

Professional Competence Study on Student of Informatics Engineering Education Study Program at Electrical Engineering Department

Wahyu Sakti Gunawan Irianto*, Hakkun Elmunsyah, Muhammad Jauharul Fuady, Ananda Putri Syaviri

Vocational Education–Universitas Negeri Malang

Jl. Semarang 5 Malang, Indonesia 65145. E-mail: wahyu_sakti14@yahoo.com*

Abstract: This research aims to reveal the basic programming competence of Informatics Engineering students using quantitative approach with *ex post facto* method. Population in this research is student of study program of Informatics Engineering of 2013, 2014, and 2015. Technique determination of population number and sample, researcher use stratified sampling and cluster sampling. Researchers use cluster sampling with the aim to choose which clusters will be taken to be more accurate in obtaining research data. The results of this study indicate that the students' competence is very high with 0.757 and 0.748 of reliability value.

Key Words: professional competence, ability in basic computer programming, test instruments, questionnaire instruments

Abstrak: Penelitian ini bertujuan untuk mengungkap kompetensi pemrograman dasar mahasiswa Teknik Informatika menggunakan pendekatan kuantitatif dengan metode *ex-post facto*. Populasi dalam penelitian adalah mahasiswa program studi Teknik Informatika 2013, 2014, dan 2015. Teknik penentuan jumlah populasi dan sampel, peneliti menggunakan *stratified sampling* dan *cluster sampling*. Peneliti menggunakan *cluster sampling* dengan tujuan untuk memilih lebih akurat kelompok mana yang akan diambil dalam memperoleh data penelitian. Hasil penelitian ini menunjukkan bahwa kompetensi mahasiswa sangat tinggi dengan nilai reliabilitas 0,757 dan 0,748.

Kata kunci: kompetensi profesional, kemampuan pemrograman komputer dasar, instrumen tes, instrumen kuesioner

INTRODUCTION

New technologies, globalization, and information revolution have significantly affected the world economy, shortened production cycles, and increased productivity. High-level technology has replaced many human tasks, resulting in increased demand for knowledgeable or knowledge workers and high-skilled workers. Due to global globalization and local migration, the world has become more integrated, with more mobility from the growing field of workers and international trade (Wang Y., 2012). Globalization has created a new world order for doing business. new information and communication technology (ICT) has dramatically changed the way of life, learning and work, and even the way of

thinking about work. The synergy of combining globalization with new communication and information technology has led to the emergence of a new economy. The new economy has created new opportunities as well as new challenges and uncertainties. Many workers are displaced, while large numbers of young people become structurally unemployed from work. Polarization skills between so-called thinkers or knowledge workers and unskilled workers, low knowledge workers make up the income gap (Boutin, Chinien, Moratis, & Pet, 2009). Young men, women and senior workers are the most affected groups. While these changes have brought considerable challenges to TVET, they have created new opportunities for change and innovation (Chinien, 2003). Technological advances in the information age have displaced

manufacturing, service and workers industries, especially in developed countries, over the past two decades (Zarini, Wilson, Mar, & Varis, 2009). The higher the progress of a technology, the professionalism of workers will always be easily monitored, just as cyber communications traffic is highly monitored by networks using software (sofana, 2010; Dean, 2013; Thomso, 2011; Gregg, 2015).

It is also supported by changes from industrial age to economy age. The industrial economy is focused on transforming natural resources such as iron and crude oil into products used for cars and gasoline. Economic knowledge transforms information, expertise, and technological innovation in required services, such as medical and mobile care (Trilling & Fadel, 2009). The community is currently facing the challenge of getting an education that gives students a set of skills and knowledge needed by the labor market. Education plays a big role to empower youth for the labor market. There is a need for education to see the new realities of education in the modern world. Reality recognizes that the primary goal of education is to transform students into critical, lifelong learners (Akomolafe & Adegun, 2009).

The important problem that needs to be solved is how big the implementation of the learning in the implementation of curriculum of Informatics Engineering Education in the Department of Electrical Engineering, Universitas Negeri Malang is now in line with the needs of the community, especially the needs of the world of work, business world or industrial world. Student of Informatics Engineering Education (PTI) is also a potential practitioner of the program. As a prospective practitioner of the program, Informatics Engineering students are required to have a standard capability that must be mastered at least based on the Indonesian National Work Competency Standards in addition to pedagogical skills. In the competence test of the field of Communication and Informatics, the most basic level of competence in the field of informatics engineering is the level of Network Technician. These students levels are expected to be able to install, operate and troubleshooting small enterprise networks. Broadly speaking, the curriculum offered for computer network competence includes fundamental networking, WAN technology, basic network security and wireless concepts, routing and switching and small enterprise network configuration. Another competence capability is Junior Programming competence which become the Standard of Indonesian National Skills Competency (SKKNI).

Understanding the skills required by entry-level workers is essential for both parties, the company and the school. According to the perspective of the company hiring well-trained people allows organizations to spend less time preparing new staff, making it more efficient to include them into the workplace. In terms of education and technical institutions, understanding the necessary skills is essential for the maintenance and development of the curriculum (McMurtrey, Downey, Zeltmann, & Friedman, 2008). Based on the description above, by relating some problems from the researches that have been done, then this research is aimed to analyze the competence ability of Junior Programming in SKKNI on the implementation of PTI curriculum. Ability of Junior Programming competence that is reflected in the Basic Computer Programming Course as well as Algorithm and Data Structure in the curriculum of Informatics Engineering Education Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Malang. This competency is chosen because it has more equal impact than other competencies in this PTI study program.

METHOD

This research used quantitative approach with ex post facto method. Population in this research is student of study program of Informatics Engineering of 2013, 2014, and 2015. Technique determination of population number and sample, researcher used stratified sampling and cluster sampling. The researchers used cluster random sampling which aims at selecting more accurate cluster in obtaining research data.

Researchers used stratified sampling by dividing the sample into several strata, for example: female students and male students. The samples were chosen using randomly quota type samples because the population number is ≥ 486 so that the researcher take samples from each offering and the force that fulfill the Competence Competency standard of Algorithm and Data Structure with total sampling of 56 students.

The research instruments used are test, questionnaire, documentation, observation, and interview. Instruments used in this study include questions and questionnaires or questionnaires. First, The Test instrument. The problem was used to find out the evaluation results of the competence unit that is examined. It was used as a measuring tool to determine whether or not competent students of Informatics Engineering Education in the Department of Electrical Engineer-

ing Universitas Negeri Malang. The problem used refers to the national competence standard (SKKNI) in the field of Competency competence of Junior Programming. Question type in the research instrument is essay. The essay question is used with the consideration that the students' reasoning ability or comprehension can be truly tested. Because if only using multiple choice questions, the results obtained will not be maximal since the success rate of students is smaller.

Second instrument was students' perception measurement instruments. Perception measurement instruments was in the form of questionnaires. This instrument was used as supporting data. Researchers aimed at expressing the opinion or perception of students after taking the course Basic Computer Programming and Data Structure Algorithm. This questionnaire was used as a result, concrete evidence or a comparison tool hence students are more confident about whether their perceptions and abilities are true or not, as a result students can prepare to improve, maintain or improve their abilities. The questionnaire was in the form of check list. Using Likert Scale for measurement scale of the results of the questionnaire filling. The indicator used as reference for the respondents was validated.

Beginner competency variable Programming used is a competence element of each competency unit consisting of four main sub-variables namely (1) basic programming algorithm competence; (2) competence of data structures; (3) writing program competence; and (4) the competence of the program code documentation. The sub-variables consist of nineteen indicators.

Test instrument was validated by the material expert then analyzed the validity of item, reliability and difficulty level of item. The small group trial on the quality of the research instruments included: (1) content validity was obtained with a feasibility average of 96%; (2) the validity of the item is said to be valid if $r_{count} \geq r_{table}$; (3) the reliability obtained from the statistical results on the criteria was very high; (4) the difficulty level of item was known to be difficult 13.89% while 63.89% and easily known 22.22%; and (5) power different category very good equal to 63.89% and equal to 36.11%. (Anggrainingsih et al., 2013; Akbar, 2013)

RESULT AND DISCUSSION

The result of test instrument mapping indicates that the ability of a person in solving a problem or

work in accordance with predetermined standards or requirements include knowledge, skills or work attitude of a person is called competence. Thus the competence standard is the agreements on the competence required in a field of work by all stakeholders in the field (Decree of the Minister of Manpower and Transmigration of the Republic of Indonesia number 615, 2012).

The competency standard for the Junior Programming cluster based on SKKNI consists of 7 competence units: (1) TIK.PR01.016.01 Maintaining professional ethics; (2) ICT.PR02.001.01 Creating a basic programming algorithm; (3) ICT.PR02.002.01 Creating advanced programming algorithms; (4) ICT.PR02.003.01 Create data structures; (5) ICT.PR02.005.01 Writing a basic program; (6) ICT.PR02.020.01 Operating database application; and (7) ICT.PR02.019.01 Create the program code documentation. The working competency standard in the field of computer programmer's expertise was developed in reference to Decree of Ministry of Labor and Transmigration No.21/MEN/2007 concerning on the procedures for determining SKKNI. Standard of competence is required by several institutions or institutions related to human resource development including Department of Electrical Engineering Universitas Negeri Malang. The use of SKKNI in educational and training institutions aims to provide information for program and curriculum development as well as reference in the organization of training and certification assessment.

Based on SKKNI, the competency standard used in the Department of Electrical Engineering Universitas Negeri Malang is formulated into the scope of subject learning. The scope and achievement of learning are adjusted with description SKKNI which is result of agreement of similar study program (in field of Kominform or Infokom), and each study program can still increase the ability of their graduates in accordance with the vision and mission of Higher Education.

The competency standard used by the Department of Electrical Engineering, Undergraduate program of Informatics Engineering Education as stated in the Department Academic Catalogue 2013 is to provide knowledge and understanding to the students about the design and creation of a structured, efficient and user friendly program in C++ language to implement the algorithm as well provide knowledge and understanding to students about the concept of data structures and algorithms in programming and

apply the concept of data structures and algorithms to solve programming problems.

Competencies used in the Basic Computer Programming courses in the Department of Electrical Engineering include: (1) identifying computer programming software; (2) identify the appearance of GUI software programming; (3) introduction to C++ basic programs and elements; (4) variables: integer, float, double and character; (5) string; (6) operator and operator priority and library function; (7) I/O operations; (8) a basic statement; (9) goto, if, switch, while, do while, for, break, continue, exit; (10) functions; (11) array; (12) pointers; and (13) dynamic memory management.

Competencies used in the course of Algorithms and Data Structures in the Department of Electrical Engineering include: (1) reviewing data abstraction; (2) reviewing the concept of arrays, records and pointers (array declarations, basic array operations (creation and destruction, insertion, value retrieval, transversal and search processing) sorting, multidimensional arrays, arrays and pointers, record structures, and representation of records in memory; (4) analyzing the stack (specification, representation, and application), (5) analyzing the queue (specification, representation and application), (6) analyzing the linked list (specification, representation, and application) analyze the tree (specification, representation, and application), (8) analyze the graph (specification, representation, and application), and (9) analyze hash table.

Another result of the test scores indicate that there is a deviation on the average score of students' ability in Beginner Programming competence. Based on the Gaussian theorem, it is stated that the larger the sample the more accurate the result. The Figure 1 illustrates the data caused by the phenomena that occur in the student. The phenomena that occur in graph deviation data include (1) how the essential components of learning applied by lecturers in the lectures; (2) how students' learning ability can be implemented in daily life, and (3) students' understanding related to related materials hence students' intellectual ability can be used properly. Figure 1 shows the scores of 0, 20, 40, 60, 80, and 90. Students with a

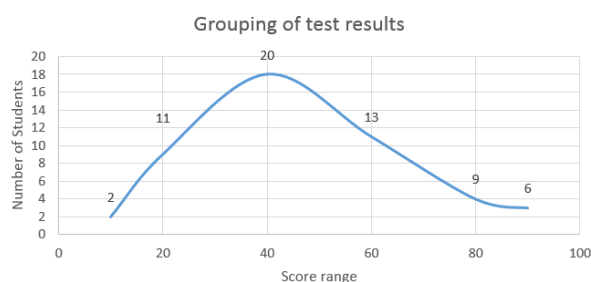


Figure 1. Distribution of Test Results

score of 0 as many as two students, score 20 as many as 11 students, score 40 as many as 20 students, score 60 as 13 students, score 80 as nine students, and score 90 as many as six students. For the range of scores in Figure 1, the result of concludes the final score of the students.

The picture shows that there is a balance between the right and the left side or also called the normal distribution (Gaussian distribution). The deviations that occur in Figure 1 either to the right or left are far from the average score of the students' ability to make the less. This proves Gauss's view that the larger the sample used the more accurate the predictions of mistakes will be. Seen from the average score of the ability of students who have conducted the competence test Junior Programming, that there is a phenomenon or error that occurs in the student, especially in terms of student competence skills. This is in accordance with the findings of several studies that there is a direct influence between academic achievement on vocational maturity. (Latifa H., 2016, Amadi, C., 2007; and Bhandari, R., 2014) Students of vocational education must keep up with the latest technological advances by not only studying at school but learning from everywhere and every time. In addition to that the students must have the determination and awareness to continue to learn and improve competence.

Based on data value from Table 1 obtained the overall average value of respondents who followed a competency test of 65.12. This indicates that it remains in sufficient category, the competence of students ability in Junior Programming competence. This is reflected in the Basic Computer Programming Course and Data Structure Algorithm because the av-

Table 1. Average Results of The Test and The Questionnaire Instrument

	The average results of the Test instrument	The average results of the questionnaire instrument	The average of both instruments
exam results	56.86	73.38	65.12

erage score is below 70. The academic value is quite low at 56.86 compared to the Junior Programming competence perception of 73.38. Illustration of students' ability measurements in three forces can be seen in Figure 1 which is consistent from the lowest and highest values in each force.

Thus, the reliability value of the instrument used is stated very high, it means that this research instrument is good enough used to measure student ability. Sub competence used as a measuring instrument in this research instrument consists of six (6) units of competence with the number of sub-competence of 26 sub-competencies and 78 indicators/criteria assessment. The six competency units include: (1) Maintaining Professional Ethics consisting of four sub competencies and 17 indicators; (2) Creating Basic Algorithm consists of four sub competencies and 10 indicators; (3) Creating Advanced Program Algorithms consists of three sub-competencies and nine indicators; (4) Creating Data Structure consists of six sub competencies and 17 indicators; (5) Basic Program Writing consists of five sub-competencies and 13 indicators; and (6) Documentation Program Code consists of four sub-competencies and 12 indicators.

This study proves that the use of competency units contained in SKKNI as a measuring tool or test can be used to measure competencies not only at the student level. In Table 2, it appears that according to the students' competence measurement instruments in different forces, the results obtained are of the same relative average. As the previous study Ardiansyah, (2013) expressed the students also can be subjected to trials for competency tests using the guidelines contained in SKKNI. In this research, the researcher successfully reveal the average ability of the students on the competence of Junior Programming, although the result is said to be below average, i.e 56.86 from the representatives of each offering in three generations.

The results of this study can also be seen that the intellectual, physical and manual competence con-

trolled by the students is very important to be considered due to the very influential on the success of the students. Evidently only three people from trials in the first small group had scores above average and only three people in large group respondents had scores above 70. As in previous studies (Octaliza, 2011 & Manihuruk, 2015). Based on research Manihuruk (2015) shows that students have low competence will also appear low intellectual, physical and manual, and interpersonal competence. Likewise with research Octaliza (2011) which proves that only some students who have high competence in all three aspects of the competence. The average of student competence is high in physical and manual competency alone which is 45.8%.

This study also proves that lectures in some courses need to be taken into account and improved, because it is the basic and compulsory (main) course that must be mastered by students as stock in the world of work that affect each other. As in the research Sugiyanto and Himawan (2009) that the certificates of competence, academic achievement, interests and supporting activities is a support for students accepted in the world of work as intern (intern) and even employees (permanent workers). With this research it can be obtained the information to note the progress of existing activities in the department to accommodate the competence or talent owned by students. It is indispensable to encourage students to continuously improve their skills in the use of information technology and media because it is indispensable for the world of work. Additionally, previous argument explains that in current advanced era, every work is integrated with ICT. Skills that must be constantly eroded include ICT literature to access information through high-level technology and skills to use technology (Westerman, G., Bonnet, D., & McAfee, A., 2014, Griffin, McGaw, & Care, The information literacy is used to obtain information from a variety of sources and manage the information for use in the workplace

Table 2. Average of Student Competency Capability

Class	Number of Respondents	Lowest Value	The highest score	Average
PTI 2013	11	39.5	80.25	61.34
PTI 2014	28	43.55	62.65	53.49
PTI 2015	17	38.5	77.5	55.74
Total/Average	56	40.52	73.47	56.86

(eg, Rasula, Rauf, Mansor, Yasin, & Mahamod, 2012; Stevenson, 2003).

CONCLUSION

Based on the results and discussion of this study the researchers conclude that:

Determination of professional competence selected Junior Programming skills by corresponding indicator SKKNI with indicators used in the lecture Algorithm Data Structure and Basic Computer Programming. The researchers determined the use of 26 sub-competencies and 78 indicators from six competency units that existed in the Junior Programming cluster.

The reliability indicator of the instrument with the category is very high, it appears that the students' ability in the Junior Programming cluster competence is said to be produced in three PTI class of study program in sufficient category. In addition to the value but also aspects or factors in the course that need to be improved and improved. The results of these instruments, evidenced by the comparative comments on the questionnaire instrument filled by the respondents.

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