

A MODEL OF VOCATIONAL COMPETENCY ASSESSMENT OF INDUSTRIAL ENGINEERING STUDENTS OF VOCATIONAL HIGH SCHOOLS

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This study aims to develop a model of competency assessment. The research population consisted of two subpopulations, namely (1) engineering and vocational education experts, machinery practice instructors, and industry practitioners, and (2) students of Industrial Engineering Vocational High Schools in Surakarta. The sample from the first subpopulation was selected using the purposive sampling technique and that from the second subpopulation was selected using the proportional random sampling technique. The data were collected through questionnaires, a paper-and-pencil test, and a performance test. The data were analyzed using the descriptive technique and the LISREL model analysis. The results show the following. First, the construct model consists of the learning style construct, personality construct, and competency construct. Second, there is a positive and significant relationship between students' personality and learning style, students' learning style and personality, students' learning style and vocational competency, and there is a negative and significant relationship between students' personality and vocational competency. The model of vocational competency development fits the empirical data. Third, the model of vocational competency assessment consists of three components, namely personality, learning style, and competency. The model is called the PLC model.

Keywords: assessment model, competency, vocational school

1. Introduction

Vocational education is an educational subsystem that specifically helps learners prepare themselves for jobs. Finch & Crunkilton (1979) explain that vocational education emphasizes the development of skills, performance, and preparation for jobs. It is related not only to the development of skills, but also to that of all competency that learners possess to express themselves in jobs. According to Wenrich (1974), all competency that can be developed includes all domains belonging to learners, namely knowledge, skills, and work attitudes, while learners' potentials include feeling, sight, thought and action. Therefore, vocational education is directly related to the way of empowering all potentials belonging to learners in order that they possess certain competency.

Empirical observations by Ministry of National Education (2004) show that most vocational high school graduates in Indonesia are not only unable to adapt themselves to the development of science and technology, but also unable to develop themselves and their careers in the workplace. This shows that they have not acquired necessary competency. According to Boud & Solomon (2001), competency refers to an ability to demonstrate what one has acquired before.

Competency attainment depends not only on the effective implementation of a learning model, but also on the assessment system. Through an integrated assessment system, schools obtain accurate information on the learning quality so that they can make up for the weaknesses. Thus, assessment plays an important role in controlling the quality of education.

Assessment is supposed to reflect understanding of integrated learning. Assessment of vocational competency can be accurately carried out if it includes knowledge, skill, and work attitude aspects. Besides, assessment can also be viewed from a variety of determinant factors directly related to competency attainment, such as a learning model and students' personality characteristics. Thus, a comprehensive description of students' quality can be obtained. In this regard, this article discusses a model of effective competency assessment and components that constitute a model of vocational competency assessment of industrial engineering students of vocational high schools. The discussion on concepts, theories and facts about the model, assessment, vocational competency is presented below.

In general, a model can be defined as a physical replication that describes a fact (Sukardi, 2006). John J.O.I Ihalauw (2000) explains that a model is concept pragmatically displayed. T. Raka Joni (1984) describes a model more fully that it can be an instrument (tool), procedure, or new system. Therefore, a model can be defined as a result of the simplification of a complex process and system so that it is easy to understand and explain.

In the context of assessment, Nitko (1996) states that assessment is different from evaluation. Assessment refers to a process of obtaining information, while evaluation refers to a process of judging performance quality. According to Stark & Thomas (1994), assessment can be defined as a process of collecting data to identify the extent to which the performance of an institution or its units can attain the objectives, while according to Borg & Gall (1983) evaluation is a process of making a decision on meaning or value of an educational program, project, material, and technique. Thus, assessment focuses on the data collection process, while evaluation focuses on the decision making.

The main concern underlying the development of an assessment model is finding constructs to measure. The assessment model is then developed on the basis of the constructs and their interrelations. In this context, the main construct to measure is competency.

Substantially, Garavan & McGuire (2001) explain that competency can be viewed from the two aspects, namely individual's attributes and learning outcomes. From the former, competency is defined as one's knowledge, skill, and ability that result in performance. From the latter, it is defined as the extent to which one's performance has satisfied the necessary standard. Hoffman (1999)

states that a complex job can employ the concept of competency as an individual's attributes, while a simple job can use the concept of competency as learning outcomes.

Broadly speaking, there are two types of competency, namely the generic competency and the specific or technical competency. The former, according to Wood & Lange (2000), includes the writing, numeracy, communication, problem solving abilities and the social skill. Nordhaug (1998) explains that the latter consists of knowledge of method, process, and technique designed to accomplish particular tasks and abilities to use tools and equipment. According to Harris, Gutrie & Hobart (1995), competency in the educational perspective is measured in terms of three separate aspects, namely knowledge, skill, and work attitude and it refers to specific and technical competency. The discussion on knowledge, skill, and work attitude is presented below.

Boyett & Boyett (1998) define knowledge as understanding of how something works and skill as an ability to apply knowledge to put something into reality. Attitude, according to Saifudin Azwar (1988), consists of knowledge, emotion, and behavior. Feldman (1993) states that knowledge refers to one's thought of and belief in an attitudinal object, emotion to feeling of an attitudinal object, and behavior to desire to act. A combination of knowledge and emotion can determine one's affective level. A high affective level makes one act. Sax (1980) states that attitude has an element of consistency. An attitude is a strong emotion to respond to an attitudinal object consistently. Therefore, attitude can be defined as a level of emotion that makes someone act. The action is stimulated by a strong and stable emotion. This means that an attitude has a characteristic of consistency to determine an action choice.

The affective domain according to Bloom's taxonomy (Woolfolk & Nicholich, 1984) has five objectives. They include receiving, responding, valuing, organizing, and characterizing. The process in which someone responds to an attitudinal object starting from receiving, responding, valuing, organizing, to characterizing reflects a careful choice of action. On the basis of a study on the concept of competency comprising knowledge, skill, and attitude, it can be concluded that competency in machinery practice consists of knowledge of the principle of operating a tool machine, knowledge of the procedure of operating a lathe machine and a milling machine, the skill of operating a lathe machine and a milling machine, work accuracy, and work consistency.

The competency attainment depends on the learning quality (learning style). The learning style, according to Hermanussen, DeJong & Wierstra (2000), is a combination of several learning activities applying certain teaching-learning situations. It is a key to developing performance (DePorter & Hernacki, 1999). Meanwhile, Aiken (1999) states that learning outcomes are influenced by personality. Therefore, competency can be explained by the learning style construct. A study conducted by Semejin, Boone, Velden & Witteloostuijn (2000) concluded that there is a linear relationship between the personality construct and the work achievement; meanwhile, a study by Ackerman & Heggstad (1997) showed that there is a positive correlation between one's personality and ability. Oaks, Ferris, Martocchio, Buckley, & Broach (2001) found out that one's

personality and ability can influence one's skill. On the basis of the results of several studies, it can be stated that competency can be explained by the personality construct. Therefore, theoretically there are two dominant constructs to explain competency, namely the learning style and the personality.

In the context of technical and vocational education, the work-based learning style is relevant to be applied in vocational high schools, because according to National Technical and Vocational Education and Training Program (1996), vocational education is directly related to preparing one to enter the job market. Boud & Solomon (2001) define work-based learning as a learning activity applying certain learning situations and directly related to work. This is relevant to the learning concept by Bower & Hilgard (1981) who state that learning is a process of acquiring knowledge through experience involving five senses. Therefore, it can be stated that real learning is learning in the work environment.

The optimum application the work-based learning concept will influence students' competency. The change in knowledge, practical experience, and personality can be acquired when one faces a situational change. In challenging situations and conditions, learners try to look for opportunities to obtain direct guidance from the instructor and their smarter peers. In society, through active processes of acquiring information, knowledge, and experience, which are problematic, complex, and situational, learners can develop their basic potentials to the optimum. In other words, the greater and more complex the work challenge is, the more optimally learners can utilize their potentials. Therefore, they not only can acquire new and practical experience, but also can develop new creativity. This means that work-based learning is characterized by work challenge, new experience, and work creativity.

This study involves the personality construct. In the learning theory context, there are four personality constructs, namely locus of control, type A behavior, self-monitoring, and sensation seeking (Semeijn, Boone, Velden & Witteloostuijn, 2000; Aiken, 1999). According to Aiken (1999) the four personality constructs influence learning outcomes.

In relation to the first personality construct, Pervin (1989) states that locus of control refers to the ability to control events in life. The events are related to anything occurring to someone. In the context of education, the events are related to achievement and performance attained by learners. Specifically, Aiken (1999) states that when one feels that he is being controlled, he will point to internal and external directions. The directions are often called the directions of attribution. A person with internal characteristics, according to Semeijn, Boone, Velden & Witteloostuijn (2000) believe that a success depends more on internal factors than on external factors; on the other hand, a person with external characteristics believe that a success depends more on external factors than on internal factors. Therefore, a locus of control refers to the directions of attribution when one controls his learning achievement and work performance.

In relation to the second personality construct, Semeijn, Boone, Velden & Witteloostuijn (2000) explain that type A behavior refers to behavioral patterns belonging to one who is in a hurry, impatient, and always tries to attain excellent achievement in a short time. Feldman (1993) explains that a person with type A

behavior is characterized by competitive, time-valuing, aggressive, and hard-working characteristics, and dislikes being disturbed when accomplishing work. Meanwhile, Aiken (1999) explains that characteristics of type A behavior are aggressive, competitive, and hard-working. Therefore, a person with type A behavior has six main characteristics, namely hard-working, aggressive, competitive, time-valuing, fond of achievement, and seriously-working.

In relation to the third personality construct, Aiken (1999) defines self-monitoring as a procedure for self-observation and refers to one's sensitivity to the environment. Meanwhile, Feldman (1993) defines self-monitoring as a tendency to change behaviors in order to perform better in certain social situations. Feldman's opinion signifies that one with a self-monitoring characteristic has an adaptive ability. This is supported by Semeijn, Boone, Velden & Witteloostuijn (2000) who state that self-monitoring refers to one's ability to adapt himself to the environment or certain situations he is facing. In other words, the adaptive ability is identical to the ability to develop relationships with other people. This means that self-monitoring refers to one's sensitivity and adaptive ability to the situations he is facing when he is trying to change his behaviors and develop relationships with other people in the new situations.

A person with high self-monitoring, according to Pervin (1989), is one who is very sensitive to situations. Specifically, Pervin states that one of the self-monitoring types has a sensitivity to an expressive behavior that he wants in a different situation and shows his expressive behavior in accordance with social needs. Therefore, self-monitoring has two main characteristics, namely sensitiveness and adaptiveness.

In relation to the fourth personality construct, Aiken (1999) states that sensation seeking is characterized by a self-prominence and a strong character. Semeijn, Boone, Velden & Witteloostuijn (2000) explains sensation seeking is related to motivation to make sensation. A person with strong sensation seeking, according to Semeijn, Boone, Velden & Witteloostuijn, always try to seek new experiences and varied, exciting events. Such a person is identical to one fond of new challenges. Therefore, sensation seeking has two main characteristics, namely fondness for new challenges and expression of motivation-arousing behaviors. In accordance with the context of the discussion on personality above, it can be concluded that personality is a certain character one possesses that consistently directs his behaviors in every new different situation. Personality has eleven characteristics, namely direction of attribution, hard-work, aggressiveness, competitiveness, time-valuing character, fondness for achievement, work seriousness, sensitivity, adaptiveness, fondness for new challenges, and expression of motivation-arousing behaviors.

The learning style and personality variables were modified in the names and the number of indicators. The modification was made after the factor analysis was done. The modification of the names was made in accordance with the instrument items constituting the factors. The aim was to obtain the best instrument construction. The names and the number of indicators were established through the expert judgment method. The modification of the learning style

indicators is presented in Table 1 and that of personality indicators is presented in Table 2.

Table 1. Factors/Indicators of Learning Styles before and after Modification

No.	Previous Names	New Names
	Indicators	Indicators
1.	Work Challenge	Creativity Development
2.	New Experience	Innovative Experience
3	Work Creativity	Skill Development

Table 2. Factors/Indicators of Personality before and after Modification

No.	Previous Names	New Names
	Indicators	Indicators
1.	Direction of Attribution	Achievement Motivation
2.	Hard work	Responsiveness
3.	Aggressiveness	Adaptiveness
4.	Competitiveness	Progressiveness
5.	Time-valuing Character	Work Spirit
6.	Fondness for Achievement	Enthusiasm
7.	Work Seriousness	Self-confidence
8.	Sensitiveness	Work Commitment
9.	Adaptiveness	
10.	Fondness for New	
11.	Challenge Enthusiasm	

Table 1 shows that through the instrument validation the names of the three learning style indicators are modified but the number remains the same. Table 2 shows that, besides the modification of the names of the personality indicators, the number becomes smaller, from 11 indicators to 8 indicators.

In line with the theoretical review, conceptual framework, and validation result, research hypotheses are formulated as follows:

1. The work principle knowledge (Y_{12}), work procedure knowledge (Y_{13}), lathe practice skill (Y_{14}), milling practice skill (Y_{15}), work accuracy (Y_{16}), and work consistency (Y_{17}) are valid indicators of vocational competency (η_3).
2. The creativity development (Y_1), innovative experience (Y_2), and skill development (Y_3) are valid indicators of learning style (η_1).
3. The achievement motivation (Y_4), responsiveness (Y_5), adaptiveness (Y_6), progressiveness (Y_7), work spirit (Y_8), enthusiasm (Y_9), self-confidence (Y_{10}), and work commitment (Y_{11}) are valid indicators of personality (η_2).

4. There is a positive and significant relationship between students' learning style (η_1) and vocational competency (η_3).
5. There is a positive and significant relationship between students' personality (η_2) and vocational competency (η_3).
6. There is a positive and significant reciprocal relationship between students' learning style (η_1) and personality (η_2).

2. Research Method

This study was a research and development study aiming to find out a model of vocational competency assessment. The problem under investigation was a model of developing students' competency and a model of assessing students' vocational competency. This study focused on lathe and milling practice competencies. The assessment model was developed in accordance with the empirical findings on the competency development model consisting of a model of assessing the competency construct, a model of measuring the construct determining the competency, and a structural model.

The research population consisted of two subpopulations, namely (1) engineering and vocational education experts, machinery practice instructors, and industry practitioners, and (2) students of Industrial Engineering Vocational High Schools in Surakarta. The sample from subpopulation (1) was selected using the purposive sampling technique; it consisted of nine vocational education experts, six machinery practice instructors, and two industry practitioners who were involved in the research instrument validation. The sample from subpopulation (2) was selected using the proportional random sampling technique; it consisted of 607 students from vocational high schools accredited A and B. The data collection aimed to (1) validate the instruments, and (2) test the model of competency development. The data collection for instrument validation employed questionnaires administered in two periods, and the model testing employed a questionnaire, a paper-and-pencil test, and a performance test. The data on the former were analyzed using the descriptive technique, while the data on the latter were analyzed using the LISREL model analysis.

3. Research Findings and Discussion

a. Research Findings

The study shows the following findings. First, the construct model consists of the learning style construct, the personality construct, and the competency construct. The learning style construct consists of indicators of creativity development with a factor loading (λ) of 0.603, innovative experience with a factor loading (λ) of 0.577, and skill development with a factor loading (λ) of 0.02; the personality construct consists of indicators of achievement motivation with a factor loading (λ) of 0.780, responsiveness with a factor loading (λ) of 0.335, adaptiveness with a factor loading (λ) of 0.190, progressiveness with a factor loading (λ) of 0.375, work spirit with a factor loading (λ) of 0.08, enthusiasm with a factor loading (λ) of 0.452, self-confidence with a factor

loading (λ) of 0.307, and work commitment with a factor loading (λ) of -0.05; and the vocational competency construct consists of indicators of work principle knowledge with a factor loading (λ) of 0.631, work procedure knowledge with a factor loading (λ) of 0.540, lathe skill with a factor loading (λ) of 0.221, milling skill with a factor loading (λ) of 0.316, work accuracy with a factor loading (λ) of 0.178, and work consistency with a factor loading (λ) of 0.222. Second, there is a positive and significant relationship between students' personality and learning style with a relation coefficient (β) of 0.564; there is a positive and significant relationship between students' learning style and vocational competency with a relation coefficient (β) of 0.905; and there is a negative and significant relationship between students' personality and vocational competency with a relation coefficient (β) of -0.840. The model of vocational competency development fits the empirical data, indicated by χ^2/df as big as 3.15; the deviation of parameter values (RMSEA) is 0.062; the indices of the GFI and AGFI model fits are 0.929 and 0.907 respectively. Third, the model of vocational competency assessment consists of three components, namely personality, learning style, and competency. This model is called the PLC model and presented in Figure 2.

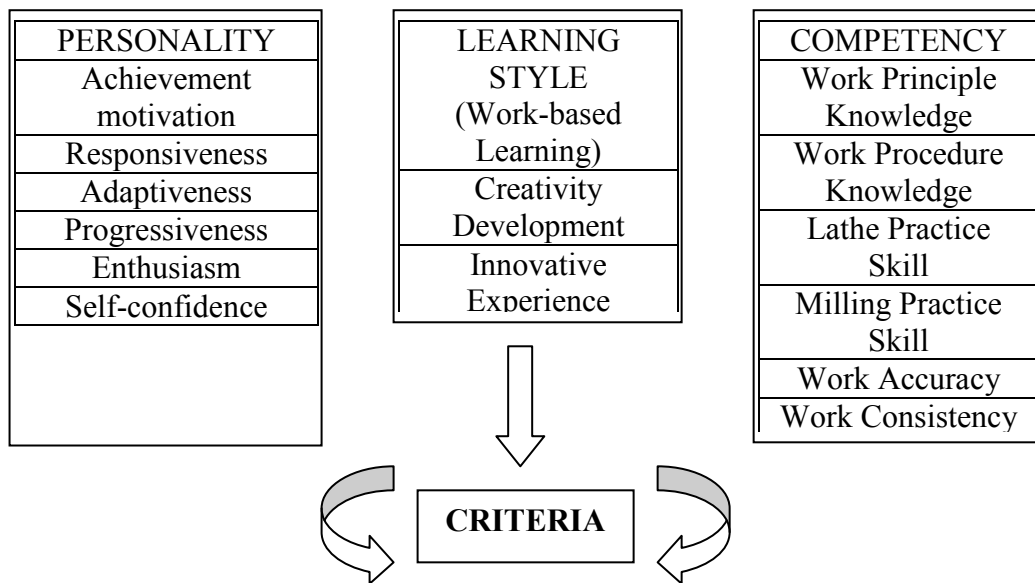


Figure 2. The PLC Assessment Model

b. Discussion

In relation to the measurement model, the research findings show that all the six indicators of the vocational competency are valid. Concerning the learning style construct, there is one invalid indicator, namely the skill development with a factor loading (λ) of 0.02, while concerning the personality construct, there two invalid indicators, namely the work spirit with a factor loading (λ) of 0.08 and the work commitment with a factor loading (λ) of -0.05. Those indicators are not valid because their t-values are less than 1.96.

In relation to the structural model, the research findings show that there is a positive and significant relationship between learning style and vocational competency, personality and learning style, and learning style and vocational competency. However, the relationship between personality and vocational competency is negative and significant with a β coefficient of 0.840 ($t = -9.132$; $p = 0.05$). The empirical fact does not fit the hypothesis stating that there is a positive and significant relationship between personality and competency. This study then analyzed the data from the research sample and found out that in vocational high schools accredited A there is a positive and significant relationship between personality and competency, while in schools accredited B there is a negative and insignificant relationship between personality and competency. In relation to this finding, in practice it is necessary for teachers and instructors to design a learning process that provides students with opportunities to develop personality and competency in the form of complex and challenging tasks. The factor of the measurement generalization can be a cause for the negative relationship between personality and competency, especially in the measurement of the practice skill aspect. According to Brennan (1983), the measurement generalization measurement depends on the qualities of the instruments, raters, and learning/practice environments. These factors simultaneously determine the data accuracy. To measure students' practice performance, this study employed rating scales. The good quality of the performance test instrument does not guarantee the accuracy of the obtained data. The rater factor plays an important role when the raters assess students' practice performance. The data accuracy is better when the observations are made by the same rater on the same observed object. However, this does not guarantee the data quality, because, according to Brennan, the room lighting factor and the condition of the room for learning and practice can influence the accuracy in the observation of students' practice performance. In this study, the observations on the students were made by the teachers or instructors in their respective schools, comprising 8 vocational high schools. Therefore, the negative and significant relationship between personality and competency may result from such factors as the school status, the rater, and the condition of the learning setting.

The research findings also show that there is a positive and significant between learning style and competency with a β coefficient of 0.905 ($t > 1.96$; $p = 0.05$), and there is a positive and significant between learning style and personality with a β coefficient of 0.602 ($t > 1.96$; $p = 0.05$). This indicates that the learning style plays a strategic role in preparing the students, because on the one hand it can develop their competency and on the other it can develop their personality. Therefore, the more complex and interesting the tasks designed by the teachers are, the more opportunities the students can get to develop their competency and personality.

In relation to the assessment model, the research findings show that the model of vocational competency assessment consists of three components, namely competency, personality, and learning style. An effective assessment of the students' vocational competency should focus on the indicators of competency, namely knowledge of work principle and work procedure, lathe and milling

practice skills, and work accuracy and consistency. The assessment of the students' competency should be conducted not only on the competency as a learning outcome but also on the factors determining the competency, namely learning style and personality. The focus of the assessment of the students' learning quality is on the indicators of creativity development, while that of the students' personality is on the indicators of achievement motivation, responsiveness, adaptiveness, progressiveness, enthusiasm, and self-confidence.

The Ministry of National Education (2007:1) sets the criteria for the assessment of the students' competency; a score of 7 is in the good category, a score of 8 is in the very good category, and a score of 9 is in the excellent category. The assessment of students' learning style and personality is norm-referenced, on the basis of S_{Bi} and M_i , namely $S_{Bi} = 1/6$ (highest score – lowest score) and $M_i = 1/2$ (highest score – lowest score). If a student obtains a score $> M_i + 1.5 S_{Bi}$, his score is very high; a score between M_i and $M_i + 1.5 S_{Bi}$ is high; a score between M_i and $M_i - 1.5 S_{Bi}$ is low; and a score $< M_i - 1.5 S_{Bi}$ is very low.

4. Conclusions

Based on the research findings and discussion, the following conclusions can be drawn.

1. The vocational competency construct consists of six indicators, namely work principle knowledge, work procedure knowledge, lathe practice skill, milling practice skill, work accuracy, and work consistency.
2. The learning style construct consists of two indicators, namely creativity development and innovative experience.
3. The personality construct consists of six indicators, namely achievement motivation, responsiveness, adaptiveness, progressiveness, enthusiasm, and self-confidence.
4. There a positive and significant reciprocal relationship between students' learning style and their personality; there a positive and significant relationship between students' learning style and their vocational competency; there a negative and significant relationship between students' personality and their vocational competency.
5. The model of vocational competency assessment as the main research finding is called the PLC model consisting of 3 components, namely personality (P), learning style (L), and competency (C). The personality consists of six factors, namely achievement motivation, responsiveness, adaptiveness, progressiveness, enthusiasm, and self-confidence. The learning style is an implementation of a learning model oriented to practice (work-based learning), namely lathe and milling practices. The learning style consists of two indicators, namely skill development and innovative experience. The competency consists of six indicators, namely work principle knowledge, work procedure knowledge, lathe practice skill, milling practice skill, work accuracy, and work consistency.

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