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Analysis of Vocational Student Performance Criteria on Work Skills Based on Industry Needs: An Analysis for Students' Skill Test Instruments

Rolly Robert Oroh*, Muhammad Muhdi Attaufiq, Metsi Daud and Rocky Frangky Roring
Universitas Negeri Manado, Indonesia

Abstract. A vocational high school (VHS) is intended to equip students with job skills. The work skills of VHS students must be relevant to the industry needs. This research was to determine the student performance criteria on work skills based on industry needs. This research uses a quantitative descriptive research approach. Research data was obtained through instruments distributed to participants. The research instrument was designed according to a job description of reinforced concrete beam structures. There were 112 VHS student participants involved in this research. This study found that the student performance criteria on the work skills of concrete structure work include several types of work, namely casting work, formwork, reinforcement work and scaffolding work. The student performance criteria obtained in this research can be a supporting component of the VHS student work skills test instrument because they are in accordance with industry needs. The VHS student work skills test instrument is intended to determine whether students are competent. The work skills of VHS students can be assessed from the 'show how' and 'do' competency levels as the basis for assessing student performance. Student work skills will be relevant if students are given real learning experiences through student practical work directly in the industry as a form of theoretical and practical collaboration.

Keywords: Vocational education; construction services; students' work skills

1. Introduction

Vocational high schools (VHS) have a function to prepare graduates with the requisite skills to be able to work in certain jobs according to their fields. The education system in Indonesia places VHS at the secondary education level. The implementation of VHS in Indonesia is an attempt to fulfil the needs of the industrial world, such as the field of construction services. Therefore, vocational education or VHS is a bridge between education and the world of work.

The learning pattern of VHS in Indonesia shows the fact that after students have completed their learning process, they are required to take skills competency examinations to gain recognition through certification. These are carried out by external parties (such as by construction service providers). The construction services party plays the role of assessor and verifier in the implementation of the skills test. Before students take the skills examination, the school measures students' competency according to the demands of the curriculum, and then the construction services test students' work skills in an examination set by the school. This form of external examination has an impact on the incompatibility with the needs of the construction services sector because the format has been prepared by the school in advance and does not involve input from external parties. This can be one of the reasons why many VHS graduates are not absorbed by construction services because the relevance of student work competencies to job market needs tends to be low (BPS, 2022). Therefore, collaboration in the implementation of vocational education between VHSs and construction service providers is important (Hiim, 2017) to guarantee the compatibility of competencies achieved by VHS students with employment needs.

VHSs in Indonesia are educational units that can produce a ready-to-use workforce at the operator level. However, data for 2022 shows that the open unemployment rate by education level is more dominated by VHS graduates, namely 10.38% of the total number of open unemployed, compared to other graduates (BPS, 2022). The data shows that VHS graduates are still among the number of unemployed people of productive age. Data for 2020 shows that 10.24% of the national gross domestic product (GDP) is a significant contribution from the construction services sector where the number of construction workers are dominated by VHS graduates, namely 70% (Kementerian PUPR, 2021). Therefore, it is an important task for VHSs whose main objective is to produce human resources with work skills that they consistently improve the quality and relevance of graduates' work skills competencies to meet the needs of the business world and the industrial world.

Vocational education through the VHSs is meant to equip students with work skills competencies so they are able to compete in the world of work. Therefore, vocational education must be relevant to the real needs of workers (Khampirat et al., 2019) in preparing students to enter the workforce (Amilda et al., 2023; Hansen et al., 2022; Rohr-Mentele & Forster-Heinzer, 2021). Vocational education with competency-based learning focuses on achieving student work competencies (Misbah et al., 2020; Oroh et al., 2018; Ralf et al., 2020). Skills are not only learned in a formal school context, but also in authentic work settings (Littke & Thang, 2015). Vocational education will be efficient if a learning environment is provided that is in accordance with the demands of the work environment where they will later be employed (De Vos et al., 2022; Ferm, 2020). Because learning is always workplace based there should be no gap between education and employment (Sylte, 2020). The learning achievements of vocational education students can be assessed when they demonstrate their ability (Ewing, 2017) to solve problems in the workplace (Pearce, 2015).

Having skills enables every individual to work effectively in the workplace according to their field of expertise. Skills are the ability to act in real work (Hadiyanto et al., 2021). They are defined as students' abilities to think and act effectively and creatively in abstract and concrete fields as a development of what they understand at school (Permendikbudristek RI, 2022). Students who are skilled will succeed in real jobs (Chen et al., 2021). The skill aspect refers to the ability to do work under various conditions and in diverse situations. The skill aspect is one of the standards needed to demonstrate one's ability (Gulikers et al., 2017). Thus, it can be stated that every skilled member of the workforce is assured of success at work (Khampirat et al., 2019) such as when carrying out concrete structural work.

The lack of relevance between the needs of the world of work and the quality of VHS graduates is one of the factors driving the low absorption of VHS graduates into the world of work (BPS, 2022). To realize an ideal VHS student skill profile, it is necessary to determine the skills that are relevant to the needs of construction services. Concrete structure work is a type of work required by construction services. It requires workers who are VHS graduates. However, it must first be confirmed whether VHS graduates have the level of concrete structure work skills that meet the demands of construction services. Thus, to be able to correlate the suitability of students' work skills with the needs of construction services, this study aims to determine the vocational student performance criteria on work skills based on industry needs.

1.1. Skills Competency of VHS Student

Vocational education learning through VHS is always directed at the process of equipping students with work skills competencies. The VHS learning process in Indonesia consists of normative, adaptive and productive learning packages. The learning package that focuses on the process of providing student work skills competence is the productive learning package (Oroh et al., 2020). Productive learning programs consist of vocational subject matter that enables students to be trained and develop work skills, including concrete structure work skills. The competency of students' work skills in concrete structure work consists of several work indicator components, such as scaffolding, formwork, reinforcement and casting work (Kepmenaker RI, 2021).

Vocational education must be relevant to the real needs of workers and the curriculum must meet the requirements of business (Billett, 2020). Vocational education enables students to enter the workforce with the work skills they have acquired. However, work skills are not fully learned only in formal school learning, but in authentic work settings as well (Littke & Thang, 2015). Students with the skills they have will be able to adapt these to workplace situations (Billett, 2020). Therefore, vocational education will be relevant if it provides a learning environment such as a real work environment.

Vocational education through VHS comprises competency-based learning. Competency-based learning must be supported by a work-based curriculum because the main objective of a workplace-based curriculum is to develop

knowledge for expert performance (Billet, 2020). One's work skills must be supported by procedural knowledge because procedural knowledge comprises a technique, skill and ability to secure work goals (Billet, 2020). Therefore, students' work skills need to be supported with procedural knowledge in order to succeed in achieving high performance goals.

The work skills provided to students in schools are still not considered appropriate or relevant to the needs of the construction service industry. Some of the skill competencies provided through subjects at school, in fact, have not fully accommodated all the competency needs for construction service work, therefore VHS teachers need to have vocational material specialization (Estriyanto et al., 2017; Grosch, 2017). It is an empirical fact that the teaching materials packaged in VHSs through the process of providing skill competencies to students are not developed or based on the requirements of construction services. Therefore, it is important to determine student performance criteria that suit the needs of construction services in carrying out concrete structure work.

1.2. Construction Services Requirements

The implementation of construction services in Indonesia continues to grow and supplies the provision of construction infrastructure. The development of the construction services business in North Sulawesi, Indonesia continues to increase along with the construction of infrastructure facilities in various fields. The reality in meeting the needs of the workforce in implementing construction services is that it appears that that more skilled workers are still being brought in from outside the region (Oroh et al., 2020). The need for labour in construction projects continues to increase and is an important factor in supporting the successful implementation of the construction business.

Construction service providers in Indonesia continue to increase in number in line with the increasing need for infrastructure development. Every year there is an increase in the number of construction service providers in small, medium and large classifications. For example, in the province of North Sulawesi, Indonesia, from the 2020 data recorded at the Central Statistics Agency, the number of business entities providing construction services from small to large classifications totalled 1,995. These consisted of 1,750 small business entities, 207 medium-sized business entities, eight large business entities, and others numbering as many as 30 business entities (BPS, 2021). The number of construction service actors will continue to increase every year (Isnandar et al., 2015).

The role of the construction service industry in the development of an area is important (Mtshali & Pillay, 2023); therefore, it needs to be supported by the availability of a competent workforce in the field of construction work. The VHSs are one of the contributing sources of workers who have construction work competencies. Therefore, VHSs need to prepare their students efficiently to have qualified and certified work skills competencies because the Law of the Republic of Indonesia No. 2 of 2017 already requires that all construction

workers who work on construction projects must have certificates, especially for the positions of experts, technicians/analysts and operators (Kementerian PUPR, 2021).

This research aims to determine criteria for student performance in work skills in carrying out concrete structure work. This type of research has not been carried out by other previous researchers, but was a further development of research on the level of relevance of students' productive skills to the requirements of construction services (Oroh et al., 2020). The contribution of this research was to identify data about student performance criteria for work skills that meet the needs of construction services.

2. Method

2.1. Research design

This research was conducted to determine criteria for student performance in work skills in carrying out concrete structure work. Therefore, a quantitative descriptive research approach was used. A quantitative descriptive design collects quantitative data at a certain time to determine and describe trends in research data (Creswell & Creswell, 2023; Roni et al., 2020). The quantitative data was obtained through instruments distributed to participants. This research is limited to the type of reinforced concrete beam structure work. Furthermore, to determine the student performance criteria on work skills, a performance analysis was conducted on the most dominant type of work as indicated from student responses through the given instrument. Therefore, the data analysis used was factor analysis.

2.2. Research participants

This study involved VHS students in the field of construction technology and property expertise as participants. Using VHS students as participants was intended to obtain data on student work skills competence achievements through the learning process at VHS. There were 112 student participants involved in this study who were randomly selected as representatives of eight VHSs from seven districts and cities in North Sulawesi Province, Indonesia. The demographics of the participants are given in Table 1, while an overview of the participants' expertise is depicted in Table 2.

Table 1: Demographic characteristics of research participants

Category	Characteristics	Number (n)	Percentage
Gender	Males	77	68,75%
	Females	35	31,25%
Age	17 years old	44	39,29%
	18 years old	68	60,71%

Table 2: Participants' expertise

Expertise	Number (n)	Percentage
Modelling design and building information	98	87,5%
Construction and property business	14	12,5%

2.3. Data collection

The research data is in the form of responses from research participants about performance in reinforced concrete structure work, which in this study refers to the type of reinforced concrete beam structure work. Data collection instruments were distributed directly to the participants. Participants responded by giving an oral description of the work of concrete structures. Their responses were then assessed as to whether they were right or wrong according to existing performance criteria. Subsequently, the results of the assessment were collated and tabulated for analysis.

2.4. Research Instruments

Data about the description of student performance criteria in reinforced concrete structure work were obtained through responses from research participants by means of the research instruments provided. The research instrument comprised a job description of reinforced concrete beam structures (Mehta et al., 2013). Table 3 depicts an example of an overview of performance criteria for concrete structural work. Allocating codes B1 to B30 in Table 3 for each performance criterion was intended to facilitate analysis. This research instrument was compiled according to the Indonesian National Work Competency Standards No. 193/2021 (Kepmenaker RI, 2021) and the Indonesian National Qualifications Framework (Perpres RI, 2012). The description of the 24 items in Table 3 is a performance criterion that only focuses on reinforced concrete structure work.

Table 3: Description of performance criteria

Code	Components of student skills performance criteria
B1	Reinforcement for the main structure of concrete beams must be in accordance with the shop drawings
B2	The process of concrete reinforcement according to the work method
B3	Selection of reinforcement forms of concrete beam structures according to technical specifications
B4	The process of assembling the stirrup reinforcement must be good so that it does not shift when castings
B5	Binding the cross bars must be according to the working method
B6	The ends of the reinforcement are bent according to the working method
B7	Requirements for installing concrete reinforcement that has been assembled according to the shop drawings
B8	Model tie reinforcement according to technical specifications so as not to shift when casting
B9	Installation of assembled concrete reinforcement must not easily shift when castings
B10	How to make formwork according to the shape of the concrete to be cast
B11	Materials for the manufacture of formwork according to technical specifications
B12	How to make formwork according to the working method so that it is strong
B13	Equipment for making formwork according to working method
B14	Formwork must not sway when casting
B15	How to install the formwork according to the working method
B16	Manufacture of scaffolding according to the working method
B17	Requirements for installing scaffolding according to shop drawings

B18	Choosing a scaffolding material must comply with technical specifications
B19	The requirements for pouring concrete when casting must be in accordance with the work method
B20	The method of casting is carried out according to the work method
B21	The thickness of the casting layer is made according to technical specifications
B22	Levelling of concrete after casting is made according to shop drawings
B23	The method of compacting concrete when casting is made according to the work method
B24	The method of mixing concrete for casting must be in accordance with the work method

2.5. Research Data Analysis

This research was conducted to determine the student performance criteria on concrete structure work, therefore so the data analysis of this study used factor analysis. The procedures carried out in factor analysis are calculating indicator correlations, factor extraction, and factor rotation (Hair et al., 2019; Widarjono, 2015). Data adequacy requirements for factor analysis use the Kaiser-Meyer-Olkin measure of sampling (KMO) values > 0.5. The requirement for instrument components to use the measure of sampling adequacy (MSA) value for each instrument component was that it had to had to have a value of more than 0.5 so that it could be analysed further. Factor extraction used principal component analysis, while factor rotation used the varimax method. Furthermore, for data processing, communality and eigenvalues are used to determine how the components of performance criteria in the student work skills instrument explain the dominant factors that are formed. Finally, the SPSS sStatistics 23 application for Windows was employed for data analysis.

3. Results and Discussion

Based on the research data obtained, factor analysis was then carried out with the help of the SPSS 23 for Windows program.

Table 4: Communalities value

Components of student skills performance criteria (Code)	Communalities
B1	0.596
B2	0.741
B4	0.685
B5	0.675
B7	0.775
B8	0.707
B9	0.797
B10	0.582
B11	0.749
B12	0.677
B13	0.708

B14	0.621
B15	0.715
B16	0.610
B18	0.806
B20	0.676
B21	0.660
B22	0.781
B23	0.760
B24	0.610

After testing the first condition in the factor analysis, the KMO value was 0.616 > 0.5. Furthermore, considering the MSA values for each component of the performance criteria on the instrument, several MSA values <0.5 were obtained. The first stage of the analysis produced a B3 item value of 0.325 which means <0.5. Then the second stage of analysis was continued on condition that B3 items were removed from the analysis process for the following stage.

After going through several stages of analysis, the fifth stage, the final stage, was reached with a value of KMO = 0.680. All the components of the performance criteria had an MSA value of > 0.5; therefore, it can be stated that the existing data is suitable for analysis through factor analysis. In the analysis of the second stage, items B3, B6, B17, B19 and B12 were excluded for each stage because they had an MSA value of <0.5. After the factor extraction process with the main component analysis method, communalities values were obtained as shown in Table 4.

Based on the communality values in Table 4, factor rotation was carried out so that the eigenvalue was obtained, followed by component rotation so that the instrument component with the appropriate criteria was obtained as shown in Table 5. The description in Table 5 is modified from the results of SPPS statistical 23 analysis, which are ordered from the largest eigenvalue to the smallest value.

Table 5: Eigenvalues

Components of student skills performance criteria (Code)	Eigenvalue		
	Total	**% of Variance**	**Cumulative %**
B8	5,124	25.621	25.621
B22	5,124		
B23	5,124		
B12	2,047	10.235	35.857
B13	2,047		
B15	2,047		
B4	1,873	9.367	45.224
B14	1,873		
B20	1,873		

B24	1,873		
B2	1,439	7.196	52.420
B5	1,439		
B7	1,439		
B11	1,289	6.446	58.866
B16	1,289		
B21	1,289		
B9	1,129	5.643	64.509
B10	1,129		
B1	1,028	5.142	69.651
B18	1,028		

Based on the eigenvalues and the description of the components in Table 5 which were obtained after rotating the factors using the varimax method, seven (7) work type factors were formed (Figure 1), with details of performance criteria as follows: Factor 1 or the casting work factor must comply with the work method, shop drawings and technical specifications, with the performance criteria, namely model tie reinforcement according to technical specifications so as not to shift when casting, levelling of concrete after casting is made according to shop drawings, and the method of compacting concrete when casting is made according to the work method.

Factor 2 or the formwork factor must be in accordance with the work method, with the performance criteria how to make formwork according to the working method so that it is strong, equipment for making formwork according to working method, and how to install the formwork according to the working method. Furthermore, Factor 3 or the casting work factor must be in accordance with the shop drawings and work methods, with the following performance criteria, namely the process of assembling the stirrup reinforcement must be good so that it does not shift when castings, formwork must not sway when casting, the method of casting is carried out according to the work method, and the method of mixing concrete for casting must be in accordance with the work method.

In addition, Factor 4 or the reinforcement work factor must be in accordance with the work method and shop drawing, with the following performance criteria: the process of concrete reinforcement according to the work method, binding the cross bars must be according to the working method, and requirements for installing concrete reinforcement that has been assembled according to the shop drawings.

Factor 5 or the material selection factor for formwork and scaffolding must comply with the technical specifications for casting, with the performance criteria, namely: materials for the manufacture of formwork according to technical specifications, manufacture of scaffolding according to the working method, and the thickness of the casting layer is made according to technical specifications while Factor 6 or the factor of reinforcement and formwork work

must be in accordance with work methods, and shop drawings, with the performance criteria, namely installation of assembled concrete reinforcement must not easily shift when castings, and how to make formwork according to the shape of the concrete to be cast. Finally, Factor 7 or the reinforcement and scaffold work factor with the following performance criteria, namely reinforcement for the main structure of concrete beams must be in accordance with the shop drawings, and choosing a scaffolding material must comply with technical specifications.

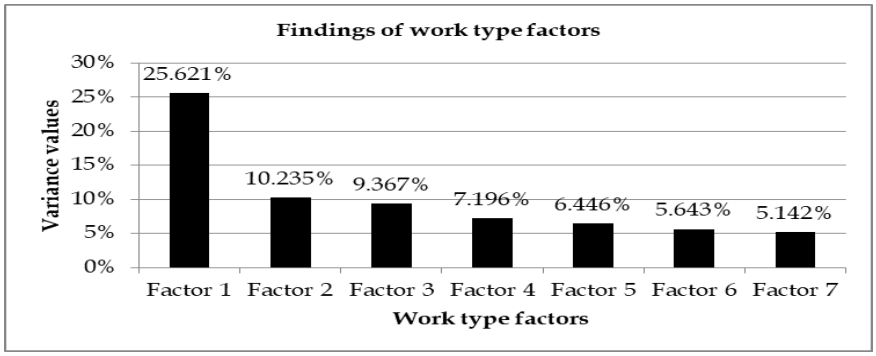

Figure 1: Variance values of the 7s factors of work type findings

Based on the results of the analysis of the dominant factors for the performance criteria of concrete structures, the overall factors formed can generally explain work indicators in concrete structure work. In addition, the results of the analysis also found that the accumulated factors could explain the variance of 69.651% as shown in Table 5 and in Figure 1. It can be said that the work skills shown by VHS students in general can explain the performance criteria in concrete structure work.

The factors formed can explain several concrete structure works with their performance criteria, namely casting work, formwork work, reinforcement work, and scaffolding work. Casting work is mentioned by Factors 1a and 3. Formwork work is mentioned by Factors 2, 5 and 6. Reinforcement work is mentioned by Factors 4, 6 and 7, while scaffolding work is mentioned by Factors 5 and 7. In general, all the work that is formed is the work required in concrete structure work. If based on the variance value of each factor in Table 3, it can be said that casting work is the most dominant skill mastered by students with a total variance value of 34.988% which is the sum of the variant values of Factors 1 and 2. The work of formwork, reinforcement and scaffolding together only gives a variant value of 34.663%.

This proves that VHS students in their learning process tend to be given more material about casting work, followed by formwork and reinforcement and scaffolding work. Learning patterns like this are supported by learning models outside of school through industrial work practice activities as a form of collaboration between schools and companies (Hiim, 2023), so that students acquire skills relevant to the job market (Nkwanyane, 2023). A practical learning pattern like that can provide a learning experience for students (Hiim, 2017)

because it is important to have theoretical knowledge as well as relevant practical work experience (Calero López & Rodríguez-López, 2020; Sylte, 2020).

The jobs that are related to the dominant factors that appear in the analysis show that the VHS students' responses to the performance criteria for concrete structure work already reveal a level of work skills that are relevant to carrying out concrete structure work. However, an examination of the work factors formed, namely casting, formwork, reinforcement, and scaffolding, with their performance criteria, reveals that there are still jobs that have not fully provided the performance criteria that meet the needs of construction services. The performance criteria that match the needs of construction services must at least describe performance, which is always adjusted to three work criteria, namely it must comply with shop drawings, technical specifications and work methods (Kepmenaker RI, 2021). The results of the analysis reveal that only the foundry work provides criteria that are in accordance with the three performance criteria based on the need for construction services. Meanwhile, the one that provided the least conformity to the criteria was the scaffolding work because it only provided technical specification criteria.

These results are in accordance with the author's observations about the learning patterns carried out at VHS, which are introduced and explained relating to casting, formwork and reinforcement. The learning pattern at VHS is also supported by student work practice activities carried out at construction service companies as a form of theoretical and practical collaboration (Sylte, 2020; Hussain et al., 2021; Hiim, 2023). Vocational student work skills with performance criteria prove that students are always directed to learning patterns according to the real needs of the world of work. This proves that learning in vocational education or VHSs always focuses on the achievement of student work skills. Therefore, skills are important so that students are competent in their field of work.

It is also important that vocational students master the competence of work skills because having good work skills will become the basic capital in carrying out work assignments according to competency skills. With good skills, students become competent and experts in their fields and having expertise will lead to ways of working that comply with job procedures (Billett, 2020). VHS students in Indonesia are prepared to become skilled workers at the executive level (Isnandar et al., 2015); therefore, students who are prepared to become skilled workers or to manage staff must equip themselves with skills according to their area of expertise. Work skills competence for students will be able to stand them in good stead in their jobs so that a construction project will be successful if it is carried out by a skilled and trained workforce (Elfaki & Alatawi, 2015). Because VHS students in their learning have been trained in real skills such as those needed in the workplace, students will always be able to adapt to workplace expectations. Thus, it can be stated that any skilled workforce will always be successful in work such as construction projects.

The findings of this study determining the performance criteria of VHS students in carrying out concrete structure work can be a supporting component for determining the achievement of student work skill competencies. This is supported by the findings of student performance criteria in this study, which are in accordance with the needs of the industrial world. The way that can be done is to prepare an instrument that can assess the achievement of student work skills. Because competency-based education needs to be assessed to determine whether students are competent or not (Wesselink et al., 2017; Misbah et al., 2020), it must be structured properly so that the data obtained later is not distorted by measurement errors (Blömeke, 2017). The Indonesian National Standards Agency issued a regulation that vocational schools must assess the competency achievements of students' work skills by involving the industry to ensure student competence meets the needs of the world of work (Misbah et al., 2020).

Assessment of student work skills competence can be adjusted to the standards required by industry or construction services. Competence can be described in four levels, namely 'know', 'know how', 'show how' and 'do', where the two lower levels address students' knowledge or cognitive capacity, while the two higher levels are directed at the performance of students (Wesselink et al., 2017). This research, through the responses of students as participants, has provided an overview of their competence at the 'know how' and 'show how' levels. Even though the findings of the performance criteria of students relatively do not fully describe the performance criteria needed in concrete structural work, in general they have described work indicators through the required performance criteria according to the needs of construction services.

Assessment is an important factor for vocational education to determine student learning outcomes. Assessment is defined as a series of activities to collect and analyse information to measure student learning outcomes. The form of assessment of student learning outcomes at VHSs in Indonesia often uses formative and summative assessment forms with an assessment approach in the form of authentic assessment, performance assessment, and portfolio assessment (Misbah et al., 2020). The form of assessment that can be carried out to assess the achievement of VHS students' work skills is a summative assessment to assess student performance in concrete structure work. Student performance can be assessed through a skills test instrument with performance criteria on Factors 1 to 7 from the results of this study. The VHS student work skills test instrument is intended to determine whether students are competent or not (Wesselink et al., 2017). To determine whether the competencies achieved by students are compatible with the needs of the industrial world, it is necessary to be equipped with performance criteria that are in line with the needs of the industrial world (Misbah et al., 2020; Preston, 2017). Therefore, the performance criteria obtained in this study can be a supporting component of the VHS student work skills test instrument.

The discussion of this research does not include the characteristics of VHS and students as participants, specifically the content of the learning material that

students have received from each VHS. Therefore, the limitations of this research can be a recommendation for researchers who are interested in conducting similar research to consider the content of the teaching materials given to students.

4. Conclusion

This study determined the student performance criteria on work skills in concrete structure work. The factors formed can explain several concrete structure works with their performance criteria, namely casting work, formwork work, reinforcement work, and scaffolding work. Casting work is the most dominant work mastered by students, followed by formwork, reinforcement and scaffolding work. The performance criteria obtained in this study through the student performance criteria can be a supporting component of the VHS student work skills test instrument. The VHS student work skills test instrument is intended to determine whether students are competent or not. To determine whether the competencies achieved by students are compatible with the needs of the industrial world, it is necessary to be equipped with performance criteria that are in accordance with the needs of the industrial world. The work skills of VHS students can be seen from the 'show how' and 'do' competency levels as the basis for assessing student performance. Student work skills will be guaranteed to be relevant if students are given learning experiences such as real learning patterns through student work practices carried out directly in the industry as a form of theoretical and practical collaboration. Such a pattern of real learning is a pattern of vocational education which is always focused on the achievement of student work skill competencies through industry-based performance criteria. Work skill competencies achieved by students through real learning patterns will guarantee more quality and relevance to the needs of the business and the industrial world.

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