerian PUPR, 2021; Subiyantoro, 2023). The use of student work skills test instruments that are in accordance with industry needs will make it easier for students to obtain certification that is recognized by the industry. This is in accordance with the Indonesian government's program that every skilled worker must have a work competency certification.

The student skills test instrument has limitations, namely it can only be used in the field of building structure expertise with a work specialization in concrete structures and cannot be applied to the field of building structure expertise in other types of work. Despite the limitations of the study, the findings of this study in the form of a student work skills test instrument are still valid for use. The results of this study have practical and theoretical implications for vocational education stakeholders in conducting student work skills testing processes.

6. Conclusion

This study found that the VHS student skills test instrument is categorized as practical, effective, and essential to be used as a tool for measuring the skill level of VHS students. The student work skills test instrument developed in this study is based on the type of concrete structure work with indicators of scaffolding, formwork, reinforcement and casting work, and is equipped with performance criteria. The instrument is able to assess the achievement of student learning process results and can determine whether students are skilled or not. The instrument is very important because it can reduce the gap between education and the world of work and may increase industry trust in VHS graduates. Also, it

can be integrated with competency certification programs that are added value for students when entering the world of work. The findings of this study can be recommended to all relevant education stakeholders in the policy of implementing the work skills testing process for prospective VHS graduates so that they become VHS graduates with work skills that are relevant to industry needs. Further similar research is recommended for the development of instruments on the knowledge aspect of VHS students.

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8. References

Aliu, J., & Aigbavboa, C. (2020). Structural determinants of graduate employability: impact of university and industry collaborations. *Journal of Engineering Design and Technology, 19*(5), 1080–1100. https://doi.org/10.1108/jedt-05-2020-0189

Ambiyar, Panyahuti, Devega, A., & Islami, S. (2024). Web and android-based test application development and its implementation on final semester examination. *JOIV: International Journal on Informatics Visualization, 8*(2), 768–776. https://doi.org/10.62527/joiv.8.2.2120

Ayre, C., & Scally, A. J. (2014). Critical Values for Lawshe's Content Validity Ratio: Revisiting the Original Methods of Calculation. *Measurement and Evaluation in Counseling and Development, 47*(1), 79–86. https://doi.org/10.1177/0748175613513808

Blömeke, S. (2017). Assuring quality in competence assessments: the value added of applying different assessment approaches to professional education (Chapter 29). In M. Mulder (Ed.), *Competence-based Vocational and Professional Education, Bridging the Worlds of Work and Education*. Springer. https://www.researchgate.net/publication/308412901_Competence-based_Vocational_and_Professional_Education_Bridging_the_Worlds_of_Work_and_Education

BPS RI. (2024). *Keadaan ketenagakerjaan Indonesia Febuari 2024* (Indonesian Labor Situation, February 2024). Berita Resmi Statistik, No. 36/05/Th. XXVII, 6 Mei 2024. Central Bureau of Statistics of the Republic of Indonesia (BPS RI), Jakarta, Indonesia. https://www.bps.go.id/id/publication/2024/06/07/bd40ab2fa4fac6c726ab4ad4/keadaan-pekerja-di-indonesia-februari-2024.html

Churiyah, M., Putri, O. M., Arief, M., Dharma, B. A., Sukmawati, E., & Zainuddin, Z. (2023). Project based learning interactive e-book: a solution to self-regulated learning and student learning outcomes. *Proceedings of the BISTIC Business Innovation Sustainability and Technology International Conference (BISTIC 2023)*, Advances in Economics, Business and Management Research, 132–142. Atlantis Press. https://doi.org/10.2991/978-94-6463-302-3_17

Deutscher, V., & Winther, E. (2019). A Conceptual Framework for Authentic Competence Assessment in VET: A Logic Design Model. In S. McGrath, M. Mulder, J. Papier, & R. Suart (Ed.), *Handbook of Vocational Education and Training Developments in the Changing World of Work*. Springer Nature Switzerland. https://doi.org/10.1007/978-3-319-94532-3

De Vos, M. E., Baartman, L. K. J., Van der Vleuten, C. P. M., & De Bruijn, E. (2022). Unravelling workplace educators' judgment processes when assessing students'

performance at the workplace. *Journal of Vocational Education & Training*. https://doi.org/10.1080/13636820.2022.2042722

Elfaki, A. O., & Alatawi. (2015). Representing the knowledge of public construction project cost estimator by using rule-based method. *Journal of Building Construction and Planning Research, 3*(4), 189–195. http://dx.doi.org/10.4236/jbcpr.2015.34019

Ewing, B. (2017). An exploration of assessment approaches in a vocational and education training courses in Australia. *Empirical Research in Vocational Education and Training, 9*(14). https://doi.org/10.1186/s40461-017-0058-z

Ferm, L. (2020). Vocational students' ways of handling the academic/vocational divide. *International Journal for Research in Vocational Education and Training, 8*(1), 1–20. https://doi.org/10.13152/IJRVET.8.1.1

Gulikers, J. T. M., Runhaar, P., & Mulder, M. (2017). An assessment innovation as flywheel for changing teaching and learning. *Journal of Vocational Education & Training, 70*(2), 212–231. https://doi.org/10.1080/13636820.2017.1394353

Hampf, F., & Woessmann, L. (2017). Vocational vs. general education and employment over the life cycle: new evidence from piaac. *Cesifo Economic Studies*. https://doi.org/10.1093/cesifo/ifx012

Hansen, S., Rostiyanti, S. F., Setiawan, A. F., & Koesalamwardi, A. B. (2022). Developing a work-integrated learning model adjusting to construction 4.0 concepts. *International Journal of Work-Integrated Learning, 23*(1), 65–80. https://www.ijwil.org/files/IJWIL_23_1_65_80.pdf

Hass, C. (2019). A Practical Guide to Usability Testing. In M. Edmunds, C. Hass, & E. Holve (Eds.), *Consumer Informatics and Digital Health*. Springer. https://doi.org/10.1007/978-3-319-96906-0_6

Hiim, H. (2017). Ensuring curriculum relevance in vocational education and training: Epistemological perspectives in a curriculum research project. *International Journal for Research in Vocational Education and Training, 4*(1), 1–19. https://doi.org/10.13152/IJRVET.4.1.1

Hiim, H. (2023). How can collaboration between schools and workplaces contribute to relevant vocational education? Results of an action research project in the school-based part of Norwegian vocational education and training. *Vocations and Learning, 16*, 1– 21. https://doi.org/10.1007/s12186-022-09300-z

Kementerian PUPR. (2021). *Era baru konstruksi berkarya menuju Indonesia maju* [The new era of construction is working towards a developed Indonesia]. Minister for public works and human settlements (Kementerian PUPR). Jakarta, Indonesia.

Kepmenaker RI. (2021). *Standar Kompetensi Kerja Nasional Indonesia (SKKNI) pada jabatan kerja pelaksana lapangan pekerjaan gedung* [Indonesian National Work Competency Standards (SKKNI) for work positions implementing building work]. Regulation of the Minister of Manpower of the Republic of Indonesia (Kepmenaker RI). Jakarta, Indonesia.

Khampirat, B., Pop, C., & Bandaranaike, S. (2019). The effectiveness of work-integrated learning in developing student work skills: A case study of Thailand. *International Journal of Work-Integrated Learning, 20*(2), 127–146. https://www.ijwil.org/files/IJWIL_20_2_127_146.pdf

Mehta, M., Armpriest, D., & Scarborough, W. (2013). *Building construction, principles, materials, and systems*. Pearson Education.

Mentele, S. R., & Heinzer, S. F. (2021). Practical validation framework for competence measurement in VET: a validation study of an instrument for measuring basic commercial knowledge and skills in Switzerland. *Empirical Research in Vocational Education and Training, 13*(18). https://doi.org/10.1186/s40461-021-00122-2

Misbah, Z., Gulikers, J., Dharma, S., & Mulder, M. (2020). Evaluating competence-based vocational education in Indonesia. *Journal of Vocational Education & Training*, *72*(4), 488–515. https://doi.org/10.1080/13636820.2019.1635634

Mulder, M. (2017). *Competence-based vocational and professional education, bridging the worlds of work and education*. Springer International Publishing Switzerland. http://dx.doi.org/10.1007/978-3-319-41713-4

Munawar, W., Ridwan, A., & Sriyono, S. (2019). Development of performance assessment standard career with dichotomy scoring as competence test at vocational school. *Proceedings of the 5th UPI International Conference on Technical and Vocational Education and Training (ICTVET 2018)*. https://doi.org/10.2991/ictvet-18.2019.113

Nkwanyane, T. P. (2023). Understanding the demand for industrial skills through the national certificate (vocational) building and civil engineering programme. *International Journal of Learning, Teaching and Educational Research, 22*(5), 674–687. https://doi.org/10.26803/ijlter.22.5.35

Ohle-Peters, A., McElvany, N., & Ullrich, M. (2023). Students' Text-Picture-Integration: The Role of Teacher Competence and Instructional Quality. *International Journal of Educational Psychology, 12*(3), 251–268. https://doi.org/10.17583/ijep.11558

Oroh, R. R., Haris, A. S., Sugandi, R. M., & Isnandar. (2018). What are the dominant factors of students' productive skills in construction services? *IOP Conf. Ser.: Mater. Sci. Eng*, 306. https://iopscience.iop.org/article/10.1088/1757-899X/306/1/012111

Oroh, R. R., Runtuwene, J. P. A., Tumanduk, M. S. S., & Palilingan, V. R. (2020). Relevance of student productive skills competencies based on construction services needs. *International Journal of Innovation and Learning, 28*(1), 4–11. https://doi.org/10.1504/IJIL.2020.108461

Oroh, R. R., Attaufiq, M. M., Daud, M., & Roring, R. F. (2023). Analysis of Vocational Student Performance Criteria on Work Skills Based on Industry Needs: An Analysis for Students' Skill Test Instruments. *International Journal of Learning, Teaching and Educational Research, 22*(10), 174–189. https://doi.org/10.26803/ijlter.22.10.10

Oroh, R. R., Kembuan, D. R., Daud, M., Attaufiq, M. M., & Roring, R. F. (2024). What is the Form of Collaboration between SMK and Construction Services in Providing Guarantees for the Relevance of Student Work Skills? *5th Vocational Education International Conference* (VEIC-5 2023) (pp. 1508-1513). Atlantis Press. https://doi.org/10.2991/978-2-38476-198-2_214

Perpres RI. (2012). *Kerangka Kualifikasi Nasional Indonesia [Indonesian National Qualifications Framework]*. Regulation of the President of the Republic of Indonesia [Perpres RI]. Jakarta, Indonesia. https://pasca.unpad.ac.id/wp-content/uploads/simple-file-list/Appendix-5-Biotechnology-KKNI-Indonesian-National-Qualification-Framework-.pdf

Ponto, H. (2019). Development of an Assessment of Science Process Skills of Basic Electrical Engineering in the Vocational High School. *International Journal of Recent Technology and Engineering*, 8(2S), July 2019. https://www.ijrte.org/portfolio-item/b10020782s19/

Preston, J. (2017). *Competence based education and training (CBET) and the end of human learning*. Springer Nature. http://dx.doi.org/10.1007/978-3-319-55110-4

Ralf, A. L. F. van Griethuijsen, Eva, M. Kunst, Marianne van Woerkom, Renate, Wesselink, & Rob F. Poell. (2020). Does implementation of competence-based education mediate the impact of team learning on student satisfaction? *Journal of Vocational Education & Training, 72*(4), 516–535. https://doi.org/10.1080/13636820.2019.1644364

Rosyid, A. (2020). Evaluation of Competency Test and Work Competency Certification Implementations at Professional Certification Institute – First Party (LSP P1). *Journal of Vocational and Career Education*, *5*(2), 81–88. https://doi.org/10.15294/jvce.v5i2.26946

Setiyawami, Sugiyo, Sugiyono, & Rahardjo, T. J. (2020). The Role of Vocational Education on the Advancement of Human Development in Indonesia. *International Conference on Science and Education and Technology (ISET 2019), Advances in Social Science, Education and Humanities Research*, *443*. Atlantis Press. https://doi.org/10.2991/assehr.k.200620.079

Subiyantoro, H. (2023). The role of vocational education as the key to economic development in Indonesia. *Proceedings of the 3rd Multidisciplinary International Conference, MIC 2023*, 28 October 2023, Jakarta, Indonesia. https://doi.org/10.4108/eai.28-10-2023.2341745

Tentama, F., Merdiaty, N., & Subardjo, S. (2019). Self-efficacy and work readiness among vocational high school students. *Journal of Education and Learning (Edulearn), 13*(2), 277–281. https://doi.org/10.11591/edulearn.v13i2.12677

Tsai, H., Lee, A., Lee, H., Chen, C., & Liu, K. (2020). An application of the fuzzy Delphi method and fuzzy AHP on the discussion of training indicators for the regional competition, Taiwan national skills competition, in the trade of joinery. *Sustainability, 12*(10), 4290. https://doi.org/10.3390/su12104290

Wahyudi, W., Suharno, S., & Pambudi, N. (2023). Evaluate the vocational school graduate's work-readiness in Indonesia from the perspectives of soft skills, roles of teacher, and roles of employer. *Journal of Curriculum and Teaching, 12*(1), 110. https://doi.org/10.5430/jct.v12n1p110

Wesselink, R., Biemans, H., Gulikers, J., & Mulder, M. (2017). Models and principles for designing competence-based curricula, teaching, learning and assessment. In M. Mulder (Ed.), *Competence-based vocational and professional education, bridging the worlds of work and education*. Springer. http://dx.doi.org/10.1007/978-3-319-41713-4