

# Students' Employability Skills of Industrial Working Practices for Construction Drawing Engineering at the Engineering Education

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## Students' employability skills for construction drawing engineering in Indonesia

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**ABSTRACT:** The aim of this study was to examine the employability skills of construction drawing engineering students in construction drawing engineering in industrial working practices in Indonesia. This is very important in improving productivity in the workplace. The sample consisted of 124 vocational high school students selected by proportional random sampling. Data analysis used descriptive analysis, matched-pairs Wilcoxon test and multivariate analysis. The results showed that the students' employability skills were categorised as *good* with a *low* discrepancy of 25.82% according to the industrial perspective and 20.81% according to the students' perspective. Furthermore, the employability skill indicators giving a significant difference were higher-order thinking skills and the personal qualities of the students.

### INTRODUCTION

Human resources are most important for economic development, and hence should be given priority for creating a prosperous and competitive country [1][2]. One of the ways to improve human resources is through quality education. Indeed Goetsch and Davis [3] state that the quality of the educational system of a country is the main factor determining labour quality, i.e. the quality of the educational system will strongly determine the quality of labour [4].

A preliminary study of vocational high schools in Yogyakarta Special Regency, Dewangga, Indonesia showed that the employment rate of vocational high school graduates was 70%, while 7.34% were self-employed, e.g. as entrepreneurs [5]. This rate is still not satisfactory since the employment rate should be 80 to 85% [6]. A challenge to be overcome is that the quality of graduates' competencies is considered to be low. The government, through vocational education, attempts to design educational programmes to respond to, and anticipate, the needs of the labour market [7].

An Indonesian Government learning programme related to students' competences involves industrial working practice. This Dual System Education (DSE) vocational educational programme involves basic theory and practice being taught in vocational schools with the skills further developed through work experience in real workplaces [8][9].

Sudira states that *industrial working practices* is a learning strategy with work-related learning [7]. This work-related learning is implemented in the workplace as a direct learning process in real work situations, i.e. on-the-job learning. In this context, students learn by performing tasks exactly as a real worker. This work-connected and work-integrated learning can mean a professional attitude to work is developed. This industrial working practice is organised by vocational education with an industrial partner to provide self-development for students by working in real workplaces [10]. The goal of this programme is to facilitate vocational high schools in adjusting learning content and work behaviour to suit the needs of the workplace. In other words, the aim of this programme is to develop students' abilities and skills to suit those required for real jobs, so that the students are *workplace ready*.

The quality of vocational high school graduates is closely related to the learning process, which is influenced by many factors. The curricula, teachers, facilities, infrastructure, school environment and industrial environment are factors that affect the quality of graduates [11]. Sudira opined that vocational high school graduates can achieve the required quality, if they are equipped with the technical knowledge, skills and attitude required by the marketplace [7].

Students need an education and training system that can provide useful knowledge, skills, working attitude and experience in order to find a suitable job for their future careers [12]. In this context, the vocational high school through industrial working practices develops the students' employability skills in accordance with the needs and changing requirements of the job market.

Employability skills are needed in every workplace in industry; knowing the employability skills required by industry is very important for vocational students. Rasul et al argue that three employability skills considered very important by industry are interpersonal skills, thinking skills and personal quality skills [13].

Interpersonal skills are related to the ability to interact and communicate effectively in the workplace. Thinking skills relate to creative and innovative thinking, and the ability to make decisions, solve problems, analyse, learn and give feedback. Personal quality skills are related to personal values, such as a self-esteem, socialisation, self-management, responsibility, integrity, safety and awareness. These values contribute to a harmonious and productive workplace and the ability to develop good relationships with customers. The students' employability skills for industrial working practices are communication skills, the higher order thinking skills and personal skills.

During industrial working practice, students may require additional learning material or information, while they are in industry. This can be provided by multi-media e-learning to facilitate the delivery of learning, while students are still in industry placements.

## METHODS

This research was a quantitative survey using the discrepancy evaluation model (DEM) [14] to measure the level of conformity or discrepancy to the ideal in vocational school students' performance in industrial working practices. The ideal performance is based upon real conditions doing industrial work, with performance based upon the relevant theory and industrial requirements. The locations were construction drawing engineering companies, where students were placed for field training for four months, from August to December 2016.

The subjects of this study were 192 students from vocational high schools and in construction drawing engineering in Yogyakarta and Sleman Regencies, Indonesia. Of the total, 124 students were selected by proportional random sampling.

Data were collected by questionnaire with the answer to each question having four options, viz. 4 - always, 3 - often, 2 - sometimes and 1 - never. The research instrument is presented in Table 1.

Table 1: The research instrument.

Variable	Indicators	Including
Employability skills	Fundamental communication skills	Communication and information management
	Higher order thinking skills	Continuous learning, make a job priority, problem-solving, decision making, creative thinking, manage conflict, resolve conflicts
	Personal qualities	Work commitment, interpersonal relationships, time management, self-management, discipline, obedience, honesty, teamwork, independence, initiative, confidence, leadership, hard work, work safety and health

Construct validity was used in the research, by analysing the exploratory factors using IBM SPSS Statistics 20. The exploratory factor analysis (EFA) was used to test the items in the questionnaire to determine the students' employability skills' indicators in industrial working practices.

The result showed that the KMO (Kaiser-Mayer-Olkin) index  $0.801 \geq 0.60$  met the KMO index minimum requirement. The significance value of Bartlett's test was less than 0.05. Thus the correlation matrix is not an identity matrix and factor analysis can be used. The 40 questionnaire items were valid and reliable with a Cronbach alpha value of 0.956.

Applied in the research was a descriptive and multivariate analysis. The descriptive analysis described the students' employability skills in accordance with the determined criteria. The multivariate analysis was used to determine, if there was a difference in the vocational school students' employability skills in industrial working practices according to industry assessment.

The criteria of employability skills assessment were divided into four categories: very good, good, fair and bad. The categories of discrepancy criteria consisted of none, very low, quite high, high and very high.

## RESULTS

The result of the descriptive analysis and Wilcoxon matched pairs test of students' employability skills based on the three indicators, which are fundamental communication skills, higher order thinking skills and personal qualities is summarised in Table 2.

Table 2: The result summary of the descriptive analysis and Wilcoxon matched pairs test.

Indicators of the employability skills	Mean		Category	Gap (%)		Gap category
	Industrial needs	Students' performance		Industrial needs	Students' performance	
Fundamental communication skills	72.29	79.35	Good	27.71	20.65	Low
Higher-order thinking skills	70.41	75.85	Good	29.59	24.15	Low
Personal qualities	76.14	80.39	Good	23.86	19.61	Low and very low

The gap values of indicators of students' employability skills assessed by the industry are larger than the gap values assessed by students themselves. It shows that industry considered that the students had lower employability skills relevant to industry. The gap between the results for industry and students can be seen in Figure 1.

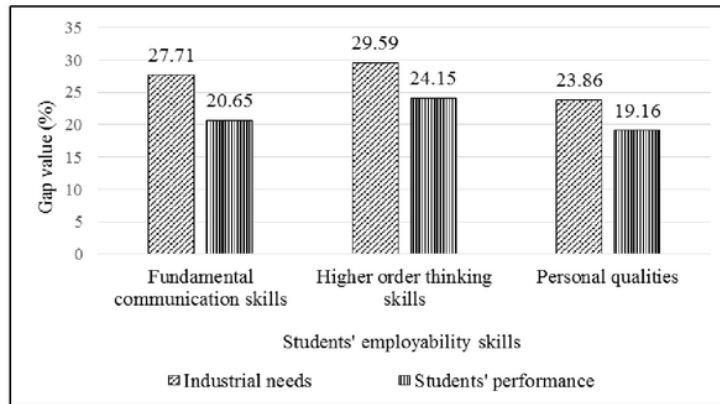


Figure 1: The gap values for employability skills between industrial needs and student performance.

A multivariate analysis was used to find out whether there was a significant difference in students' employability skills between industrial needs and student performance. The schools involved in the research were vocational high schools in the Yogyakarta and Sleman Regencies, Indonesia, viz. Public Vocational High School 2 Yogyakarta, Public Vocational High School 3 Yogyakarta, Public Vocational High School 2 Depok and Public Vocational High School 1 Seyegan.

The data were tested for variant and covariant homogeneity. The two homogeneity tests used were the variant equality test (Levene's test) and covariant equality test (Box's M test). The results of the homogeneity tests are summarised in Table 3.

Table 3: Summary of the homogeneity tests.

Indicators of employability skills	Levene's test (Sig. > 0.05)	Box's M test (Sig. > 0.05)
Fundamental communication skills	0.000	0.070
Higher order thinking skills	0.004	
Personal qualities	0.014	

In Table 3, Levene's test results on students' employability skills was not significant since results for employability skills were all less than 0.05; thus variant equality homogeneity had not been demonstrated. On the other hand, Box's M test shows an equality of covariant values with the significance level of 0.07, which is greater than 0.05; thus demonstrating covariant equality homogeneity. According to Trihendadi, a multivariate analysis is valid since one of the equality requirements had been met [15].

The multivariate analysis result showed a significance value of 0.021 for Wilk's lambda. The criteria used is that there was a difference if the significance was less than 0.05 [16]. Therefore, it can be concluded that there is a significant difference in students' performance between vocational high schools in the drawing construction engineering competence in industrial working practices. The between-subjects effects are presented in Table 4.



Table 4: The summary of the homogeneity tests.

Indicators of the employability skills	Tests of between-subjects effects (Sig. < 0.05)	Results
Fundamental communication skills	0.322	There is no a significant difference
Higher-order thinking skills	0.045	There is a significant difference
Personal qualities	0.005	There is a significant difference

Table 4 shows that the indicators of employability skills with significant differences were the higher-order thinking skills (sig.  $0.045 < 0.05$ ) and personal qualities (sig.  $0.005 < 0.05$ ). The students' fundamental communication skills (sig.  $0.322 < 0.05$ ) were not significant different for students from Public Vocational High School 2 Yogyakarta, Public Vocational High School 3 Yogyakarta, Public Vocational High School 2 Depok and Public Vocational High School 1 Seyegan.

## DISCUSSION

### Employability Skills

The gap values of students' employability skills was 25.82% and 2.81% according to students' self-assessment, which is a *small gap*. The gap was in fundamental communication skills, higher-order thinking skills and personal qualities as the indicators of students' employability skills in field industrial training.

In industrial working practices, students try to learn to take advantage of work opportunities to make them valuable to the company by having skills, knowledge and an attitude relevant to the industry. Makgato explains that to ensure success in an engineering field an engineer should have basic technical skills needed for the job, and non-technical skills in order to be able to develop as a professional engineer in the company [17]. As explained by Mannan, technical skills along with the non-technical skills, in this case employability skills, are fundamental for an engineer to be successful in his or her career [18].

The findings are similar to the results of Burgaz's research, who explains that competence in the labour market not only depends on vocational competences, in this case technical skills, but also on employability competences, which can support career development and adaptation to changes in society, technology and organisations [19]. This is relevant to vocational schools, which play an important role in providing skilful workers to fulfil industry needs. Therefore, the education programmes should equip students with technical and employability skills to meet work demands and professional expectations [20].

Employability skills play an important role in supporting individuals in work. Zaharim et al state that vocational school students should be equipped with employability skills to make them competitive, employable and successful in their profession [21]. In relation to vocational education, the industry would like employability skills included in the curriculum. This is because employability skills are important in preparing students for the labour market [13].

### Fundamental Communication Skills

The students' fundamental communication skills according to the results of the descriptive analysis had a mean score of 72.29 out of 100 according to the industry assessment, and 79.35 out of 100 according to the students' self-assessment, the score category being *good*. The Wilcoxon matched pairs test showed that there is a gap between fundamental communication skills of students in industrial work training according to the industry assessment and students' self-assessment.

The gap in the fundamental communication skills was 27.71% according to the industry assessment and 20.65% according to students' self-assessment, which falls into the *small gap* category. The gap is in the students' skills relates to the ability to discuss in order to complete work and to manage or to interpret a message or information in order to give accurate feedback.

In industrial working practice, students try to learn to communicate and manage information in doing work tasks allocated by student advisors in the industry. Students understood how to do work tasks through effective communication both with the advisor and workers in the industry environment.

Riemer states that communication skills are the important component in vocational education to prepare students for their future careers [22]. Therefore, engineering graduates need to continuously improve their verbal/non-verbal/visual/multi-language communication skills to maintain relevance in the 21st Century.

Oral communication and listening skills are needed to understand verbal communication in the workplace. Mastery of visual communication skills may be needed in certain professions to produce visual material as a means of communication.

Students tended to be slow to finish work even though the work was well-done. Difficulties and problems faced were not communicated by the students to their industry advisors. Hence, work could not be finished on time. Students need to discuss work completion in relation to the problems and steps needed, so that students will be able to work to achieve an accurate result within the time limit set by industry. Besides, students need to communicate confidently so they can interact easily and appropriately and respond to every message or communication. Rasul et al stated that in relation to fundamental communication skills, employers felt that understanding instructions, listening and verbalising are important in the workplace [13]. Therefore, institutions and schools should place a strong emphasis on the curriculum related to effective communication in the workplace.

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#### Higher-order Thinking Skills

The students' higher-order thinking skills as a result of the descriptive analysis had a mean score of 70.41 out of 100 according to the industry assessment and 75.85 out of 100 according to the students' self-assessment, which falls into the *good* category.

The result of the Wilcoxon matched pairs test showed that there was a gap between the students' higher-order thinking skills in industrial working practices of 29.59% according to the industry assessment and 24.15% according to the students' self-assessment, which falls into the *low* category. The gap is in the students' ability to think creatively in showing picture designs, both in two- and three-dimensions.

In industrial working practices, students can optimise their higher-order thinking skills by finishing work tasks that form an important base from which to build success in the future. Students perceived that the tasks were an opportunity to learn and practice, so that they are able to renew their skills and improve their personal work quality. If they have complex problems, they could try to find a way forward and take initiatives to overcome the problems through consultation with student advisors. Rojewski states that vocational education needs to prepare students to solve real problems logically and rationally, and investigate alternative solutions. This enables students to adapt to work changes, fulfil their personal needs, participate in society and prepare for life [23].

Sandra explains that vocational schools need to be involved in developing students' higher-order thinking skills. The vocational school plays a key role in developing the cognitive skills needed for a productive, complete and satisfying life [24].

Higher-order thinking skills are needed because:

- 1) work depends more on cognitive capability;
- 2) changes to the working environment require flexibility and adaptive skills;
- 3) vocational education provides a real word context for cognitive development.

Students need to use software to creatively design pictures. Therefore, they must be able to apply good drawing techniques to produce picture designs with good spatial organisation, including innovative 3D building models. This research can be a source of information about students' capacity for innovative and creative thinking.

#### Personal Qualities

The personal qualities according to the descriptive analysis had a mean score of 76.14 out of 100 according to the industry assessment and 80.39 out of 100 according to the students' self-assessment, which falls into the *good* category.

The result of the Wilcoxon matched pairs test showed that there was a gap between the vocational school students' personal qualities in industrial working practices of 23.86% according to the industrial assessment and 19.61% according to the students' self-assessment. The industrial assessment gap was in the *low* category, whereas the students' self-assessment gap was *very low*.

The gap relates to students' skills to initiate, to be disciplined in finishing work to a deadline, in leadership in controlling and managing work tasks, managing work completion and being independent by performing tasks with minimal help from others.

In industrial working practices students try to develop good personal qualities as a worker. The students were very diligent and could finish work supported by mastery of the AutoCAD and SketchUp software systems. They had a strong motivation to adapt in the face of new technologies in the working environment. Their confidence in building good interpersonal relations increased and they showed good manners, honesty, obedience, and overall created a comfortable working environment. If there was misunderstanding about a design, students were adaptive and liaised with the advisor to ensure quality work. Students had a commitment to perform quality work by implementing the design principles and by paying attention to health and safety.

Students tended not to ask for further tasks after finishing a task. Many tasks involved design; students were not accustomed to managing their work to achieve completion within the given time limit, though students were well able to thoroughly complete the task. Therefore, students need more practice to correctly finish work tasks on-time, thus having a positive effect on the success of a project.

In this case, students need to inculcate leadership skills, so they are disciplined in work and time management. Radovic-Markovic stated that workers will face challenges in the workplace and need to motivate themselves to overcome these challenges. Thus an individual's personal qualities can lead to harmony and good relations in the workplace, and this will increase productivity [25].

Finally, based on the results of the multivariate analysis, there was a significant difference in employability skills of students between vocational schools in industrial working practices. The indicators of employability skills with the most significance are the higher-order thinking skills and the personal qualities; the fundamental communication skills are not a significant indicator for vocational school students.

The research findings show that the higher-order thinking skills and personal qualities of students in industrial working practices varies as measured by industry assessment. This is because students have different skills, knowledge, attitude and experiences learned from school.

Vocational schools should provide learning activities for students to practice solving problems in the workplace logically and rationally, while also seeking alternative solutions. This develops higher-order thinking skills and personal qualities in work. This accords with Prosser's basic principle that vocational education will be effective, if the competence training develops work and thinking habits to be able to solve problems relevant to the work needs of industry.

## CONCLUSIONS

The employability skills of vocational high school students who are studying construction drawing engineering in industrial working practices according to industrial assessment and students' self-assessment were categorised as good with small gap values of 25.2% and 20.81%, respectively. The gap is in all indicators of employability skills, viz. fundamental communication skills, higher-order thinking skills and personal qualities. These include:

- 1) the skills to finish work and interpret a message or information and give accurate feedback;
- 2) the skill to think creatively in producing a picture design in both two- and three-dimensions;
- 3) the skills to initiate and finish work tasks by a deadline, in controlling and managing work tasks and in being independent in performing tasks with minimal help from others.

There is a significant difference in the employability skills of students between vocational schools in the drawing construction engineering competence in industrial working practices in the Yogyakarta and Sleman Regencies. This is according to the industry assessment and students' self-assessment; the significance value of the result was 0.021, which is less than 0.05, showing it is significant. The between-subjects effects test showed that the employability skills of students between vocational schools are significantly different in higher-order thinking skills and personal qualities, but not in fundamental communication skills.

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