DEVELOPING A COMPUTER AND NETWORK ENGINEERING MAJOR CURRICULUM FOR VOCATIONAL HIGH SCHOOL (VHS) IN INDONESIA

A DISSERTATION

Presented as Partial Fulfillment of the Requirements for the Attainment of

Doctoral Degree in Technology and Vocational Education

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TECHNOLOGY AND VOCATIONAL EDUCATION STUDY PROGRAM
GRADUATE SCHOOL
YOGYAKARTA STATE UNIVERSITY

2017

RATIFICATION SHEET

DEVELOPING A COMPUTER AND NETWORK ENGINEERING MAJOR CURRICULUM FOR VOCATIONAL HIGH SCHOOL (VHS) IN INDONESIA

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Defended in front of The Board of Examiners
Graduate School Yogyakarta State University
Date: 29 March 2017

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ABSTRACT

Rahmatul Irfan: *Developing A Computer And Network Engineering Major Curriculum For Vocational High School (VHS) in Indonesia*

This study aims at developing curriculum for Computer and Network Engineering major which is relevant to industrial needs.

The study employed the qualitative method. The data were collected through an in-depth interview, documentation, and focus group disscussion. The research population comprised of (1) industry practitioners from computer and network engineering industries, and (2) teachers of vocational high schools in Special Region of Yogyakarta. In this qualitative research, the one who became the instrument or tool of the research was the researcher himself. Understanding the qualitative research method and the knowledge related to the field of the research, the researcher was sure that he had sufficient knowledge both academically and technically.

The findings of this study consisted of four parts, namely (1) standard competence of Computer and Network Engineering major for vocational high school; (2) the curriculum of Computer and Network Engineering major that is currently implemented; (3) competences in the field of Computer and Network Engineering demanded by industries; and (4) the curricuulum of Computer and Network Engineering major that is appropriate for industrial needs.

Keywords : curriculum, vocational high school, computer and network engineering

ACKNOWLEDGEMENTS

The author praises and thanks Allah SWT for all His mercy and grace so that the author can complete his dissertation, entitled “Developing a Computer and Network Engineering Major Curriculum for Vocational High School (VHS) in Indonesia”.

This dissertation completion is inseparable from the assistance and support from various parties. I would like to express my gratitude to the first, second, and third supervisors of this dissertation. My best gratitude goes to my first supervisor, Prof. Dr. Thomas Koehler, for his supervision, suggestions, guidance, and feedback all the way through the process of writing this dissertation. My sincere thanks may also go to my second and third supervisors, Prof. Slamet PH, Ph.D. and Prof. Djemari Pardjono, Ph.D. for their great supervision and suggestions. Moreover, the author also wishes to express most sincere gratitude to:

1. Dr. Moch Bruri Triyono as the Director of Graduate School of Yogyakarta State University, the lecturers, and educational staff who have provided guidance, service, and assistance;
2. The Doctoral Examination Committee: Dr. Moch Bruri Triyono, Prof. Dr. Thomas Kohler, Prof Soenarto, Ph.D., Prof Slamet PH, Ph.D., Prof Pardjono, Ph.D., who have provided guidance, encouragement, and suggestions;
3. The practitioners from industries: Bino Utomo from Indoakses, Wahyu Jatmiko from Lintas Data Prima, Dwi from Global Media, Taufik M Heriawan from Media Sarana Data and Mr. Timotius from Axioo, who have been generously encouraging by attending the focus group discussion (FGD) and providing suggestions for enhancing the quality of this dissertation;
4. Rector of Yogyakarta State University (YSU), Rector of Technische Universität Dresden (TUD), Dean of Faculty of Engineering YSU, Dean of Fakultät Erziehungswissenschaften TUD, and Head of Electrical

Engineering Education Department who have allowed the author to pursue the doctoral degree;

5. Prof. Dr. Thomas Kohler and Dr. Bahaaeldin Mohamed who have guided the author during Joint Degree Programs at Technische Universität Dresden (TUD), Germany;
6. Dean of Engineering Faculty of Yogyakarta State University (YSU), colleagues from Electronics and Informatics Engineering Education Department of Yogyakarta State University (YSU);
7. Vocational High School teachers, especially Mr. Haryanto and Mrs. Nurul as the research respondents, thank you for your cooperation;
8. My Parents, my wife, my children, and my sister who are always beside me for supporting me during the research.

Finally, I hope that this dissertation may be helpful for the readers. However, I realize that this dissertation is far from being perfect. Therefore, any criticism, ideas, and suggestions are highly appreciated for the improvement of this dissertation. Thanks to everyone who has provided support and motivation to the author in completing this study. The author hopes that Allah will always give his blessing to us. Ameen.

Yogyakarta, 29 March 2017

Rahmatul Irfan

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CHAPTER I

INTRODUCTION

A. Background

The ability to empower and manage human resources in science and technology is the key to a nation's victory in the era of globalization. For a nation, globalization is an opportunity and a challenge as well. Globalization can accelerate the pace of development: the relationship between regions, provinces, and countries can be established quickly without any borders (borderless); however globalization may also cause competition to be tighter and sharper as every country will compete for the their own sakes. Major force in winning the global competition is the competitive advantage of the products and services produced. The key for gaining competitive advantage is fostering the competitiveness of the human resources. Efforts in improving the quality of human resources cannot be separated from the quality of education that belongs to a country's culture. Providing qualified education is one of the strategic factors in improving the quality of human resources.

The Indonesian Ministry of Education and Culture has issued a series of policies oriented to the improvement of standard competence at every level of the educational units. Competency-Based Curriculum in Indonesia was born as the implication of the Act No. 23 of 2014 issued by the Regional Government and Government Regulation on the authority of the Government and the Provinces as Autonomous Regions. Based on this act, there was a change in the education

policy: the school management is centralized rather than decentralized. As the policy changed, of course, there were some implications for curriculum improvement; every region was given the freedom to develop their education sector based on their region characteristics. As one of the results of decentralization in education, curriculum-based competence played role as the direction which truly fitted the needs of the potential development of the learners at school by taking into account the local interests as well as following the national and global demands. Policy for increasing the number of ratio between Vocational High School and General High School from 30:70 to 67:33 was stated in the strategic plan of the Ministry of National Education in 2005-2009 and 2010-2014. Indonesian government had planned to increase the number of vocational learners proportionally by structuring efforts and expertise in vocational courses and internship facilities so that they could be relevant to the needs of the workforce. Structuring is done so that the graduates of vocational schools have adequate competence to fulfill the needs of the workforce.

Vocational High School has orientation to direct students to work on specific areas. Government Regulation (PP) No. 29 of 1990 Article 1, paragraph 3 mandates vocational schools to develop students' abilities in carrying out a particular job. Charles Prosser, the father of vocational education, proposed a theory stating that: 1) vocational education will be effective if the students are taught with materials, tools, machines, and tasks of the same types with those the students will work in the workforce; 2) vocational education will be effective if the students are introduced to the real situation of thinking, feeling, and behaving

just like the workers do in the industry, where students will work after graduation; 3) vocational education will be effective if the students are directly trained to think regularly; and 4) for each job, the individual must have a minimum capability so that they can defend themselves to work in that position.

Based on the preliminary study done in Vocational High School (SMK) 2 Yogyakarta and the office of Education, Youth, and Sports of Special Region of Yogyakarta (DIY), it had been shown that 80 percent of vocational school (SMK) graduates in DIY were absorbed. The Head of Central Beureu of Statistics (BPS) DIY, Rachmawati, said that the open unemployment rate in DIY in 2014 reached 3.33%, while in 2015 the open unemployment rate reached 4.07% or more than 80,000 people. "In DIY, for every 100 people, four people were unemployed, it was based on the labor force in the province, which reached 1.97 million," she said. Open unemployment (TPT) rate in February 2016 amounted to 5.50%. Of the 100 workforce, 5 to 6 people are unemployed. Related to the educational level, TPT from vocational high schools (SMK) occupies the highest position of 9.84%, followed by Diploma I/II/III at 7.22%. In other words, 9 to 10 vocational graduates are currently unemployed. Haryanto, a teacher from Vocational High School 2 Yogyakarta said “a good synergy between vocational high school and industry could make vocational high school (SMK) graduates competent in their field and their competence could match industrial needs”.

B. Problem Identification

Prosser (1979) outlined three principles related to the vocational education and industry as follows: (a) vocational education will be efficient if the environment in which the students are trained is a replica environment of the place where they would work; (b) an effective vocational education can only be granted if the exercises are done in a way in which the same tools and machinery as stipulated in the workplace; and (c) vocational education will be effective if a person is trained in the habit of thinking and working as required by the work itself. This is certainly not easy to be realized and it requires closed cooperation between schools and industry to produce graduates who have the ability (skills) accepted by the labor market.

The unpreparedness of graduates from the Vocational High School (VHS) upon working in industry has a domino effect on the industrial stakeholder, because the industry itself then must provide suitable training to prepare its workforce. Thus the industry should allocate extra costs beyond the cost of production (Pardjono, 2011). Due to the Strategic Plan of the Indonesian Ministry of National Education in 2010 – 2014, the educational outcomes should meet the needs of the business and industry in order to suit the alignment of education and the needs of the business and industrial world. The Ministry of National Education (2012) in the alignment of the compilation report results of a pilot project in 2011 mentioned that the unfitted competence between vocational high school graduates and industrial demand had raised: (1) gap between the number of graduates and the number of the workforce needs; (2) gap between the

students' competency and the workforce competencies required; (3) inability of the industry in absorbing local/province graduates due to the gap between the quantity of the graduates and the industries; (4) changes in some conditions (economic) concerning local, national, and global education.

Based on the results of tracer study carried out by the education and workforce adjustment team in 2010, it was shown that there were 4 dimensions of gap (quantity, competence, location, and time). They also conducted a comprehensive survey to measure the satisfaction of the workers from vocational school. The survey results were analyzed by using gap analysis, Kruskall Wallis test, mean test, and regression analysis. It was proved that there was a negative gap related to the relationship between vocational school and workforce. (1) The cooperative relationship with the industry showed a gap of -0.30, (2) Evaluation coordination and curriculum, together with the development of educational institution and industry, raised a gap of -0.26. (3) The duration of education program had a gap of -0.29. (4) There was a gap of -0.71 in the industry curriculum development. (5) The gap in teaching material accuracy between the portion of hard skill and soft skill was -0.59. (6) The available time for industry practice was in a gap of -0.45. (7) The evaluation on the results of work done on the same practice among the educational institutions with industry as the place to practice had a gap of -0.57. Based on the above data, the biggest gap between vocational sector and industry in vocational training was on the curriculum factors, the industry was not satisfied with the conformity of vocational high school as there was a gap of -0.71.

C. Problem Statement

According to the research background above, the problems of this research are in the following areas:

1. Gap between the numbers of graduates and the number of the needs of the workforce;
2. Gap between the students' competencies and the required workforce competencies;
3. Gap in curriculum between those of vocational high school (VHS) and industry;
4. Inability in absorbing the graduates from the local region so that they could not wok in their own region;
5. Changes in some conditions (economic) concerning local, national, and global education.

Considering the time and effort, it would be unrealistic to investigate the whole problems as stated above, thus this research was limited to the competence and curriculum for Computer and Network Engineering major of vocational high school (VHS) in Indonesia based on the industry's demand.

D. Research Objectives

According to the literature study, the researcher can confirm that there are no previous studies about developing a Computer and Network Engineering major curriculum for the vocational high school (VHS) in Indonesia. Therefore, this study seeks to research the major curriculum in Computer and Network Engineering major which is relevant to the industry's needs. The research objectives are to:

1. investigate the qualification standard of Computer and Network Engineering major;
2. examine the curriculum of Computer and Network Engineering major especially on what is being implemented recently;
3. study the competence demanded by industries in the field of Computer and Network Engineering; and
4. develop the curriculum for Computer and Network Engineering major that is relevant to industrial needs.

E. Benefits of the Research

1. Theoretical Benefits

The finding of a map of competence and curriculum in Computer and Network Engineering major is expected to be an alternative curriculum in Computer and Network Engineering major in vocational high school (SMK).

2. Practical Benefits

a. The discovery of a map of competence in Computer and Network Engineering major in accordance with the needs of industry can be used by school management as a benchmark for vocational education's learning activities.

b. The discovery of curriculum in Computer and Network Engineering major in accordance with the needs of industry can be used by school management as a benchmark for vocational education's learning activities.

c. The findings can improve the goverment policy on 2013 Curriculum espesically that of Computer and Network Engineering major competence.

CHAPTER II

LITERATURE REVIEW

Chapter II consists of fifteen major issues concerning the supporting theories as the basis for developing the Computer and Network Engineering major curriculum for vocational students, namely: (1) national education goals, visions, missions, and objectives of vocational secondary education; (2) the foundation of vocational education; (3) curriculum; (4) curriculum model; (5) differences between curriculum, course, and syllabus; (6) forms of curriculum; (7) model of curriculum; (8) curriculum development in technical and vocational education; (9) a rationale for curriculum development in vocational and engineering education; (10) constructing curriculum content; and (11) vocational education in Indonesia; (12) 2013 Curriculum; (13) spectrum of expertise for vocational education; (14) pack of Computer and Network Engineering Major; and (15) vocational education in Computer and Network Engineering Major.

A. Theoretical Review

1. National education goals, vision, missions, and objectives of vocational secondary education

The goals of national education as mandated by the 1945 Constitution are to educate the nations and develop the man power into those who are faithful and devoted to God and have noble characters, knowledge and skill, as well as social and national responsibility. The Ministry of National Education stated that the

realization of the vision of vocational education is that vocational education produces graduates who have national identity, are able to develop local advantage, and are able to compete in global market.

The missions of vocational education, include: (1) enhancing the professionalism and good governance in vocational school as the center of civilizing competence, (2) improving the quality of education provision, (3) establishing and empowering vocational education to produce graduates who have both a national identity and competitive advantage in the national and global market, (4) empowering vocational school to develop a potential comparative advantage, (5) empowering vocational school to develop cooperation with industry, PPPG, LPMP, and related institutions, and (6) improving and expanding equitable access to vocational education quality.

The purposes of vocational education, include: (1) realizing the vocational institution that is accountable as the center of civilizing the competence of a national standard, (2) educating human resources who have the work ethic and international standard competence, (3) providing various services of vocational education which are not only permeable and flexible but also integrated and equitable in quality, and (5) raising the local advantages as the competitiveness of the nation.

Wardiman Djojonegoro (Djojonegoro, 1998) affirms that one of the characteristics of vocational education is to prepare students to enter the workforce. Therefore, vocational education must be "demand driven" i.e. the need of the world of work. Charles Prosser (Prosser, 1979) listed sixteen principles of

vocational education: (1) vocational education will be efficient if the environment in which the learner is trained is a replica of the environment in which they must subsequently work; (2) effective vocational training can only be given if the job trainings are carried out by utilizing the same operations, the same tools, and the same machines as those utilized in the real workforce; (3) vocational education will be effective if the individual is directly and specifically trained in terms of the thinking habits and the manipulative habits required in the occupation itself; (4) vocational education will be effective as it enables each individual to capitalize his interest, aptitudes, and intrinsic intelligence to the highest possible degree; (5) effective vocational education for any profession, calling, trade, occupation, or job can only be given to the selected group of individuals who need it, want it, and are able to gain advantages by it; (6) vocational training will be effective as the specific training experiences for forming right habits of doing and thinking are repeated; (7) vocational education will be effective as the instructors have successful experience in applying the skills and knowledge that they teach; (8) for every occupation, there is a minimum productive ability which an individual must possess in order to secure or retain that occupation; if vocational education is not carried out to that point it is neither personally nor socially effective; (9) vocational education must recognize conditions as they are and must train individuals to meet the demands of the "market" even though it may be true that the more efficient ways of conducting the occupation may be known and that better working conditions are highly desirable; (10) the effective establishment of process habits in any learner will be secured in proportion as the training is given

on actual jobs and not on exercises or pseudo job; (11) the only reliable source of content for specific training is an occupation that is in the experience of the masters of that occupation; (12) for every occupation there is a body of content which is peculiar to that occupation and to which has practically no functional value in any other occupation; (13) vocational education will render efficient social service in proportion as it meets the specific training needs of any group at the time that they need it and in such a way that they can most effectively be profited by the instruction; (14) vocational education will be socially efficient in proportion as in its methods of instruction and its personal relations with learners, it takes into consideration the particular characteristics of any particular group which it serves; (15) the administration of vocational education will be efficient in proportion as it is elastic and fluid rather than rigid and standardized; and (16) while every reasonable effort should be made to reduce per capita cost, there is a minimum below which effective vocational education cannot be given, and if the course does not permit this minimum per capita cost, vocational education should not be attempted.

Based on theoretical review above, vocational education must be managed with reference to the main objective, which is to prepare graduates who are ready to enter the world of work. Vocational school management must be designed to achieve effectiveness and efficiency at the same time. The important task of vocational school is planning and implementing the program as closed as possible to the conditions in the workplace. Curricula should be developed based on the needs of the world of work (demand driven). Equipment and machines for the

practices should be provided with the same criteria or at least approaching those used in the world of work. Vocational school should be such that graduates are truly ready to enter the working world, in the sense of having the knowledge, skills, and attitudes needed in the workplace.

2. The Foundation of Vocational Education

According to Wardiman Djojonegoro (Djojonegoro, 1998), the foundations of vocational education include:

a. Legal Foundation

Law No. 2 of 1989, the national education system Article 11 paragraph (1) and (3) which state: "This type of education including the type of school education consists of general education, vocational education, special education, service education, religious education, academic education, and professional education". "Vocational education is an education that prepares students to work in a particular field". Article 15 says that "secondary education consists of general education, vocational education, special education, service education, and religious education." Government Regulation No. 29 of 1990, concerning secondary education, chapter 1 of Article 1 paragraph (3) states that "vocational secondary education is education in secondary level that promotes the development of students' ability to carry out certain types of work". Chapter II, Article 3, paragraph (2) says that "vocational education prioritizes the preparation of students to enter the workforce and develop a professional attitude". An outline of state policy in 1993, “Pelita VI”, Section 4 Item F number 26 mandates that

"national education need to be organized, developed, and strengthened by completing various statutory provisions and regulations and prioritizing equality and improving the quality of basic education, expanding, and improving the quality of vocational education.

b. Philosophical Foundation

Basically what should be taught to the learners is philosophy. The philosophy is what is believed to be a way of life that is considered right and good. There are two streams of philosophy used as the basis of vocational education, namely existentialism and essentialism. Existentialism philosophy believes that education should optimally raise and develop learners' existence through educational facilities and a dignified process, facilitate changes, raise and develop talents, interests, and learners' abilities. The learners are valuable national asset and are strong competitors who are able to respond to the challenges of globalization optimally. Essentialism philosophy holds that vocational education should be functional and relevant to the needs of individuals, families, as well as the needs of the surrounding community. The demand of globalization is that education must prepare a human resource that can compete internationally. Vocational education should be linked to the other systems such as the economy, employment, political, social, religion, and moral.

c. Scientific Foundation

Vocational training is organized by a strong scientific foundation. Some are

used as the basis of scientific disciplines, including economics, psychology, and sociology. John Dewey states that education is the process of establishing the fundamental skills intellectually and emotionally toward nature and fellow human beings. Rossseau believes that education is giving us the supplies that exist in childhood through adolescence that will be needed in adulthood. The opinion of the philosophical emphasis on aspects of human life in society, meaning that the students before entering the realm of social life need to be educated in a variety of life skills, in order to play a role and be accepted in society properly. Based on both of the above opinions, it can be drawn a conclusion showing that education is a conscious and deliberate effort to realize the learning process of students actively, in order to develop children's talents and traits that have intelligence, emotions, and skills necessary to live in a society. Life in society requires various types of skills, and conceptual skills cannot be obtained without effort, it must be obtained through education or purposeful and well-planned training. Institution that fits and is competent to handle such challenges is a vocational institution. Vocational education is one form of the education systems in Indonesia. Vocational education mission is to assist students in developing professional attitude, to make them capable of competing, and to support them in pursuing their development stages in order to prepare them to face the field of work and career in the industry. The purpose of vocational training specifically is to increase the intelligence, knowledge, personality, character, and skills of the students to live independently and to follow further education in accordance with the vocational program in order to work effectively and efficiently, develop expertise

and skills, master expertise and the basics of science and technology, has a high work ethic, communicate the appropriate demands of the job, and have the ability to develop themselves (Education, 2006). The statements above implicitly state that the duty of vocational education is to prepare qualified human resources who have the competence, independence, ability to work and are able to create jobs, adapt, and compete. Substantially vocational education is in charge of forming students who have the ability, insight, and skills in relation to industry field and master engineering concepts that exist in the industry.

3. Curriculum

There are a lot of definitions for the term “curriculum” expressed by some experts, from both narrow and wide point of view. This term is interpreted differently by experts in the field of curriculum development since the past until the present. The definition of curriculum constantly evolves in line with the development of the theory and practice of education. Etymologically, the word "curriculum" is drawn from Latin which has the same meaning as the word "racecourse". Term "curriculum" in the form of the verb in Latin is known as "*curere*" which means "runs the race" (running of the race). The meaning of this race course is not a one-track race but a record of actions and experiences that guide an individual for intellectual, functional, and ethical growth. The meaning of curriculum is the subjects comprising a course of study in a school or college (Oxford English Dictionary). There are several opinions about the meaning of curriculum. Curriculum is a subject that must be taken and studied by students to

gain some knowledge. (Takatchov & Pollnow, 2012) In A Practical Guide to Teaching and Learning, it is said that curriculum includes the way in which the content will be covered and the materials that will be sued to teach and assess that standard, the standard is the knowledge or skill that the student needs to learn. Subject matter is the discovery and experience of parents and smart people in the past, which are then arranged in a systematic and logical way. “Systematic” means according to certain rules, and received by means of logical sense and mind. The more experience and discovery by parents and good people in the past, the more subjects are incorporated into the curriculum and students learn at school. Good curriculum supports students in attaining knowledge or new concepts through existing knowledge. Another definition of the curriculum is curriculum as an academic plan. According to Lattuca & Stark (Lattuca & Stark, 2009), the academic plan definition implies a deliberate planning process that focuses attention on important educational considerations, which will vary by field of study, instructors, students, institutional goals, and so on. Lattuca & Stark (Lattuca & Stark, 2009) said academic plan should involve decision about (at least) the following elements:

a. Purposes : knowledge, skills, and attitudes to be learned
b. Content : subject matter selected to convey specific knowledge, skills, and attitudes
c. Sequence : an arrangement of the subject matters and experiences intended to lead to specific outcomes for learners

d. Learners : how the plan will address a specific group of learners

e. Instructional Process : the instructional activities by which learning may be achieved

f. Instructional Resources : the material and settings to be used in the learning process

g. Evaluation : the strategies used to determine whether decisions about the elements of the academic plan are optimal

h. Adjustment : enhancements to the plan based on experience and evaluation

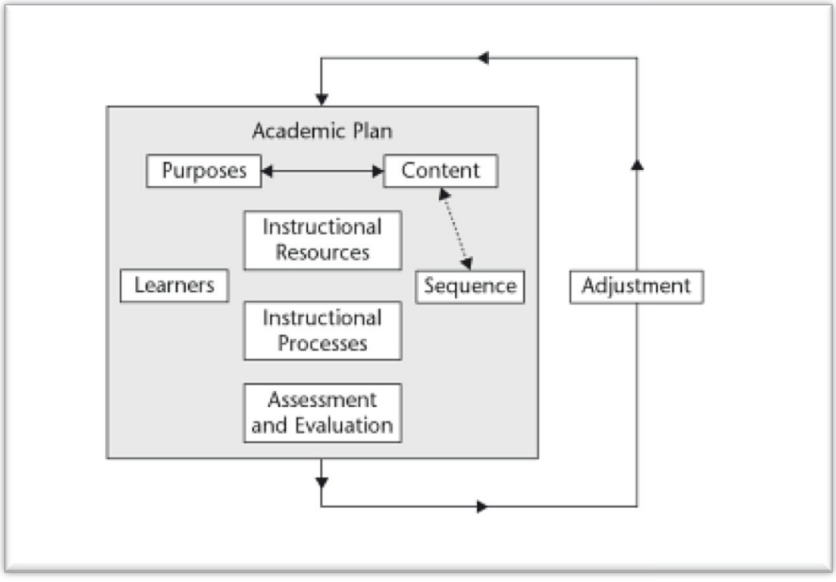

Figure 1 Elements of Academic Plan (Lattuca & Stark, 2009)

The figure illustrates that the curriculum system as an academic plan is

comprised of eight components, namely: purposes, content, sequence, learners, instructional process, assessment and evaluation, and adjustment evaluation. As a system, each component must be related to one another. When one of the components that make up the curriculum system is disturbed or not related to the other components, then the curriculum system as a whole will also be violated. Lattuca & Stark (Lattuca & Stark, 2009) in accordance with (Curtis R. Finch, 1999) state that a curriculum is a collection of activities and learning experiences to be experienced by a group of students under the direction and responsibility of a school. The same opinion was also said by (Print, 1998) stating that curriculum as experience a more recent image sees curriculum as a set of experiences learners encounter in educational contexts and most of these experiences have been purposively planned by means of the written curriculum.

(Atherthon, 2013) said “curriculum” is a term used in a number of related ways:

a. first, it can refer to the overall content of what is to be taught, which specifies the content of by far the largest part of compulsory schooling;
b. second, it can refer to the underlying principles of the approach to teaching and learning, as in a "developmental curriculum" or a "competency-based" curriculum;
c. third, it can embrace both elements, and refer to the overall "what", "how" and "why" of teaching; note that on the whole, it is a "teaching side" — rather than "learning side" — term.

The curriculum represents a set of desired or valued goals that are activated through a development process and culminate in successful learning experiences for students. Chandra said about curriculum in (S.S. & K.Sharma, 2004) that curriculum includes those experiences and activities which provide the student with the knowledge and the skills he will require in facing the various situations of real life. It has been suggested by Tyler in Kelly (Kelly, 2009) that the curriculum has to be seen as consisting of four elements, and curriculum planning, therefore, as having four dimensions: objectives, content or subject matter, methods or procedures, and evaluation. Tyler's own way of putting this point is to suggest that there are "four fundamental questions which must be answered in developing any curriculum and plan of instruction" (Kelly, 2009) as the followings:

a. What educational purposes should the school seek to attain?
b. What educational experiences can be provided that is likely to attain these purposes?
c. How can these educational experiences be effectively organized?
d. How can we determine whether these purposes are being attained?

Based on some notions that have been stated above, it can be concluded that the common understanding curriculum provides learning experiences provided for students and under the supervision of the school or college, and the definition of curriculum can be grouped as a plan, curriculum as a learning experience, and curriculum as a result of learning.

4. Curriculum Model

The concept of the curriculum determines how the directions of the curriculum will be achieved. In the future, the selection of an appropriate curriculum concept is expected to be able to provide more value for each school, such as (1) the flexibility of learning; (2) the suitability of the learning experience; (3) encouragement to the long-term education; and (4) involvement of cultural environment.

a. Ralph Tyler Model

Tyler's popular four-part model became the basis for many other common models: 1) Defining Objectives of the Learning Experience, 2) Identifying Learning Activities for Meeting the Defined Objectives, 3) Organizing Learning Activities for Attaining the Defined Objectives, and 4) Evaluation and Assessment of the Learning Experiences (Ralph, 1949).

b. Zais Model

Zais Model (Robert S, 1976) describes two models of curriculum development, namely:

1) Administrative Model

Administrative models are also known as top-down line-staff model, i.e. models for curriculum development initiatives come from the educational administrator (or top-level officials). All subjects involved parties or are

determined by the administrator. Curriculum development focusing on administrators can then be deployed at schools. The procedure passes on this model are: 1) establish a steering committee to formulate the basic concepts of the curriculum, establish lines of policy, prepare formula, establish general goals of education, 2) establish a working committee to define and develop a policy that had been developed by a steering committee, 3) assessing and testing the curriculum to make improvements, 4) disseminating and implementing the curriculum in schools.

2) Grass Root Model

It is the reverse of the administrative models. Grass Root model begins from the initiative of educators (teachers) for their dissatisfaction, problem, and mismatch between teachers' needs and the available draft in the field. For proper development of a Grass Root model curriculum, necessary care and high professionalism of the school include 1) schools/teachers are critical to addressing the on-going curriculum, 2) schools/teachers have innovative ideas and are responsible for developing a curriculum that fits the needs and potentials, 3) schools/teachers are continually engaged in the process of curriculum development, 4) schools/teachers are open-minded and can accommodate any inputs in order to develop the curriculum.

c. Beauchamp Model

The concept of a curriculum system implies a governing cluster of

relationship. Most of them have to do with the human engineering required in the process of curriculum development and curriculum usage. According to George A Beauchamp at (Beauchaamp, 2015), the fundamental tasks of curriculum system set the framework for needed relationship ties. The tasks inherent in a curriculum system: 1) the choice of arena for curriculum decision-making, 2) the selection and involvement of persons in curriculum planning, 3) organization for and techniques used in curriculum planning, 4) actual writing of a curriculum, 5) implementing the curriculum, 6) evaluating the curriculum, 7) providing feedback and modification of the curriculum.

d. Taba Model

Hilda Taba stated (Taba, 1962) that there should be a clear definite order to curriculum design and that teachers must be involved in the process. There are 8 steps to the Taba (Taba, 1962) model of curriculum development: 1) identify the needs of the students, 2) develop objectives, 3) choose content that matches the objectives, 4) organize contents considering the learners experiences and background, 5) select instructional method that promotes student engagement, 6) organize learning experiences by sequencing contents, 7) evaluate to ensure mastery, and 8) check the balance and sequence.

e. DACUM (Developing a Curriculum) Approach

The DACUM approach to occupational analysis is quite different from job analysis. DACUM is an acronym for Development a Curriculum, but it actually

involves only the first step in a full vocational curriculum development process. Instead of job observation, DACUM uses guided group discussion with expert workers. The DACUM process includes, in addition to occupational specific tasks, the separated identification of work enablers: general knowledge and skills, worker behavior (personal traits and interpersonal skills), and tools and equipment used. These tasks become the focus of curriculum development; a DACUM analysis workshop involves a trained DACUM facilitator and a committee of 5-12 expert workers from the position, occupation, or other area of analysis. The profile chart that results from the usual two-day workshop is a detailed and graphic portrayal duties and tasks performed by the workers involved (Norton, 2008).

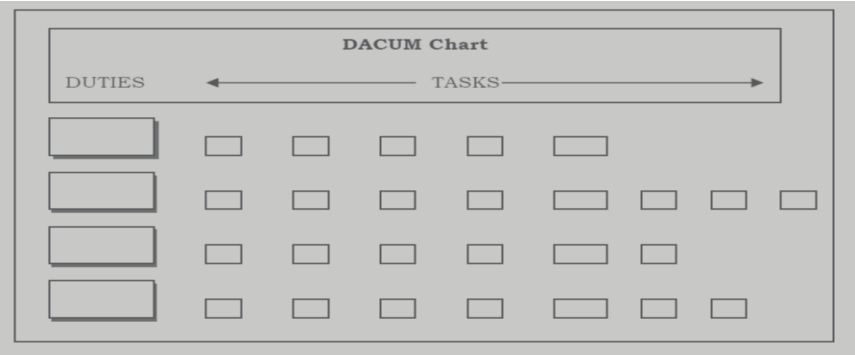

Figure 2 DACUM Research Chart Design (source: (Norton, 2008))

DACUM is based on three logical premises (Norton, 2008):

1) Full-time workers are real experts and can describe and define their job/occupation more accurately than anyone else. Person who are working full-time in their positions are the real experts on that job. Even though

supervisors and managers usually lack the expertise needed for a high quality analysis.

2) An effective way to define a job/occupation is to precisely describe the tasks that expert workers perform. In order to help to prepare and train other experts.
3) All tasks, in order to be performed correctly demand the use of four enablers which are: knowledge, skills, tools, and positive worker behaviors. These enablers are so important in the analysis that should be listed separately from the tasks.

In three logical premises, Robert Norton said full-time workers are real experts because he/she can describe and define their job. Describing the tasks that expert workers perform is an effective way to define a job/occupation and knowledge, skills, tools and positive worker behaviors. Those are the factors for task analysis.

Robert Norton (Norton, 2008) said DACUM analysis is ideally suited two particular purposes:

1) The development of new vocational education and training. Precondition is that a labor market analysis has been carried out to reveal the need for a new curriculum. DACUM can then quickly identify the competencies needed to perform the job for which new education and training has to be set up.
2) The review of the existing curricula for education or training. A group of expert employees within the profile in question can be convened to identify

the competencies that should be delivered in an existing curriculum, just as it can be convened to identify the competencies for a new curriculum. In this case, once the competencies have been carefully identified by expert employees, the existing curriculum is examined to see if it addresses all required tasks. Modifications of the education or training curriculum are then made where necessary to ensure current relevance of the curriculum. In the statement above, Dacum analysis can be used for analysis for the development of new vocational education and training by conducting labor market analysis and for the review of existing curricula for education and training by gathering expert employees within the profile in question. It then can be convened to identify the competencies for a new curriculum.

According to the Handbook of DACUM by Robert Norton (Norton, 2008), there are a lot of planning and preparation before the actual workshop, as follows:

1) Selection of the DACUM workshop participants

One of the most important tasks connected with the DACUM workshop is the selection of the workshop participants. The people chosen to be the DACUM workshop members should have several important characteristics. The proper selection of the participants is probably the most complex aspect of organizing a successful workshop. The qualities of the interactions that are going to take place, as well as the quality of the DACUM chart, depend to a large extent on the people chosen. The participants have to be either employed within the agreed occupational area or be the direct supervisors in this occupational area. Decisions,

based on the chosen criteria, must be made in relation to the kinds of employees that have to be included or excluded. According to Norton (Norton, 2008) the following criteria have to be taken into account during the selection process:

a) Technical skills

The people chosen have to be highly – qualified for their jobs and they should be aware of the actual development and needs referring to this area. Plenty of years spent in doing the jobs do not necessarily mean that the person has the necessary qualifications to be the competent DACUM member. Generally speaking, indirect supervisors can recommend the most competent employees as far as technical skills are concerned.

b) Full-time employment

The chosen people should have a full –time job in the given occupational area. This is how we can be sure that they have the necessary knowledge and information about all the aspects of their jobs. Some of them can be supervisors if they directly supervise the employees whose occupation is being analyzed. Supervisors with the recent practical experience of the job can provide useful information about the job that is being analyzed.

c) The presence of the occupational area on the market

The selected DACUM workshop participants should show the real situation as far as employment is concerned for the job that is being analyzed. If the job which has to be analyzed is different in terms of the employees' fields of specialization, then the DACUM participants must be chosen to show these specializations.

d) Efficient in communication

In order to be efficient, the DACUM participants have to be very precise when they give detailed and exact explanations of what they do. Since the DACUM workshop participants are the group of people who work on the further development of ideas and reaching the consensus, the members of the group have to be able to listen to other people's views carefully and to participate in the group discussion in an effective way.

e) Team player

The DACUM participants should influence each other, but they should not be dominant or being dominated by others, they should not be too critical, and they should not try to overanalyze or reorganize their contributions all the time. Ideally, each participant should be willing to participate in the process. It excludes the individuals who were "just sent" with no explanation or who were told by the supervisor to go since there was a "vacant committee position".

f) Full commitment

All participants should be fully committed to the DACUM workshop during the required time. They should come to meetings on time, since the participants who are late or are just partly present will miss some part of the orientation or group discussion and this may have the negative impact on the workshop.

g) Biased – free

DACUM participants have to be open – minded and biased – free. It is the primary reason why teachers should not be the members of the group. Teachers may try to influence the contributions of the participants, which can have a negative impact on the process and the ways of sharing information. Teachers should be encouraged to come to the workshop as observers and hosts. The participants of DACUM must have some criteria for successful workshop, some criteria for DACUM participant must have highly technical skill, full time employment for sure that they have the necessary knowledge and information about all the aspects of their jobs, the presence of occupational area on the market the mean is participants should show the real situation as far as employment is concerned for the job that is being analyzed, besides that the participants have soft skill like efficient in communication participants have to be very precise when they give detailed and exact explanations of what they do, participants could a good team player and full commitment and open minded. Ideally, each participant should be willing to participate in the process and should come to meetings on time.

The process of identifying the key contact people is very important. Robert Norton (Norton, 2008) said the teachers and instructors in the school and/or training center can usually be helpful in identifying various employers in the community that employ the type of experienced people needed as DACUM workshop participants. Although the teachers and instructors should never serve as participants on the DACUM group itself, they are probably the best single source for identifying potential employers and/or participants. Sometimes a

teacher/ instructor or groups of teachers/instructors resist involvement in the planning process. Resistance may arise for many reasons, but usually it disappears quickly once they understand what DACUM is all about and how it can help them do a better job, by getting an updated education/training program. The other tasks that have to be done before the DACUM workshop are: 1) making contacts with the companies that employ this kind of qualified / expert employees and 2) making contacts with potential DACUM participants.

a) Making contacts with the company

The main tendency in making contacts with the employers is to convince the HR (Human Resources) manager, supervisor, or any other contact person that the school or the center needs the help of the company to modernize or establish the relevant education or training program. The facilitator has to persuade the representative that the results of the DACUM workshop will be used by the institution to develop a curriculum to the benefit of companies. It is important for the facilitators to make the appointments by phone or even a visit to the employers can be done. Important is to explain them the DACUM process and to ask for further co-operation with them. Written materials about the DACUM process and some of the DACUM charts can be helpful to hand out. If the formal approval is needed, the facilitators have to be ready to write a formal letter on the memorandum of their institution in which they ask for help. The only approach that is not good enough is writing letters. Written requests are usually written to the people in charge of the public relations who want to help, but might not be qualified enough to help. These people may not have the sufficient knowledge

about the request and can appoint themselves or other people who are not technically or individually adequate for that job. If the facilitator uses letters, they must be accompanied by phone calls in order to have the request or the people as potential DACUM participants discussed.

b) Contact to potential DACUM participants

Before start inviting/calling the DACUM participants, you should decide on the size of the DACUM group. In order to have the "ideal" DACUM group, of 8 to 10 participants, it is best to choose first 10 – 12 participants. In this way if one or two members cancel in the last minute, the group will keep the satisfactory size for the proper functioning. The personal contact of the 'third' party in the company (HR director/supervisor, etc.) can be helpful; the facilitator should send a written copy of the criteria to the 'third' party who will follow these criteria in the selection process. However, personal involvement of the facilitator is of great value. Once the potential participant is appointed it is important, that the facilitator makes a contact personally to the participant. Potential participants might be indecisive in relation to their commitment to a completely new or different experience. The DACUM facilitator has to explain the purpose of the analysis and the role of the DACUM participants in this process. (Tell the participants that they were selected because they are the experts in their area. Tell them that they will be asked, together with other employees from the same occupational area – profession, to talk about different tasks they perform as part of their work).

c) Review the duties and tasks

For review the duties and tasks, Robert Norton (Norton, 2008) said the facilitator now asks the participants to compare the duty and task lists with the very first list of activities that were made by the participants in order to describe their work; these were the lists that were made before the duties identification. This check will almost always result in identification of 3-8 new tasks. From time to time, it can result in the identification of one or two new duties. The duties statements and tasks statements should be checked for clarity and precision. Certain changes may be made and something can be erased in order to improve the quality of the chart. There are several more issues to emphasize. The tasks statement should contain as fewer words as possible (maximum eight) and at the same time it should be fully described. Three words are usually enough. Long statements tend to lose the focus and are not appropriate for the presentations in the chart. Even though task statements can be shifted from one area of duty to the other during the improvement process for the sake of the best possible fitting, the same task should not be repeated twice. Instead of this, the participants should decide on the best fitting. If there are two similar but still different tasks for which the participants think are important, then different definitions should be used. Each area of duty should comprise at least six special tasks statements. If the participants can provide only two or three tasks, the area of duty should be combined with the other related areas. On the other hand, if the particular area of duty results in identification of a huge number of tasks (for example, 20-30), there must be an excuse for the division of this area into two duties. Once the tasks in all areas of duty are improved the facilitator should ask the participants whether

the duty statement still represents the precise description of the general area of responsibility. Sometimes the range of the duties statements should be narrowed or expanded in order to determine the specific tasks more precisely.

5. Difference between curriculum, course, and syllabus

Curriculum is a very general concept, which involves consideration of the whole complex of philosophical, social, and administrative factors, which contribute to the planning of an educational program. Using educational concepts, we can say that the curriculum defines the educational foundations and contents, their sequencing in relation to the amount of time available for the learning experiences, the characteristics of the teaching institutions, the characteristics of the learning experiences, in particular from the point of view of methods to be used, the resources for learning and teaching (e.g. textbooks and new technologies), evaluation and teachers' profiles (Braslavsky, 2005). Allen in David Nunan (Nunan, 1988) said syllabus, on the other hand, refers to the subpart of curriculum, which is concerned with a specification of what units will be taught and syllabus is the specification and ordering of content of a course or courses. A course is "an integrated series of teaching-learning experiences, whose ultimate aim is to lead the learners to a particular state of knowledge" Hutchinson and Waters in Irma (Irma Dolores, 2007). Curriculum structure contains a description of the number of lesson hours in each lesson, the content standards for all types of majors/ programs at the school for each semester prevailing in the school year. The content standards refer to the Ministerial Regulation number 22 of 2006,

referring to the KTSP curriculum development of primary and secondary education which is compiled by BSNP.

Curriculum structure which is presented in a matrix form includes numbers, code of competencies, lessons group/competencies, years/levels and semesters, and the number of lesson hours. Based on the implementation analysis in the field, due to the presence of normative subjects (Arts and Culture) and adaptive subjects (Social Sciences and Natural Sciences), the time allocated for the productive subjects which are suited to the students' major is reduced. Therefore, the ratio of the number of lesson hours related to the time allocation for face to face, school practice, and industry practice is 1:2:4. It makes the matter more complicated since this ratio does not meet the time allocation as mandated by the standard contents (to accommodate the number of hours per week of 40 hours in maximum). As the results, the hours of real practice in schools and industry should be calculated as well as the addition of a number of teaching hours over 4 hours of lessons to meet the required time allocation in competency standards.

Analysis of the subject groups that contains a specific description of vocational high school subject groups, refers to the ministerial regulation number 22 year 2006 which includes three groups of subjects, namely normative, adaptive, and productive group. Normative group is a group of subjects which is allocated permanently covering Religious Education, Citizenship Education, Indonesian, Health and Physical Education, and also Arts and Culture. Adaptive group consists of subjects in English, Mathematics, Science, Social Studies, Computer Skills and Information Management, and Entrepreneurship. Productive

group consists of a number of subjects which is grouped under the Vocational Basic Competency and Vocational Competence. Vocational High School also has specificity. The specificity lies in the productive subjects. Like other subjects, the content standards (SI) and competency standards (SKL) of productive subjects also need to be assessed. The activities are proposed to be carried out by involving teachers and lecturers who have experiences in professional industry in the field and related professional associations. Opaque final needs openly disseminated to the stakeholders to be commented. The KTSP curriculum of Vocational High School refers to the National Competence of Indonesia (SKKNI); however not all programs in SKKNI expertise are synergistic to those of BNSP (National Professional Certification Board) for the preparation of related SKKNI is not yet published.

Enforcement of the Republic of Indonesia's Law No.20 of 2003 on National Education System, Government Regulation No.19 of 2005 on National Education Standards, and Government Regulation No. 22 of 2006 on the Content Standard for Primary and Secondary Education require a different perspective on the development and implementation of the curriculum. Curriculum development was conducted by education units expected to provide more flexibility for school to design curriculum that is appropriate to the circumstances and needs of education units. Unit Level Curriculum (KTSP) development is based on the national standards of education, content standards, process standards, competency standards, standards of educational personnel, facilities and infrastructure standards, management standards, financial standards, and standards of

educational assessment. From the eight content standards above, content standards and competency standards are the main references in curriculum development. Standard content is the scope of material and level of competence as outlined in the criteria of graduate competences, study material competences, subject competences and syllabus of learning that must be filled by students at different levels and types of education.

Curriculum development has been done by some educational units in primary and secondary education with reference to the content standards. Curriculum development that has been made by the education unit with reference to the content standards should be examined to get more information about the problems encountered related to the implementation of the content standards. As stated above, we can infer that curriculum is a very general concept, which involves consideration of the whole complex of philosophical, social, and administrative factors, which contribute to the planning of an educational programme. Syllabus, on the other hand, refers the subpart of curriculum, which is concerned with a specification of what units will be taught. Curriculum should not simply be seen as a kind of super syllabus because there is a qualitative difference between the two. On the one hand, curriculum may be viewed as the programme of activities, the course to learn by pupils in being educated. On the other words, curriculum may be defined as all learning, which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school. That is one school of thought regards the curriculum as a plan, while the other views it as activities.

6. Forms of Curriculum

Atherton (Atherthon, 2013) sets up a model (Figure 2.1), which works along two dimensions, and distinguishes four types of curricula: academic, vocational/professional, mastery/induction, and developmental/constructive. He derives these types dictated by the questions, "What is this material being taught for?" and (the student version) "Why do we have to learn this?"

a. Academic

The material is deemed to be important in its own right, either because the students are interested in it, or they ought to be interested in it. Either there is no great concern that they should use it, or the variety of ways in which it might be used is so great that we do not concern ourselves with it.

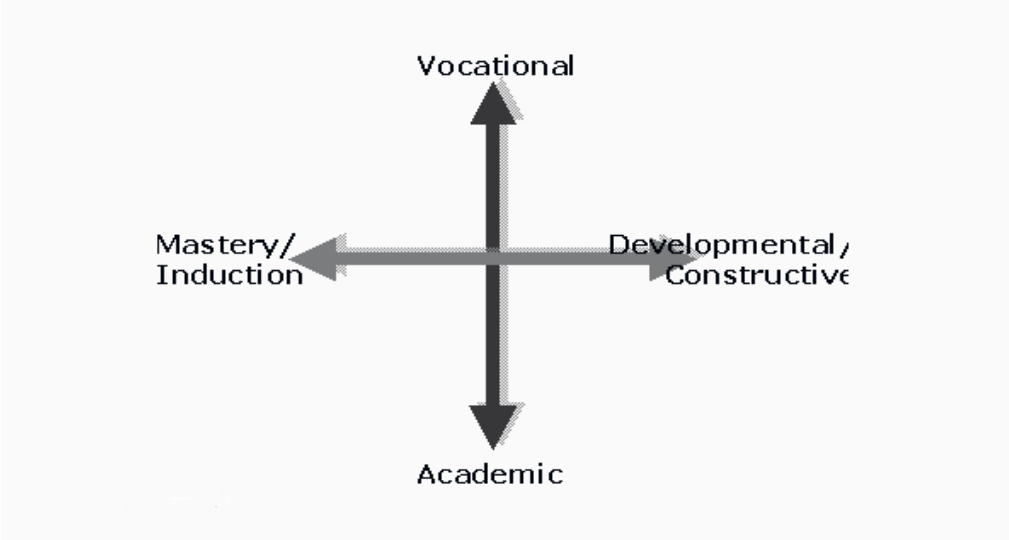

Figure 3 Two dimension of curriculum model. Source (Atherthon, 2013)

b. Vocational Curriculum

The basis of this vocational type curriculum is developed from the question "Why do we have to learn this stuff?", "Because you can use it to...” The emphasis is on using the material in order to do something else. That means that it may not matter whether pupil can remember the concept of computer networking or not but how to set up computer networking for working in daily life.

c. Mastery/Induction

This kind of curriculum assumes that what needs to be learned exists "out there" — that the task of education (or training) is to induct you into an established body of knowledge. Competence-based curricula are almost necessarily based on this model. It is assumed that the curriculum designer knows what competence consists of, in a particular vocational area, and what performance criteria constitute evidence of it. For example student mastering in the particular of computer networking such mastering the cabling and then they can continue to mastering in Internet Protocol (IP Address), etc.

d. Developmental/Constructive

The other kind of curriculum — often concerned with quite advanced skills (rather than simple knowledge) — is a developmental one. It is centered on the development of the student — "maximizing potential" is the jargon phrase — and tries to take them forwards from wherever they are to a more sophisticated

understanding or skill in a particular area: the measure is "improvement" rather than the achievement of a particular level.

The Vocational/Mastery oriented teacher (or trainer) designs an efficient and probably standardized curriculum which takes learners step-by-step to a pre-determined level of competence. The threshold of competence is determined by clear right and wrong answers, and it is easy to formulate objectives. The Vocational/Developmental teacher is probably working with more experienced practitioners, and uses open-ended exercises and promotes peer interaction to help them to cultivate their expertise. There is more uncertainty, and feedback is more discursive. Assessment is much more difficult, and the teacher may struggle to formulate objectives which do not contain words like "understand" and "appreciate". (Although that is not as much of a sin as some hard-liners maintain). The Academic/Induction teacher is probably the teacher we all knew in school. She has a clear body of knowledge to pass on, and your success is assessed by the extent to which your answers conform to hers. What counts as acceptable performance and knowledge, however, can always be debated: in practice the debate is often curtailed by the demands of assessment bodies, which set the "syllabus". The Academic/Constructive teacher may well be yourself—the same person as the learner— when you set out to learn about something simply because you are interested. What counts as progress may be highly individualized: the "syllabus" may be subordinated to your interests, and the most important assessment is self-assessment.

7. Model of Curriculum

a. Subject-Centered Curriculum

The subject-centered curriculum is the classical tradition. The basics of subject-centered curriculum is those subjects that many still believe all children should learn, continue to hold their place in the daily schedule, to a degree this can be attributed to the perennials view that the best of the past, the important thinking, writing and literature, is just as pertinent to the present (Ebert II & Culyer III, 2012). The subject-centered design corresponds mostly to the textbook written for the specific subject.

b. Learner-Centered Curriculum

Learner-Centered Learning is defined by Mccombs & Miller (Mccombs & Miller, 2009) as three things. First, it means that each learner through unique combination of factors, including heredity, experiences, temperament, beliefs, values, perspectives, talents, interests, capacities, and needs. This means that each learner approaches any given learning situation with a set of strengths and challenges built on the history of her or his previous learning experiences, and each person's history is at least slightly different from everyone else's. Second, being learner-centered means focusing on the best available evidence about learning, how it occurs, and which teaching practices are most likely to result in the highest levels of student motivation and achievement. Third, being learner-centered means that the content of learning the knowledge and skills needed for our future world and present realities must equip and reflection on who they are

and what the world needs. Learner-centered curriculum will allow students to participate more fully in the arrangement of their own learning experiences in such a way that two key objectives are realized. One, students will participate in the shaping of curriculum thereby addressing the imperatives of many contextual issues that include a new situational personal culture. Two, student involvement is arranged such that students engage in meta-learning; providing them the opportunity to learn about design and construction of purposeful learning activities (Emes & Cleveland-Innes, 2003).

c. Learning Field Curriculum

The “Learning Field concept “offers the best possibility to realize the principle of action-oriented vocational education. This is the concept of structuring the curriculum in vocational schools and provides orientation for planning and organizing didactical lesson. Typical of “the concept of learning field " is that the content of the subjects related to professional action and a typical work situation. Professional work process is the starting point for the development of “learning field “(Lernfelder). The central theme of “Learning the concept of field " is the development of vocational competence in the unity of professional competence, social competence, and the competence of methodical. "Learning Fields" conditioned according to the working situation, learning and assessment of students' professionalism refer to the industry such as 1) look for information, 2) plan, 3) decide, 4) realize, 5) control, and 6) assessment. (Bauer et al., 2007, p. 161). “Learning fields” are described in curriculum as thematic unities with

competence oriented.

Formulation of objectives, contents, and time are allowed. The new German curricula for vocational education will find 12-15 “Learning fields” for each profession. These are big unities with 40 to 80 hours. These big unities are divided for the educational process at school each into 3-5 learning situations. Within the “Learning field concept”, three connected terms are found : Professional action fields (Handlungsfelder) Learning fields (Lernfelder), and Learning situations (Lernsituationen). (Bader in Ahmed (Ahmed, 2010)).

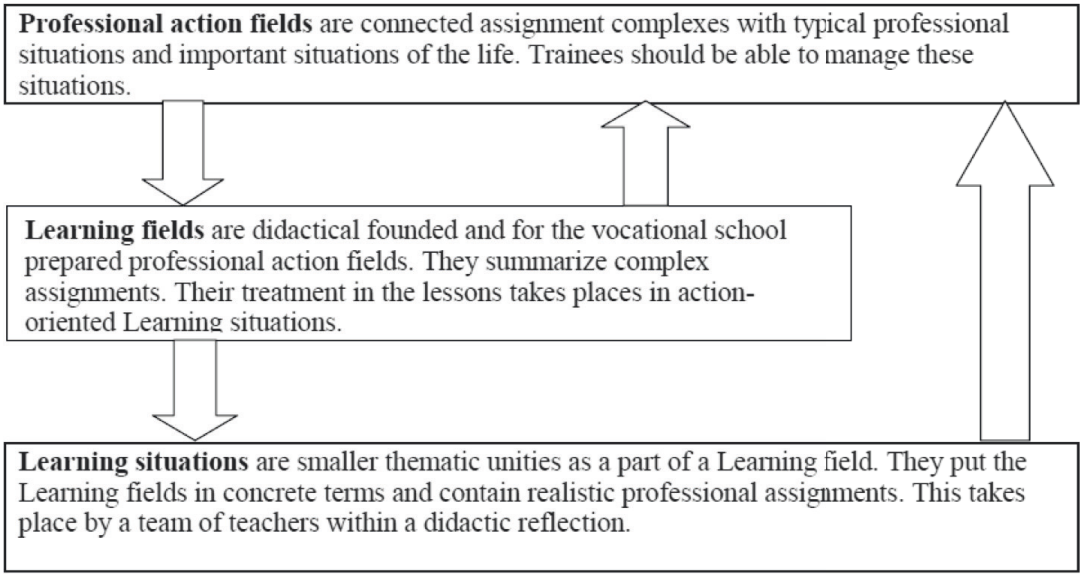

Figure 4 Connection between Professional action fields, Learning fields, and Learning situations (Source: Bader in Ahmed (Ahmed, 2010))

In this definition, there are two supporting concepts. First, the center of the curriculum is the student. This means each student has his or her own curriculum, since student often selects courses, experiences, and noncredit activities that align

with their unique personal needs and aspiration. The second is the breath of learning experiences and activities associated with a curriculum.

8. Curriculum Development in Technical and Vocational Education

a. Characteristics of the vocational and engineering curriculum

Even though vocational and technical education is included within the overall framework of education, the vocational and technical curriculum has certain characteristics that distinguish it from the rest of the education milieu, these characteristics represent a curriculum focus that may be best associated with curriculum building, maintenance, and immediate and long-term outcomes, and can be viewed from orientation, justification, focus, in-school success standards, out-of-school success standards, school-workplace-community, relationships, government involvement, responsiveness, logistics, expense. (Curtis R. Finch, 1999).

b. Orientation

Traditionally, the vocational and technical curriculum has been product- or graduate-oriented. Although a major concern of vocational education has been to provide a means for each student to achieve curricular outcomes, the ultimate outcome is more far-reaching than the educational process. The ultimate success of a vocational and technical curriculum is not measured merely through student educational achievement but through the result of that achievement, result that take the form of performance in the work world, thus the vocational and technical

curriculum is oriented toward process (experiences and activities within the school setting) and product (effects of these experiences and activities on former students).

c. Justification

The vocational and technical curriculum is based on identified occupational needs of a particular locale, these needs are not merely general feelings, they are clarified to the point that no question exists about the demand for workers in the selected occupation or occupational field, thus curriculum justification extends beyond the school setting and into the community.

d. Focus

Curricular focus in vocational and technical education is not limited to the development of knowledge about a particular area. The vocational and technical curriculum deals directly with helping the student to develop a broad range of knowledge, skills, attitudes, and value; each of which ultimately contributes in some manner to the graduate's employability.

e. In-School Success Standards

Although it is important for each student to be knowledgeable about many aspects of the occupation he or she will enter, the true assessment of student success in school must be with "hands-on" or applied performance. In-school success standards must be closely aligned with performance expected in the

occupation, with criteria used by instructors often being standards of the occupation. The student may be required to perform a certain task or function in a given amount of time using prescribed procedures, with each of these standards having its parallels in the work world.

f. Out-of-School Success Standards

The determination of success is not limited to what transpires in a school setting. A career and technical curriculum must also be judged in terms of its former students' success. Thus, there is a major concern for the product or graduate of the curriculum, particularly with respect to employment-related success. Although success standards vary from school to school and from state to state, they quite often take the form of affective job skills, technical skills, occupational survival skills, job search skills, and entrepreneurial skills. There are certainly other standards that could be added to this list; however, the above items are out-of-school success standards that career and technical education as well as business and industry leaders rank as being very important curricular outcomes.

g. School-Workplace-Community Relationships

Although it is certainly recognized that any educational endeavor should relate in some way to the community, career and technical education is charged with the responsibility of maintaining strong ties with a variety of agriculture, business, and industry-related areas. In fact, strong school-workplace-community partnerships exist in many locales. Since there are a number of potential

"customers" in the community who are interested in products (graduates), the curriculum must be responsive to community needs. Employers in the community are, likewise, obligated to indicate what their needs are and to assist the school in meeting these needs. This assistance might consist of employers serving on curriculum advisory committees, donating equipment and materials to the schools, or providing internships and shadowing experiences for students. Whatever relationship exists between the career and technical curriculum and the community, it should be recognized that strong school-workplace-community partnerships may often be equated with curriculum quality and success. Vocational and technical education is charged with the responsibility of maintaining strong ties with a variety industry-related areas, the curriculum must be responsive to community needs.

h. Government Involvement

The extent to which government involvement affects the curriculum may constitute a distinct asset or a liability. Requirements such as certain clock hours of instruction and certain types of equipment to be used in the shop or laboratory might foster a higher level of quality. On the other hand, there may be certain requirements that place undue restrictions on curriculum flexibility, and thus hinder attempts at innovation or at meeting the needs of certain student groups. Schools that desired support for the operation of vocational curricula have had to meet certain requirements, requirements such as certain clock hours of instruction

and certain types of equipment to be used in the shop or laboratory might foster a higher level of quality.

i. Responsiveness

Another basic characteristic of the career and technical and technical curriculum is responsiveness to technological changes in our society. Typically, the skills and knowledge developed in an apprentice program would be useful for the rest of one's productive life. Today, however, the situation is quite different. The Industrial Revolution and, more recent the integration of technological concepts into our everyday life have had a profound impact on career and technical education curricula. The contemporary career and technical curriculum must be responsive to a constantly changing world of work. New developments in various fields should be incorporated into the curriculum so that graduates can compete for jobs and, on they have jobs, achieve their greatest potential.

j. Logistics

Bringing together the proper facilities, equipment, supplies, and instructional resources is a major concern to all persons involved in the implementation of career and technical curricula. The logistics associated with maintaining any curriculum are often complex and time-consuming, but the sheer magnitude of most career and technical curricula makes this factor quite critical to success or failure. Some logistical concerns are associated with any curriculum. The highly specialized equipment needed to operate quality programs usually

requires regular maintenance and must be replaced as it becomes obsolete. Materials used in the curriculum must be purchased, stored, inventoried, replaced, and sometimes sold. The need for coordination of cooperation, career, and technical programs with businesses and industries in a community working closely to establish and maintain relevant work stations for students presents a unique set of logistical problems. The logistics associated with operating a career and technical curriculum are indeed complex, and these complexities need to be taken into account when a curriculum is being established and after it becomes operational.

k. Expense

This expense may depend on the particular area of instructional emphasis, but there are some items in the career and technical curriculum that show up quite regularly. These include basic operating costs such as heating, electricity, and water; purchase, maintenance, and replacement of equipment; purchase of consumable materials; and travel to work-based learning locations that are away from the school. Some of these costs are necessary to operate any school; however, the career and technical and technical curriculum may often require greater basic operating expenditures because of facilities that have a large square footage or equipment such as welders, ovens, or computers that require large amounts of energy for their operation. Equipment must be updated periodically if the instructor expects to provide students with realistic instruction, and this updating process can be very expensive. The ever-increasing costs associated with

the purchase of high-quality equipment make this area one of tremendous concern to career and technical educators. Finally, the purchase of consumable materials requires a sustained budgetary commitment to the curriculum. The expense need to be available to buy consumables as they are used by students throughout the school year.

In the statement above, the vocational and technical curriculum is oriented toward process and product, the curriculum oriented toward the student; support for that curriculum is derived from employment opportunities that exist for the graduate. The focus of vocational and technical curriculum deals directly with helping the student to develop a broad range of knowledge, skills, attitudes, and values, each of which ultimately contributes in some manner to the graduate's employability. Although it is important for each student to be knowledgeable about many aspects of the occupation he or she will enter, the true assessment of student success in school must be with "hands-on" or applied situations. The industrial revolution and, more recently, the integration of technological concepts into our everyday life had a profound impact on vocational and technical education curricula; the contemporary vocational curriculum must be responsive to a constantly changing world of work. Schools that desired support for the operation of vocational curricula have had to meet certain requirements, requirements such as certain clock hours of instruction and certain types of equipment to be used in the shop or laboratory might foster a higher level of quality. The contemporary career and technical curriculum must be responsive to a constantly changing world of work. Bringing together the proper facilities,

equipment, supplies, and instructional resources is a major concern to all persons involved in the implementation of vocational curricula, the logistics associated with maintaining any curriculum are often complex and time-consuming, but the sheer magnitude of most vocational curricula makes this factor quite critical to success or failure. Expense may depend on the particular area of instructional emphasis, but there are some items in the vocational curriculum that show up quite regularly. The different interpretations of curriculum show that curriculum is a complicated concept with ambiguous meanings. This directly reflects the complexity of curriculum research. In fact, the birth of every new definition indicates a different development of curriculum research (Zhao & Rauner, 2014). Since the late twentieth century, the following development trends of vocational education curriculum have emerged:

1. Competence Orientation: Traditional curriculum, especially in school education system, has been systematically focusing on the knowledge of scientific or technological disciplines, such that the connection between learning and working is not tight. Currently, the development of professional competence has been regarded as the orientation of curriculum development in many countries, even though there are different understandings of competence.
2. Focus on Long-Term Career Development: The curriculum based on job requirements is facing huge challenges due to the changed world of work. With the popularization of the concept of lifelong learning, the promotion of

career development, and situated learning regarding modern apprenticeship have become an important task of modern curriculum.

3. Focus on The Connection between Learning and Work: Along with the change of work organization, the connection between vocational learning and work process has become even tighter. The acquisition of work process knowledge can be achieved only through case learning in workplace and during work process. The work place has become an important venue of learning.

9. A Rationale for Curriculum Development in Vocational and Engineering Education

As a curriculum is being developed, a curriculum assists students to enter and succeed in the work world spells out success, it is hoped that these outcomes will lead to a vocational and technical curriculum that is data-based, dynamic, explicit in outcomes, fully articulated, realistic, student-oriented, evaluation-conscious, future-oriented, and world class-focused (Curtis R. Finch, 1999).

a. Data-Based

The contemporary career and technical and technical curriculum cannot function properly unless it is data-based. Decisions about whether or not to offer a curriculum need to be founded upon appropriate school and community related data. Curriculum content decisions should be made after a variety of data, such as student characteristics and the nature of the occupation being prepared for, have been gathered and examined. The quality of curriculum materials is determined

after data have been obtained from instructors and students who use them. In fact, the use of data as a basis for curriculum decisions cannot be overemphasized. The reason for this is that developers of traditional curricula have often neglected to place emphasis on the relationships that should exist between data and curriculum decisions.

b. Dynamic

It might be said that a static curriculum is a dying curriculum. Just as career and technical education is in a dynamic state, its curricula must, likewise, be dynamic. Administrators, curriculum developers, and instructors must constantly examine the curriculum in terms of what it is doing and how well it meets student needs. Provision must be made for curricular revisions, particularly those modifications that are tangible improvements and not just change for the sake of change. This does not mean that once each year or so the curriculum is checked over by a panel of "experts." Provision must be made to redirect, modify, or even eliminate an existing curriculum any time this action can be fully justified. The responsiveness of a curriculum to changes in the work world has much bearing on the ultimate quality of that curriculum and its contribution to student growth.

c. Explicit Outcomes

Not only must the contemporary career and technical and technical curriculum be responsive to the world of work, it must also be able to communicate this responsiveness to administrators, teachers, students, parents,

and employers. Broadly stated goals are an important part of any curriculum; however, these goals are only valid to the extent that they can be communicated in a more explicit manner. Although it is recognized that we cannot state all curricular outcomes in specific measurable terms, many of these outcomes may be written down in such a manner that the broad curricular goals are made more quantifiable. To the extent that outcomes are explicit, we will be able to tell whether students achieve them and how the outcomes relate to a particular occupation or field. This is perhaps the most commanding reason for ensuring that curriculum outcomes are clear and precise.

d. Fully Articulated

Although courses and other educational activities contribute to the quality of a curriculum, the way that they are arranged in relation to each other makes the difference between experiences that are merely satisfactory and experiences that are superior. Curriculum articulation may involve the resolution of content conflicts across different areas or development of a logical instructional flow from one year to the next. Articulation might extend to determining the ways co-curricular activities, such as student career and technical organizations, lend support to the rest of the curriculum or deciding which mathematics concepts should be taught as a prerequisite and/or within a particular technical course. It may include the articulation of curriculum content between career and technical and technical and general education courses.

e. Realistic

The career and technical curriculum cannot operate in a vacuum. If students are to be prepared properly for employment, the curricular focus must be one that is relevant. Content is not developed merely on the basis of what a person should know but also includes what a person should be able to do. Career and technical curriculum content is typically based upon the actual worker's role with relevant tasks, knowledge, skills, attitudes, and values serving as a foundation for what is to be taught. Great emphasis must be placed upon practicality. Since the bulk of a worker's time is spent in applied areas, many student experiences must, likewise, be of a contextual nature. Hands-on experiences in laboratory and work-based educational settings provide the student with a relevant means of transferring knowledge, skills, and attitudes to the world of work. Vocational curriculum content is typically based upon the actual worker’s role with relevant tasks, knowledge, skills, attitudes, and values serving as foundation for what is to be taught.

f. Student-Oriented

Most curricula are, to some extent, student-oriented, and curricula in career and technical education are certainly no exception. Currently there is a great deal of concern about how a curriculum can best meet students' needs. Various approaches such as team teaching and individualized instruction have been used by instructors to help meet these needs. But, regardless of the approach an instructor uses, a basic question has to be answered: To what extent will the

approach actually assist students in preparing for employment? Another aspect of student orientation deals with the teaching-learning process. Not only must the curriculum meet group needs, but there is an obligation to meet the individual student's needs. In order for these needs to be met in an expeditious manner, arrangements could, for example, be made to provide instruction that accommodates various students' learning styles, to develop individual work-based learning plans, or to make available alternate paths for the achievement of course objectives. Whatever the means used to assist students, a basic concern should be with the individual, and how he or she may be helped in the best possible ways. Vocational and technical education curricula a great deal of concern about how a curriculum can best meet student's needs.

g. Evaluation-Conscious

Evaluation is perceived by many to be an activity that comes periodically in conjunction with accreditation procedures. Realistically, administrators and instructors cannot wait that long to find out how successful they have been. Curriculum evaluation has to be an on ongoing activity-one that is planned and conducted in a systematic manner. Anyone who is involved with the career and technical curriculum should be aware that evaluation is a continuous effort. As a curriculum is being designed, plans must be made to assess its effects on students. Then, after the curriculum has been implemented and data have been gathered, school personnel may actually see what strengths and weaknesses exist. Although most educators recognize that evaluation is not a simple activity, it is one that

should be carried out concurrently with any curriculum effort.

h. Future-Oriented

Educators, particularly career and technical educators, are very much concerned about the future. What technological changes might affect the need for graduates? What types of school laboratories win be needed twenty years from now? What sorts of continuing education will be needed by students who are in school right now? These and other questions are often raised by educators who think in futuristic terms. Persons responsible for the contemporary career and technical curriculum need to ensure that ongoing curricula are considered in relation to what will or may occur in the future. As decisions are being made about curriculum content and structure, thought should be given to the future results that might come from those decisions. Any curriculum that hopes to be relevant tomorrow must be responsive to tomorrow's as well as today's needs. The extent to which a curriculum is successful twenty, thirty, or even forty years from now will be largely dependent on its future-oriented perspective.

i. World Class-Focused

In recent years, much discussion has centered on the world-class workplace. This is a place where employees are world-class performers and their collective performance results in products and services that rank among the best and most competitive in the world. Benchmarking against world-class standards, focusing on total quality, and empowering self-directed work teams are several of the ways

that businesses and industries can become world class. Likewise, curricula that prepare students to work in these businesses and industries must be sure what is taught includes world class-focused learning experiences. Before graduating, each student should know what makes the difference between world class and less than world class performance and be prepared to perform in an occupation or field at a world-class level. As more and more companies are faced with worldwide competition, persons who work for these companies must be ready to produce and provide service at this level.

In the state above a **r**ationale for curriculum development in vocational and technical education is a curriculum assists students to enter and succeed in the work world spells out success. Curriculum content decisions should be made after a variety of data, such as student characteristics and the nature of the occupation being prepared for, have been gathered and examined. Vocational and technical education is in a dynamic state, its curricula must, likewise, be dynamic, so administrators, curriculum developers, and instructors must constantly examine the curriculum in terms of what it is doing and how well it meets student needs. Vocational and technical education curricula must be able to tell whether students achieve them and how the outcomes relate to a particular occupation or field. Articulation might extend to determining the ways co-curricular activities, such as student vocational organizations, lend support to the rest of the curriculum or deciding which mathematics concepts should be taught as a perquisite and / or within a particular technical course. Vocational curriculum content is typically based upon the actual worker's role with relevant tasks, knowledge, skills,

attitudes, and values serving as foundation for what is to be taught. Vocational and technical education curricula a great deal of concern about how a curriculum can best meet student's needs. After curriculum has been implemented and data have been gathered, school personnel may actually see what strengths and weakness exist. Vocational and technical curriculum hopes to be relevant tomorrow must be responsive to tomorrow's as well as today's needs. Benchmarking against world class standards, focusing on total quality, and empowering self-directed work teams are several of the ways that business and industries can become world class.

10. Constructing Curriculum Content

The content of the curriculum requires a certain amount of flexibility and adaptability to the changing conditions of dynamic labor markets. Ute (Kassel, 2005) proposes three-phase procedure for selecting and structuring for vocational training 1) Creating Profile, 2) Module Construction, 3) Putting the Curriculum into Practice in Class.

a. Creating Profile

The phase of creating the profile describes in detail about the competency profile. This phase specifically classifies the purpose of vocational education based on work occupation (naming core tasks, making hierarchical level, labelling the course, and define the most important thing in a work occupation).

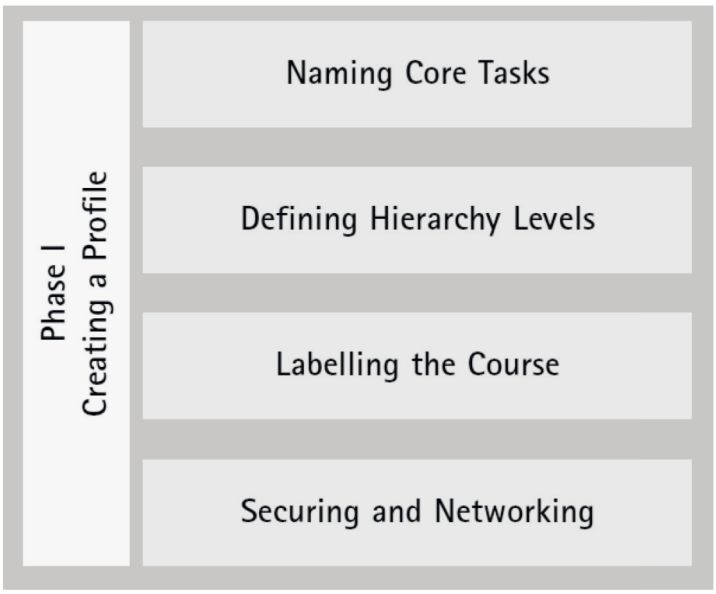

Figure 5 Phase I Creating a Profile (Source: (Kassel, 2005))

b. Module Construction

The Module Construction phase defines the content of the individual modules including Task Analysis, Competence Analysis, Didactic Analysis, and Developing a Module Structure.

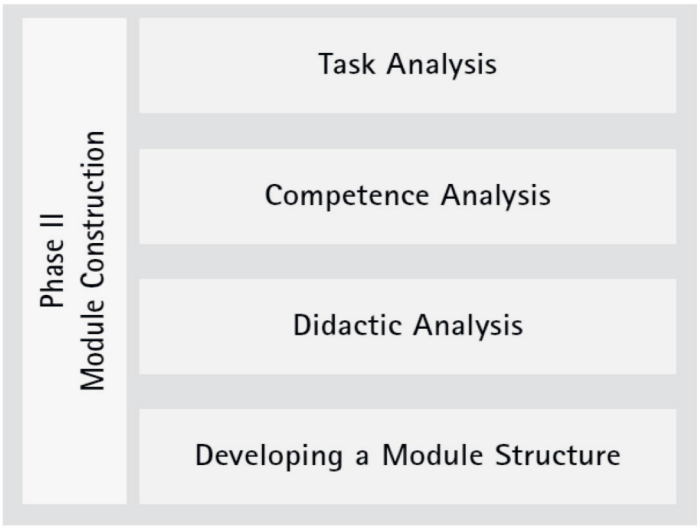

Figure 6 Phase II Module Construction ((Kassel, 2005))

Task analysis is the process of breaking a skill into smaller, more manageable steps in order to teach the skill. As the smaller steps are mastered, the learner becomes increasingly independent in his or her ability to perform the larger skill. Competency analysis is necessary to identify the knowledge, skills, and process abilities required to perform the organization's business activities so that they may be developed and used as a basis for workforce practices. Competency analysis begins with identification of the workforce competencies required to perform the organizational business activities. Once the competencies are identified, a mapping between the targeted and actual value of competencies is required to measure, analyze and predict the future capability of competencies and take necessary corrective/preventive action to either enhance or maintain the current capability. Identifying the tasks, skills, knowledge and attitude required to perform various organizational roles can be used in formulating job description, assessing employees' current level of competency, and activities like planning career development and coordinating competency development. Didactic analysis is a model to prepare an educational activity. It takes through the steps and elements of the learning experience. Elements of didactic analysis are (1) Starting situation, the first step is collecting information about the state of existing competencies and proficiencies of learners, (2) Outcomes, expectations of learners about what will be achieved in this learning experience. Learning experience itself is divided in subject matter, methods, learning activities and learning materials/aids/media.

c. Class Implementation

The last phase is Class Implementation; indicators of success can be seen after the curriculum is implemented in the learning or the learning environment

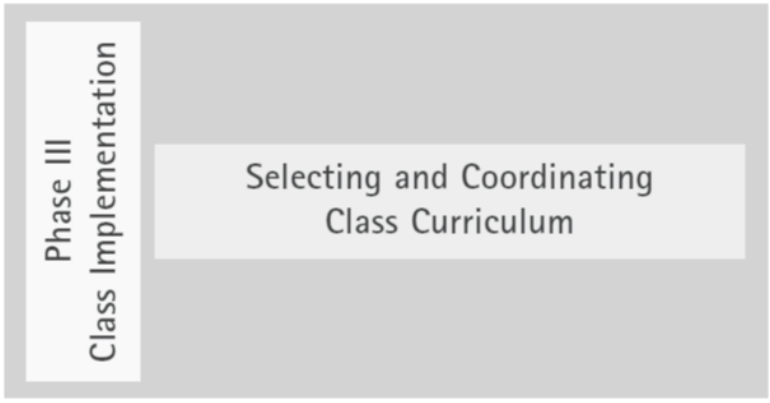

Figure 7 Phase II Class Implementation ((Kassel, 2005))

11. Vocational Education in Indonesia

Vocational education is a special education which is planned for preparing students entering industrial world dependent on the skills chosen by students and developing professional attitude in a certain profession field. It is designed for preparing someone in order to have skills for working in a group work or job field. Essentially, vocational education is inseparable with a whole education system but it has a certain characteristic which differentiate with the other subsystem education reflected on the aspects: the education oriented, justification for the existence, the curriculum, the success, the sensitiveness towards society development, the logistic supplies, and the relationship with business world society.

The existence of vocational education according to Law of the Republic Indonesia No. 20 / 2003 on National Education System (law No. 20 year 2003 on National Education System) stated that "Vocational Education is an education preparing students to be able to work in a certain field." From the statement above, in other words, vocational education has a requisition towards the preparation of professional human resources who are expected to give a big contribution to national development goal achievement so the function of vocational education is preparing students as an individual who has useful skills for their self-development. Vocational education also has a relationship with economic dimension because conceptually, it is a part of resource investment frame and the value of return from the result of vocational education, so the result should have faster chances in fulfilling the rate of return compared with general education. This is due to the objective and content of vocational education which are designed based on society development and manpower needs development related to the duties to be handled or students' career development after passing vocational education.

Vocational education in Indonesia nowadays is facing challenges in welcoming the era of free trades year 2020 in preparing manpower having competence to compete with the foreigner as a consequence from the reign of the era of Asian Free Labor Association (AFLA) and global and regional trade liberalization, so they need to improve the quality of education and the best practices. The improvement of the quality of education and vocational practices could be done by making an effort with business and industrial world's

involvement and support especially in determining various skill standards, curriculum and practice development, and the policy of organizing educational system as an effort in improving ability and competency of human resource that is fulfilling job market demands, therefore it needs interrelationships between labor supplier and industrial world that needs them in the form of straightforwardness and cooperation in determining competency standard of human resource. It is formulated conditionally by the industrial side, while the labor supplier side can develop and organize educational program for fulfilling competency standard that is expected by industry. Under Article 15 of the Laws of the Republic Indonesia No. 20 / 2003 on National Education System (article no 15 law no. 20 year 2003 about educational system standard), Vocational High School (SMK) as a form of vocational education units, is high school education that is preparing students especially for working in a certain field. According to the 2004 Curriculum, Vocational High School is designed for preparing students or graduates who are ready to work, able to develop professional attitude in vocational field, productive, and ready to face the job competition. From the statement above, the extra point of vocational high school compared with general high school is that the graduates of vocational high school are expected to fulfill job vacancy in business and industrial world as stated in the special objectives of Vocational High School as stated below:

a. Improving students' faith and devotion to God.
b. Developing students' potential to be citizens who are well behaved, healthy, educated, qualified, creative, independent, democratic, and responsible.
c. Developing students' potential to have nationality insight, comprehend, and appreciate the variety of Indonesian cultures.
d. Developing students' potential to have a concern with living environment, actively protect and preserve the living environment, and make use natural resources effectively and efficiently. (DEPDIKNAS, 2004)

As the realization of the law's instruction, Vocational High School as subsystem national education, there are some changes for the sake of correction and improvement of the quality of education result. It prepares the graduates to work in a certain field with the provision of knowledge, skill, and way of work which depends on the business and industrial world's needs or even entrepreneurship. Based on the research conducted by Indonesian Science Department (LIPI), it is stated that most graduates of Vocational High School are not so able to adapt themselves with the science and technology changes, hard to re-exercise, and not so able to develop themselves (Vocational High School Curriculum, 2004). The result of the research found that the teaching and learning process in Vocational High School was not enough in developing students' adaptive skills. Students need to be prepared more seriously by sharpening their adaptive skills and emphasizing local strength in line with the requisition of competency standard of Vocational High School graduates. In the other words, the

students' competence needs to be more developed thoroughly and balance considered from life skill aspects of Vocational High School graduates.

Meanwhile, there is still a big problem and challenge to improve the quality and quantity of technology and vocational education in Indonesia. The process of completing or correcting the high quality and complete vocational high school education for creating an intelligent and competitive human being in the future according to Directorate of Vocational High School Development (2008) had been done and resulting in three main pillars, they are: "(1) Distribution and enlargement of the educational access; (2) Improvement of the quality, relevance, and competitiveness; and (3) Way of strengthening management, accountability, and public creation". The consequence of requisition above is that educational system and training in Vocational High School should be able to prepare the graduates to have competences based on industrial standard whether nationally or internationally, so competency standard will be the basis of curriculum development and training program, teaching and learning materials, competency and certification test, teacher's competence and training management (DEPDIKNAS, 2008).

According to the Indonesian Government Regulation No. 19 / 2005 on the Educational National Standard (Indonesian Government Regulation No. 19 Year 2005 on National Education Standards), education standards in Indonesia cover: content standard, process standard, competency standard of graduates, teacher and educator standard, infrastructure standard, management standard, financial standard, and educational assessment standard. The achievement of competency

standard is set by industry, business world, profession association, so training substance in Vocational High School is wrapped in the various education and training which are grouped and organized into a normative, adaptive, and productive program.

Normative Program is group of educational and training lessons which are useful to build students to be a complete person who have life norms as individual or social being whether as an Indonesian citizen or world citizen. Adaptive Program is group of educational and training lessons which are useful to build students as an individual having wide and strong prior knowledge to be able to adapt with the changes happened in the social environment, working environment, and able to develop themselves along with science, technology, and art development. Productive Program is group of educational and training lessons which are useful to build students as an individual having work competence based on Indonesian National Working Competency Standard (SKKNI) and competency standard which is agreed by the representative forum of business/industrial world or profession association (DEPDIKNAS, 2004).

12. 2013 Curriculum

2013 Curriculum takes effect from the academic year of 2013/2014. The purpose of the 2013 Curriculum is to prepare Indonesian people to have the ability to live as individuals and citizens who are faithful to God, productive, creative, innovative, affective, and able to contribute to the society, nation, state, and world civilization. In the book of 2013 Curriculum Document issued by the Ministry of

Education and Culture in 2012, mentioned the characteristics of the curriculum in 2013 is as follows:

1. The curriculum content. 2013 Curriculum realized in Core Competence (KI) subjects and further is specified in the Basic Competency (KD).
2. Core Competence (KI) is a categorical description of the competencies that must be learned by learners of school level, class, and subjects.
3. Basic Competency (KD) is a learned competence of learners to a subject in a particular class.
4. The emphasis of attitude competence, cognitive skills, psychomotor skills, and knowledge to an education unit and subjects is characterized by the KD number of subjects.
5. The learning process is based on efforts to be a master in competencies at a satisfactory level by observing the characteristics of competence where knowledge content is content that is complete (mastery). Cognitive and psychomotor skills are the ability of mastering content that can be trained. The attitude is the ability to master the more difficult content to develop and require educational process indirectly.
6. Assessment of learning outcomes covering all aspects of competence is formative; and the results are followed by remedial learning to ensure mastery of competencies at a satisfactory level.

To implement the concept of similarity between high school and vocational high school curriculum, compulsory subjects and optional subjects are developed.

Compulsory subjects include as many as 9 (nine) subjects with study load of 18 hours per week. Curriculum content (Core Competence / KI and KD) and packaging content as well as content label (subjects) for the compulsory subject for high school and vocational school are the same. This structure puts the principle that learners are subject in the study and they have the right to vote in accordance with their interests. In 2013 Curriculum Structure, the compulsory subjects are also known as subjects of Group A and Group B. Optional subjects consist of academic selection for Senior High School (SMA) as well as the choice of academic and vocational for Vocational High School (SMK). The optional subjects provide shades to the function of educational units and in it there is a choice in accordance with the interests of learners. The load of learned subjects in high school for Year X, XI, and XII is respectively 48 hours of study per week. One study hour is 45 minutes. In 2013Curriculum Structure, elective subjects are also known as Group C or Competency Skills.

The structure of high school and vocational high school curriculum for compulsory subjects can be seen in Table 1.

Table 1 Structure of High School and Vocational High School Curriculum for Compulsory Subjects

Subjects	Time allocation for subjects per week			
		X	XI	XII
	Group Subject A			
1.	Religion	3	3	3
2.	Pancasila and Civic Education	2	2	2
3	Bahasa	4	4	4
4	Mathematics	4	4	4
5	Indonesian History	2	2	2
6	English	2	2	2
	Group Subject B			
7	Art	2	2	2
8	Craft and Entrepreneurship	2	2	2
9	Sports, Physical Education, and Health	3	3	3
	Time allocated per week	24	24	24

Basic competence in the compulsory subjects provides the same basic capabilities for Secondary Education graduates for those studying in high school and vocational school. For those who choose a high school or vocational school, they have choice to choose groups (majors), specialization, and free subjects. Specialization Group names are used because they have the openness to learn outside the group; while the department has the connotation of the name is limited to what is available in the majors and prohibit taking subjects outside the department.

13. Spectrum of Expertise for Vocational Education

The spectrum of vocational secondary education in 2013 was based on a "decision of the General Director of Education, Ministry of Education and Culture" number 7013 / D / KP / 2013 on Spectrum of Expertise for Vocational Secondary Education. This spectrum consists of nine subject areas of expertise, namely:

a. Technology and Engineering
b. Information and Communication Technology
c. Health
d. Agribusiness and Agro-technology
e. Fisheries and Maritime Affairs
f. Business and Management
g. Tourism
h. Arts and Crafts
i. Performing Arts

Computer and Network Engineering skills are included in the area of Information and Communication Technology skills.

14. Pack of Computer and Network Engineering Skills

Computer and network engineering competency skills provide students to master skills in troubleshooting PCs and laptops, troubleshooting networking (LAN and WAN), as well as network administration. For productive subjects,

students learn an important lesson of computer and network engineering with a composition of 30% theory and 70% practice. The material studied by students is a matter of assembling the PC and Laptop, LAN (Local Area Network), WAN (Wide Area Network), Server, Network Administration.

In implementing the study, every school refers to the 2013 Curriculum structure in the determination of the subjects to be taught to students. Based on the 2013 Curriculum Document page 14 issued by the Ministry of Education and Culture, in the 2013 Curriculum structure, there are three groupings, namely the subjects of Group A, Group B, and Group C. Group A is the subject to provide orientation on aspects of intellectual and affective competence. Group B is in the aspect of Affective and Psychomotor. Group C is the group of subjects which are suited to the specialization (majors) of the students. Group C is further divided into C1, C2, and C3 to adjust the subject area of expertise, skills programs, and skill pack.

The curriculum structure for Vocational High School on expertise field of Information and Communication Technology in the Program of Computer Engineering and Information Package Expertise computer technical and computer network in Curriculum 2013 contains a whole list of subjects to be studied by students of packages expertise in TKJ at the level of X, XII, and XII. List of the subjects Group A and Group B are shown in Table 2. Meanwhile, the list of Group C subjects studied by students can be seen in Table 3.

Table 2 2013 Curriculum Structure for Computer and Network Engineering Group C-C1

SUBJECT		Grade					
		X		XI		XII	
Groups C (Major Subjects)							
C1. Basic Skills							
	Physics						
	Basic Programming						
	Computer System						

Group C-C1 is taught specific subjects in the field of expertise. Another skill program from the field of Information and Communication Technology skills which also receives these materials is the membership program of Telecommunication Engineering and Broadcasting Engineering.

Table 3 2013 Curriculum Structure for Computer and Network Engineering Group C-C1

SUBJECT		Grade					
		X		XI		XII	
Group C (Major Subject)							
C2. Basic Skills							
	Computer Assembly						
	Digital Simulation						
	Operating System						
	Basic Network						
	Web Programming						

Table 4 2013 Curriculum Structure for Computer and Network Engineering Group C-C3

SUBJECT		Grade					
		X		XI		XII	
C3. Skill Packet							
Computer and Network Engineering Skill Packet							
	1. Applied Computer						
	2. Data Communication						
	3. Network Operating System						
	4. Server Administration						
	5. Network Design						
	6. Wireless Network						
	7. Network Security						
	8. Network *Troubleshooting*						
	9. Work Project						2
TOTAL		**8**	**8**	**8**	**8**	**8**	**8**

15. Vocational Education in Computer and Network Engineering

Vocational High School expertise program, Computer and Network Engineering (TKJ), is a part of expertise fields of technology and industry with the department of Information and Communication Technology skills. The objective of expertise program of Computer and Network Engineering generally refers to the content of Laws of the Republic Indonesia on National Education System, Article 3 regarding the National Education Objective which is explained on Article 15. Especially, the objective of expertise program of Computer and Network Engineering is to provide the students with skills, knowledge, and attitude to make them competent in:

a. installing personal computer device and operating application system;
b. installing Local Area Network device;
c. installing Wide Area Network device;
d. designing structure and administering Local Area Network; and
e. designing structure and administering Wide Area Network.

The effort for creating vocational high school students who fulfill the requisition of the objectives of Computer and Network Engineering Skill program and industrial world needs to be supported with the curriculum which is designed and developed by considering the needs of industrial world. By the curriculum support, it is expected that Vocational High School will be able to create the graduates who have a readiness to compete with others and a qualification of certain working field based on the expertise field of Computer and Network Engineering. Competency standard of the expertise field of Computer and Network Engineering is based on the Indonesian National Working Competency Standard (BNSP, 2008:12) which is divided into:

a. Network Analysis, is a job for determining or creating specification from network system that will be made. Specification of network system will be achieved based on the needs of network user candidates.
b. Network Design, is a job for designing a network configuration and determining network components that will be involved. The designing is done based on the specification of determined customers' needs.

c. Network Fabrication, is a job for choosing and buying network components that is needed, and doing the simple installation to simulate the designed configuration.
d. Network Testing, is a job for checking simulated installation, whether it can work well based on the determined specification, including doing network testing and the simulation of network structure design.

The implementation of teaching and learning in Vocational High School, especially technology and industrial field in the expertise program of Computer and Network Engineering is aimed to develop the students' academic potential and personality, to master the standardized competency, and to internalize attitude and professionalism value as a highly qualified manpower as the need and development of industrial world and current technology. The learning process of the students should be based on the determined plan in order to achieve the competency mastering. Teaching and learning process can be done in the school or industrial world. Teaching and learning process in the school is aimed to develop the students' academic potential and personality, master science and technology as needed by the development of industrial world and teaching-learning/training process. While industrial world is aimed to make students master the standardized competence, develop, and internalize attitude and professionalism value as a highly qualified manpower, whether when working as an employee or as an independent worker. To adjust the competence with industrial world requisition, the government had designed a link and match policy

as a solution for solving the problem about the obvious relationship between educational organizer and society needs, that is industrial world for the graduates. The policy is basically as a media to build a partnership with vocational education. By this partnership, indirectly, planning and implementation of vocational education program are considering the tendency of requisition of job market needs, which is expected to be able to improve the quality of the graduates of Vocational High School. The current curriculum that is implemented in the Vocational High School is the 2013 Curriculum. It is based on 8 (eight) Educational National Standards that involve content standard, competency standard of graduates, teacher and educator standard, infrastructure standard, management standard, financial standard, and educational assessment standard. Specifically, the objective of the 2013 Curriculum is for preparing Indonesian in order to have a living ability as an individual and citizen who is faithful, productive, creative, innovative, and affective, also to be able to give contribution towards the life of the community, the people, the nation, and the world civilization. The ability had been accommodated in the curriculum of Vocational High School that includes several groups of Normative (C1), Adaptive (C2), and Productive (C3). The teaching-learning process of productive program (C3) is an important element in the implementation and training in Vocational High School. In its implementation, it has 2 main characteristics in the form of competence-based teaching and learning process, and also in the form of planning, implementation, and assessment that refer to programmed competency mastering between Vocational High School and its couple institution; while production-based teaching and learning process is a process and working

standard that is done in the real job for creating things or services based on the costumers' and market requisition**.**

Electronic Technician Association Founded in 1978 (Association, 2014), the Electronics Technicians Association, International (ETA® International) represent the electronics industry, from the technician and educator to the corporate institution. ETA has issued over 150,000 technical certifications covering more than 80 certification programs in a variety of technology fields. ETA International represents a wide variety of professionals from many industries, including: Avionics, Biomedical, Data Cabling, Fiber Optics, Gaming & Vending, Industrial Electronics, Information Technology, Renewable Energy, Smart Home, and Wireless Communications. ETA also offers FCC Commercial Radio Operator licensing. Employers worldwide choose ETA-certified professionals because of ETA's certification programs' competency criteria and testing benchmarks that conform to the highest international electronics standards. ETA-certified professionals work for some of the most widely-known companies, including Bellsouth, ADT Security, American Airlines, AutoZone, Boeing, Budweiser, Canon, Caterpillar, Ford Motor Company, Google, Home Depot, Kmart, Lockheed Martin, Motorola, Quest Communications, Raytheon, State Farm, TD Ameritrade, Verizon Communications, and many more.

ETA describes The Computer Service Technician as performing hardware servicing and providing systems software skills for personal computers. The knowledge used includes Computer Assembly/Disassembly; Motherboards; Buses; System Resources, Processor Characteristics; Physical and Electronic Memory Characteristics; Secondary Storage Devices; Peripheral Devices; Ports; Power Concepts and Supplies; Basic Networking; Portables; Digital Concepts; Troubleshooting/Preventive Maintenance; Operating Systems;

File Management; Safety, Security and Workplace Practices. ETA also describes a Network Systems Technician as a network professional who is expected to obtain knowledge of computer network basic concepts, which are applicable to the various specialty areas of the computer industry. The NST must be familiar with the followings: Computer Network Terminology, Network Administration, Wide Area Networks and Devices Used to Extend Networks, Network Architectures, Computer Network Topologies and Classifications, Network Services, Network Operations, Network Standards, Troubleshooting LAN/WAN Test Equipment, Network Server and Workstation Computer System Hardware, Network Operating Systems, and Disaster and Security Planning for Networks

B. Related Research

(Cedefop, Curriculum reform in Europe, 2012) The curriculum development process faces a number of challenges that need to be carefully considered from the outset. The appropriate use of expertise can help overcome some of these challenges. (William & Hiebert, 2002) Technical and vocational education and training (TVET) is often regarded as inferior, or as a second choice after professional education, regardless of the student's interests (indeed passions) or abilities. Many people therefore dismiss promising and meaningful career paths in areas where employment demand is greater, simply because of the stigma attached to technical and vocational occupations. Education systems continue to be directed primarily towards preparation for university education, even though the majority of students move directly into the labor force. Elwood and James (F. Holton & Jr, 1996) argue that vocational education and HRD have a significant opportunity to be a force for changes in preparing a world class workforce. Forging these linkages will help ensure successful, vital programs. A mutually supportive relationship with HRD is one dimension that should not be overlooked. The potential benefits from this relationship span all levels from preparation for job entry, through university programs at both undergraduate and graduate levels, to on-the-job training. It is a logical marriage with deep historical and philosophical roots that represents a true win-win for both. There are at least two broad approaches to matching VET supply and demand for qualifications in initial VET. First, broader supply profiles to absorb change by increasing flexibility of individuals and enterprises (the flexibility approach). Second, the specific supply profiles linked to demand (the

specificity approach). The first approach avoids the problem of visible mismatch but makes the quality of matching difficult to judge. The latter solution poses the problem of adaptation to changing demands. In reality, most systems mix flexibility and specificity.

C. Conceptual Framework

DACUM is an acronym for Developing a Curriculum. It was developed in British Columbia, Canada in 1968, and has been tested by several institutions in Latin America, Asia, and Africa.

DACUM is a competence - based method of curriculum development. It can be used for developing curricula for long or short courses in various disciplines. The DACUM process enhances the ability of learners to meet specific objectives formulated according to set standards. The process works on the following principles:

1. Stakeholders (workers, employers, farmers, etc.) can define their job requirements more accurately than anyone else.
2. Any job can be effectively described in terms of the tasks that successful workers in that occupation perform.
3. A curriculum for a specialized training should aim at developing the required competencies for performing the identified tasks.
4. In order to be performed correctly, all tasks demand certain knowledge, skills; and The DACUM process has four main components: The planning stage, the DACUM workshop, data analysis, and the development of the course.

1. The planning stage

The planning stage involves the review of existing information about training needs and decision about the course to be offered, identification of DACUM facilitator, venue for the DACUM workshop, the workshop participants, and the required resources for the process.

Information review: It is important that the training to be offered is put in the context of the needs of the sector, and the general education ideologies/philosophies, if the training is to appeal to many trainees, attract funding, and also be sustainable. A review of existing information or studies will therefore, greatly help in focusing on identified training gaps. In instances of limited information, a training need assessment survey should be carried out.

The DACUM facilitator: The DACUM workshop is largely dependent on the facilitator. The identified facilitator must be knowledgeable about DACUM, and should ensure maximum coverage of each topic and elicit contributions from all participants. The DACUM facilitator should be impartial, patient, and tolerant. S/he must be skilled with the techniques of task analysis and group dynamics.

The workshop venue: A venue for the workshop should be carefully chosen to take into consideration factors such as easy accessibility, availability services, and minimum interruption of proceedings.

Identification of workshop participants: Effort should be made to have representation from the various categories of stakeholders at the workshop. These should include both outsiders and insiders while paying special attention to the results of the stakeholder interest assessment and the stakeholder

importance/influence analysis.

2. The DACUM workshop

The DACUM workshop is the focal point of the curriculum development where different categories of stakeholders who are interested in the graduates of a training program, are gathered to define the competencies required of the graduates. The workshop has five steps:

a. *The introduction* - this exposes participants to the objectives of the workshop, the process, and the expected outputs.

b. *Agreement on the span of possible job positions* - this secures consensus of the stakeholders on the job positions that can be available for graduates of the curriculum.

c. *Identification of duties* - assists in defining the major areas of knowledge, skills, and attitudes that the graduates must have as basic components of competencies.

d. *Identification of tasks* - this stage describes in detail the tasks which the graduates of the curriculum "must be able to do" focusing on one job position and duty at a time.

e. *Refining and production of the competence chart* - this stage enables participants to agree on the accuracy of the DACUM chart.

3. Analysis of DACUM Chart

Each of the statement in the DACUM chart is stated in a behavioral form, completing the statement "The graduate will be able to ...." Each cell in the DACUM chart represents clearly identifiable knowledge, skills, and attitudes that must be developed. Some cells may have common characteristics - these should be considered for merging. The question that follows is "what topics must be studied to enable the graduate to perform the tasks identified in each cell?" Educators who are familiar with the field of study normally address this question. Topics are listed for each cell. These are later assembled in a logical manner to form subjects that will be taught. Note that a topic may appear in several cells. This merely demonstrates its relative importance. At the end of this stage a listing of the subjects or modules is possible. Then subject matter specialists refine the contents of the subjects to be taught to achieve the desired objectives. It is important that a thorough analysis of the DACUM chart is carried out because the outcome at this stage greatly influences the next process in terms of time distribution, and course content.

4. Course Development

During course development, it is important to rank and sequence modules to determine core modules and the order of teaching. Training objectives for the course, general objectives for each module/topic, and time allocation are also carried out during course development. It is also important to define the training paradigm or philosophy at this stage.

D. Research Questions

This research seeks to answer the following research questions:

1. What are the qualification standard of Computer and Network Engineering major?
2. What is the curriculum of Computer and Network Engineering major that is currently implemented like?
3. What are the competences in the field of Computer and Network Engineering demanded by industries?
4. What is the curriculum of Computer and Network Engineering major that is appropriate with what industries demand?

CHAPTER III

METHODOLOGY

A. Research Design

The problem to be studied by the researchers was a social and dynamic matter. This study used mixed research design or a combination of some methods that is qualitative in nature. This method was employed to reveal detail phenomenon. In-depth study on how the curriculum for computer and network engineering major was developed was also carried out quantitatively to clarify and sharpen the qualitative data so that the obtained data and information were more comprehensive, valid, reliable, and objective. Therefore, the researchers chose to use qualitative research methods to determine how to look for, collect, process, and analyze the data from this study. The method used was non-hypotheses, descriptive explorative method using survey approach. This method aimed at describing something, variables, objects, symptoms, incidence, factual, and systematic order. “Explorative” meant answering the questions that had been formulated in the study. “Non-hypothesis” meant not using the hypothesis as the instructions/directions in research instead the study only described clearly and sequentially the research questions that had been determined before the researchers went into the field. Creswell (2008: 552) stated that “A mixed methods research design is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative data at some stages of the research process within a single study, to understand a research problem more completely."

The data were collected through participant observations, in-depth interviews, and focus group discussions. The steps of the research were (1) identifying the problems, (2) limiting and formulating the problem clearly, (3) determining the objectives and benefits of the research, (4) conducting literature review; (5) determining the research framework and questions, (6) creating a research design that included determining the population, sample, sampling techniques, and instruments, (7) collecting the data; (8) organizing and analyzing data, and (9) creating a research report. Qualitative research could be used to understand the social interaction, such as in an in-depth interview which could reveal a clear pattern.

B. Research Setting

1. Research Location

The study was conducted in five internet service provider companies in Yogyakarta which had some branch offices in other provinces in Indonesia and was the member of Indonesian Internet Service Provider Association. The companies that were used as the research subjects were those which ran their business in the field of Internet service and computer device providers located in the territory of Indonesia, had operated for more than 5 years, recruited vocational graduates-TKJ major as employees, and became a partner for schools in implementing the job training program for vocational students, especially Computer and Network Engineering major students. After observing some companies, the researcher got a list of companies that met the above criteria, as

shown in Table 5:

Table 5 List of the Companies

No	Company	Address
1	Axioo education	Mitra Abadi Building 2nd Floor : Jl. Bukit Indah 1 no 105F Ciumbuleuit Bandung – 40142
2	PT Global Prima Utama	Jalan Cik Di Tiro no. 1, Yogyakarta
3	PT Lintas Data Prima	**Head Office** Darmo Residence No.1, Sonopakis Kidul, Bantul Yogyakarta Telp : 0274-6670303 Email : info [at] ldp [dot] net [dot] id **POP Jakarta** IDC 3D Duren Tiga Jakarta Jl. Duren Tiga Raya No. 7H Email : info [at] ldp [dot] net [dot] id **POP Surakarta** Springville Residence No. B1 Jl. Mangesti Raya, Gentan Sukoharjo 57556 Telp (0271)7882088 / 7882188 Email : info [at] ldp [dot] net [dot] id **POP Bali** Jl. ByPass Ngurah Rai No. 227/229 Denpasar Bali 80228 Telp : 0361-3333933 Email : info [at] ldp [dot] net [dot] id **POP Madiun** Jl. Letkol Suwarno, Perum. Bumi Mas 1 no. 20 Madiun, Jawa Timur Telp : 0351-7771711 Email : info [at] ldp [dot] net [dot] id **POP Ngawi** Jalan Ahmad Yani No.90 Ngawi Email : info [at] ldp [dot] net [dot] id
4	PT. Media Sarana Data	**Head Office :** Jl. Daradasih No. 11A Patangpuluhan Wirobrajan Yogyakarta 55251 Telp. 0274-380345, Fax. 0274-379593 Email. info@gmedia.co.id **Semarang Office :** Jl.Jangli Dalam No. 29J Semarang - Jawa Tengah 50254 Telp. 024 - 850 9595, Fax. 024 - 850 9696 Email. info.smg@gmedia.co.id **Jakarta Office :** Ged. Cyber Lt. 5 Jl. Kuningan Barat No. 8 Jakarta Selatan 12710 Telp. 021-5210810 Fax.021-52905141 Email. info.jkt@gmedia.co.id **Bali Office :** Lucky Square Kav G Jl. Gunung Andakasa, Penamparan Denpasar - Bali Telp. 0361 - 4715157, 4715158, 4715159,

		Solo Office : Jl. Pandu Dewanata 110 Kartopuran Solo - Jawa Tengah Telp. 0271 - 668 800 Email. info.solo@gmedia.co.id **Salatiga Office :** Jl. Argoboga No. 35 D Salatiga - Jawa Tengah Telp. 0298 - 342 9797 Email. info.smg@gmedia.co.id	4715160 Email. info.bali@gmedia.co.id **Surabaya Office :** Graha Pena Building 14th Floor Suite 1401 Jl. Ahmad Yani 88 Surabaya Telp. 031 - 8282 683 Email. info.sby@gmedia.co.id
5	CV. Indoakses	Jalan C Simanjuntak 12 Yogyakarta 55223	

2. Research Time

This research was conducted in January 2014 to August 2015.

C. Analysis Unit

1. Research Subject

In this study, the research subject was the company that could be used as a data source. Criteria for the company, the name, and the location of the company were mentioned in the previous subsection. Respondent in the company was the technical manager. Furthermore, the documents of the research were documents from the electronics technician especially the computer and network technician document, Indonesian competence standard document, especially computer service technicians and computer network administrator.

2. Research Objects

The objects of this research were the computer and network engineering curriculum and competencies needed in the workplace. Specifically, the curriculum studied in computer and network engineering was a list of subjects used as core competencies, while the competence used in the world of work were derived from the list of competencies that were used in the company where the data were collected.

D. Operational Definition of the Research Variables

This research had two main variables: (1) the curriculum studied in Computer and Network Engineering major which was a list of subjects as core competencies and (2) technical competence of Computer and Network Engineering that were needed by companies engaged in the information technology field.

The operational definition of those variables were created in order to explain the variables used and avoid misinterpretation. The operational definitions of the variables used were as follows:

1. Computer and Network Engineering Competency

Computer and Network Engineering skill competency, the capability to apply or use a set of related knowledge, skills, and abilities in Computer and Network Engineering was required to successfully perform "critical work functions" or tasks in a defined work setting. Competencies in Computer and Network

Engineering often served as the basis for skill standards that specified the level of knowledge, skills, and abilities required for success in the workplace as well as potential measurement criteria for assessing competency attainment. Industrial work in this research was the company that organized the Internet connection services and other services related to computer or network engineering.

2. Computer and Network Engineering Curriculum

Computer and Network Engineering curriculum was a list of subjects which was designed to give lesson to the participants in a period of education in vocational high school majoring in Computer and Network Engineering.

E. Data Sources

1. Primary data

The primary data were the informants' words spoken verbally, gestures, or behavior which could be trusted, were related to the research variables, or were obtained directly from them.

2. Secondary Data

The secondary data were obtained from data collection techniques that supported the primary data. In this research, the secondary data were collected through review of some literatures such as books, journals, and websites.

3. Sampling

The sampling method used in this research was purposive random sampling method. The samples must fulfill the following criteria:

a. Industries

1) The company must be the member of Indonesia Assosiciation of Internet Service Provider.
2) The company had been operating for 5 years or more.
3) The company had a branch/branches in another province in Indonesia.
4) The person for in-depth interview was the company's technical manager.

b. Vocational High School

1) The vocational high school had a good track record.
2) The respondens were teachers who had teaching experience of more than 5 years.

F. Data Collection Techniques and Research Instruments

1. Data Collection

Data collection techniques were the ways that the researcher used to get the data in research. In this research, the researcher chose the type of qualitative research, the data obtained should be deep, clear, and specific. Researcher used qualitative data collection techniques such as observation, documentation, interviews, and focus group discussion. Qualitative research was aimed at gaining a deep understanding of a specific organization or event, rather than surface description of a large sample of a population. It aimed to provide an explicit rendering of the structure, order, and broad patterns found among a group of participants. It was also called ethnomethodology or field research. It generated data about human groups in social settings. Qualitative research did not introduce

treatments or manipulate variables, or impose the researcher's operational definitions of variables on the participants. Rather, it let the meaning emerge from the participants. It was more flexible in that it could adjust to the setting. Concepts, data collection tools, and data collection methods could be adjusted as the research progresses. Qualitative research aimed to get a better understanding through first-hand experience, truthful reporting, and quotations of actual conversations. It aimed to understand how the participants derive meaning from their surroundings, and how their meaning influenced their behavior.

Qualitative research used observation as the data collection method. Observation was the selection and recording of behaviors of people in their environment. Observation was useful for generating in-depth descriptions of organizations or events, for obtaining information that was otherwise inaccessible, and for conducting research when other methods were inadequate. The three most common qualitative methods, explained in detail in their respective modules, were participant observation, in-depth interviews, and focus groups. Each method was particularly suited for obtaining a specific type of data.

a. Participant Observation

Participant observation was appropriate for collecting data on naturally occurring behaviors in their usual contexts. Participant observation was a qualitative method with roots in traditional ethnographic research, of which objective was to help researchers learn the perspectives held by study populations (Duke, 2015). A qualitative researcher presumed that there would be multiple perspectives within any given community. Qualitative researchers were interested

both in knowing what those diverse perspectives were and in understanding the interplay among them. Qualitative researchers accomplished this through observation alone or by both observing and participating, to varying degrees, in the study community's daily activities. Participant observation always took place in community settings, in locations believed to have some relevance to the research questions. The method was distinctive because the researcher approached participants in their own environment rather than having the participants come to the researcher. Generally speaking, the researcher engaged in participant observation tried to learn what life was like for an "insider" while remaining, inevitably, an "outsider." While in these community settings, researchers made careful, objective notes about what they saw, recording all accounts and observations as field notes in a field notebook. Informal conversation and interaction with members of the study population were also important components of the method and should be recorded in the field notes, in as much detail as possible. Information and messages communicated through mass media such as radio or television might also be pertinent and thus desirable to document.

b. In-Depth Interviews

In-depth interviews were optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics were being explored. An in-depth interview was an open−ended, discovery−oriented method that was well suited for describing both program processes and outcomes from the perspective of the target audience or key stakeholder. An in−depth interview was a conversation with an individual conducted by trained staff. The

goal of the interview was to deeply explore the respondent's point of view, feelings, and perspectives. In−depth interviews could be used to obtain preliminary information that could be used to develop more concrete quantitative and qualitative surveys. In essence, in−depth interviews involved not only asking questions, but the systematic recording and documenting of responses coupled with intense probing for deeper meaning and understanding of the responses. Thus, in−depth interviewing often required repeated interview sessions with the target audience under the study. Unlike focus group interviews, in−depth interviews occurred with one individual at a time, or sometimes pairs of respondents, to provide a more involving experience.

c. Focus Group Discussion

Focus groups were small structured groups with selected participants, normally led by a moderator. Focus groups were set up in order to explore specific topics, and individual views and experiences, through special groups in terms of purposes, size, composition, and procedures. Lita Litoselliti (Litosseliti, 2007) described a focus group as ‘a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment, where participants share and respond to comments, ideas and perceptions’. It was important that those taking part found the discussion comfortable and enjoyable, did not feel pressurized to make decisions or reach consensus, and were encouraged to express different point of views. Groups were focused in the sense that they involved some kinds of collective activities around a small number of issues and were interactive in that the group forces and

dynamics. Focus groups were facilitated by a moderator, who guided the discussion using a number of predetermined and carefully developed open-ended questions, with minimal intervention. The moderator maintained the group's focus, discussion developed, and the participants did not shift away from the topic of discussion or dominated it. To moderate a group successfully required considerable planning and a moderator with good communication, managing, and interpersonal skills.

In this research, according to the research object, the researcher chose participant observation and interview for data collection. Participant observation was an observation technique in which the researchers took part in the activities undertaken by the object under investigation. This observation was done by observing and recording directly to the object of the research, by observing the activities of existing activities in 5 companies. With participant observation, the researcher could determine the informant to be studied; his/her position, task/activities, addresses, and telephone number to make it easy to get the information for research purposes.

Interviews have 3 types, structured, semi-structured, and in-depth interview. The researcher chose an in-depth interview to collect complex information, opinions, attitudes, and personal experience. To avoid loss of information, the researches requested permission to the informant to use tape recorder. Before conducting the in-depth interviews, the researchers explained or provided a snapshot, background, and clarity on the topic of the research.

The researcher must consider how to conduct interviews, which were as follows:

1) The interviewer should avoid words that had double meanings, taxa, or ambiguity.
2) The interviewer should avoid lengthy questions containing specific questions.
3) Long question should be broken down into several new questions.
4) The interviewer should ask the concrete question with the clear time and place.
5) The interviewer should ask questions in order to explore respondent's real experience.
6) The interviewer should mention all of the available alternatives or did not mention an alternative.

2. Research Instrument

In this qualitative research, which became the instrument or tool of the research was the researcher himself. By understanding qualitative research methods and having mastery of the knowledge to the field under study, the researcher was ready to be the research instrument-both academically and logically.

CHAPTER IV

FINDING AND DISCUSSION

Presentation and analysis of the data in this study referred to the observation, in-depth interviews, documentation, and focus group discussion. The observations were observation participant, where the researcher worked directly in 5 companies and internet service providers and involved in their work. In-depth interviews were conducted with five internet service provider companies by conducting interviews with the technical managers. Documentations were collected from the Indonesian National Board of Professional Standards and Electronic Technician Association. Focus group discussions were held with teachers, computer engineers and computer networks experts, and curriculum experts. Retrieval of data in the world of work (company) aimed to seek the competence of the computer and network engineering major that must be possessed by the graduates of vocational high schools.

A. Finding

Based on the data collected in industry, data on the competencies required and used in industry were obtained. The data from observation method were collected by approaching the respondents directly and systematically and organizing records with interview guides that had been prepared. List of the industrial samples was presented in Chapter 3.

1. Data From Industries, International And National Competence Standard

a. Data From Industries

Observation participant were conducted in 5 companies: Axioo, CV. Indoakses, PT. Global Prima Utama (UII Net), PT. Lintas Data Prima, and PT. Media Sarana Data in March 2014 to March 2015. The researcher joined in an internship in those 5 companies with the aim to find out the routine work in the companies.

1) Axioo Class Program

The data obtained from Axioo Class Program were presented in Table 6.

Table 6 Competence Required by Axioo Class Program

Level	Competence	Description
Level 1	Individual has ability in Computer System.	Computer History Computer Architecture Computer Organization Computer Technology Numbering System
	Individual has ability in Hardware Introduction	Input Device Process Device Output Device Storage Device
	Individual has ability in Software Introduction	Software History Software Type Software Function Introduction of Computer System
Level 2	Individual has ability in Basic Computer Assembly	Occupational Health and Safety Introduction of computer assembly tools Computer assembly steps
	Individual has ability in Computer Assembly	Installing Mainboard Installing Processor and Fan Installing Memory Card Installing Hard disk drive Installing Graphic Card Installing Sound Card

		Installing Network Interface Card Installing Power supply Bridging between processor and Monitor Installing keyboard and mouse
	Individual has ability in Setting up BIOS	Introducing BIOS BIOS Function BIOS Component
	Individual has ability in Installing software	Installing Operating System Installing Software Application
	Individual has ability in Quality Control	Introducing Quality Control Trial and Error Finishing
Level 3	Individual has ability in basic notebook assembly	Occupational Health and Safety Introduction of computer notebook assembly tools Computer notebook assembly steps
	Individual has ability in Notebook Assembly	Installing display Installing speaker Installing Daughter Board Installing Motherboard Installing Hotkey Button Board Installing Power Button Board Removing Logic Upper Installing Keyboard Installing Optical Disc Drive (ODD) Installing Hard Disk Drive (HDD) Installing Wireless LAN and Bluetooth as combo module Installing Memory Module Installing Central Processing Unit (CPU) Installing Thermal Module Installing Battery pack
	Individual has ability in Setting up BIOS	Introducing Notebook BIOS Notebook BIOS Function Notebook BIOS Component
	Individual has ability in Installing Software	Installing Operating System for Notebook Installing Software Application for Notebook
	Individual has ability in Disassembly Notebook	Removing Battery Pack Removing Thermal Module Removing Central Processing Unit

		Removing Memory Module Removing Wireless LAN and Bluetooth Module Removing Hard Disk Drive Module Disassembly Optical Disk Drive Removing keyboard Removing Logic upper Removing power button board Removing hotkey button Removing Mainboard Removing daughter board Removing speaker Disassembly display
	Individual has ability in Quality Control	Introducing Notebook Quality control Trial and error notebook Finishing
Level 4	Individual has ability in Basic Computer Maintenance	Introduction of computer maintenance tools Introduction of computer software for maintenance Steps for computer maintenance
	Individual has ability in Notebook Maintenance	Display Maintenance Keyboard Maintenance Virus Scanning Hard Disk Defragmenter Optical Disk Drive Maintenance Mainboard Maintenance Memory Maintenance Thermal Module Maintenance

2) CV. Indoakses

Data obtained from CV. Indoakses was from an interview with Mr. Bino Oetomo as wireless engineer.

Table 7 Interview with Mr. Bino Oetomo as wireless engineer

No	Code	Question	Answer
1.	BO1	I'm here means to collect data on the competency needed by vocational students in majors of Network and Communication Engineering who can be absorbed in industry. So, they are not useless if they have graduated from vocational schools. Nah, what skills are needed? Mr. Gino and Mr. Anggit can tell me about the major focus of Indoakses in wireless especially. In curriculum before there are computer systems, hardware skills, and software skills Sir. So, what skills are needed? For example, in the first/ basic level, they have skill in hardware-software installation, in the second level what skill should they have? Then, in the third level, what skill they need from the competency? What hardware competence they must have?	It is a little bit harder, because in Indoakses, the needed skills are more specific than general majors of Network and Communication Engineering. If they are doing conversation with me, for example Anggit is more incline to network when chatting with me. So, for a year ahead he just chats about network, learn a network, and can't analyze a motherboard if he is asked to analyze it. Wireless Network Interface Card, Access Point, Wireless Router, and Antenna is hardware competence in here.
2.	BO2	How about the development of Wireless LAN Network?	They should comprehend Protocol 802.11 and 802.11a,b,g. They must have ability to describe Protocol 802.11 architecture.
3.	BO3	Ok Sir, I think installation and the others can be represented here, because it's a Network and Communication Engineering, what specific skills are needed if we want	They can set a cable, for example crimping cable, maybe in cramping a cable, they open the cable jacket too much, so when they want to clip it, the items that are clipped are the cables not the jacket, it must be

		to work at Indoakses?	avoided. Cable drawing technique for example, why I decide to not use a pipe instead we use cable dating, because if we use pipe and the cable inside of it is broken, whereas the pipe has been set, how to put the cable to the pipe? If the pipe is set in a vertical way, it is easy to change the broken cable, but if it is set in horizontal? Another example, we want to fold the cable, then route it, how much the network needed-> It has router -> It should be connected to here and there. Sub netting IP Address Public IP Address Private IP Address IP address Assignment IP Routing Diagnostic Signal Tools

According to the interview transscript above, conclusions can be drawn as presented in Table 8.

Table 8 Competence Required by CV. Indoakses

No	Competence	Sub-Competence	
1.	Development of Wireless LAN	Protocol 802.11 architecture Protocol 802.11a architecture Protocol 802.11b architecture Protocol 802.11g architecture	Have ability to describe Protocl 802.11 architecture
2.	Wireless tools 802.11	Wireless Network Interface Card Access Point Wireless Router Antenna	
3.	Configuration and Wireless LAN Component	Adhoc Connection mode Wireless LAN Infrastructure Access Point Extension Point Directional Antenna	
4.	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment IP Routing Diagnostic Signal Tools	

3) PT. Lintas Data Prima

Data from PT. Lintas Data Prima. were obtained through an interview with Wahyu Jatmiko, the Chief of Engineering Department.

Table 9 Interview with Wahyu Jatmiko, the Chief of Engineering Department

No	Code	Question	Answer
1.	JW3	Yesterday I had a discussion with Axioo and Indoakses, Sir. In Axioo we had the discussion with Mr Timoteus; his position in Axioo was the Head of Education Center. Then in Indoakses I met Mr. Bino, he was a senior engineering in Indoakses. We had recorded a matrix from these both interviews. I as the researcher aim to know what competency needed by vocational graduates to be absorbed by industries so that they can apply their skill from their vocational schools. Nah, I have several required points for them such as having the ability to assemble, install, operate, protect, maintain, and repaire computer. The sub-points such as installing operating systems, then troubleshooting systems or software in computer, and diagnosing hardware/ software, malfunction/ damage of hardware/ software in computer/ personal laptop, do you think the competencies are necessary in LDP Sir?	It is so interesting Sir if we discuss about vocational schools, because I am also from vocational schools. More or less, I still remember the curriculum when I studied there. When we talk about the competency needed in industry, LSP is clearly engaged in internet, service, or internet access service, or anything related to the internet. OSI Layer is the basic of all data communication including internet, if we talk about scientific data communication. I've become examiner in vocational school like SMK 3 Yogyakarta, and I think for vocational graduates, the target you want should be higher than others because industry can't be measured by education; they are more advance than the world of education. So, I think that the basic technique concept is needed to be understood. Maybe from basic technical foundation like OSI Layer, then Network concepts, OS, and not only Windows but Linux mastery is needed because it is used in many industry. I think the basic competency is needed to be strengthened, in other side not only the skill when we talk about the worker/ job, but how interest and skill from them, their work desire, attitude, or non-technical sides it must be built. So, how their behaviour in the world of work, how mature or polite they are, actually it is the other material that I want to say. Because if we talk about

			vocational graduates in the world of work, their desire and mature, how about their teamwork and skill are only given from their experience and I think it also must be procured in schools, not only the technical skill.
	JW4	Are skills like maintaining computer, installing, then troubleshooting hardware-software necessary, Sir?	Yes, it is surely needed. Today, in all employment sectors, when we talk about IT then the focus is where the aims of it, to programming or network. Surely, the basic is from the mastery of OS, installation, how to process hardware, then troubleshoot hardware. But for internet itself, it is more inclined to network, wire and wireless skill, then routing, and cabling. Cabling skill is from the basic then how to connecting two devices, switch hub routing, and included it.
	JW5	Are the concept of OSI or ISO layer as you said before, then TCP/IP, and network topology necessary, Sir?	Yes, certainly.
	JW6	Then, how far should we master the routing concept, shall we master the dynamic or static routing?	If we talk about concept, it can be given. But if we talk about the master of static concepts, it is a little bit enough.
	JW7	Is the mastery of IP needed?	Yes, it is a must because it is related to TCP/IP concepts. Sub netting IP Address, Public IP Address, Private IP Address.
	JW8	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment IP address allocation
	JW9	How About LAN, Sir ?	For V-LAN, I think it is more advance, and I know nothing about the goal of vocational students. But whether its material needs to be tested or taught to them depends on the regulation

			terms; but I think it is too difficult for vocational school level.
	JW10	Today, the application model is based on smartphone, android, etc. What wireless concepts is needed in LDP? Does the concepts till smartphone application or wireless using frequency of 2,4 or 5,2 or until the content access based on the smartphone?	Well, the first thing of wireless that developed by ISP is the backbone. It is used to connect inter BTS, applied with frequency that is allocated for them. Next for Last Mile is used for handling end user, like from BTS to customer. I used the frequency of 2,4 and point 5. Something that was related to gadget maybe about how much the scope of customer can be minimized. If we should cover the customer until the gadget level, I think it is more difficult because we need more resource
	JW11	How about the competence needed in cabling?	Familiar with Cross and straight cabling Familiar with Fiber optic
	JW12	How about Network Topology?	Planning network topology will be used in client or in Point of presence (branch)

According to the interview transscript above, it can be concluded as follows:

Table 10 Competence Required by PT. Lintas Data Prima

No	Working Level	Competence	
1.	Junior Technical	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand about Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin.
		Cabling	Be familiar with cross and

			straight cabling Be familiar with fiber optic
		Network Topology	Be familiar with types of computer network topology, like bus topology, star topology.
		Operating system	Be familiar with Windows and Linux Be able to install Windows and Linux
	Senior Technical	Internet Protocol (IP) Address	Sub-netting IP Address Public IP Address Private IP Address IP address Assignment IP address allocation
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin. Be familiar with frequency and channel Be familiar with Frequency 2.4 GHz, 5.7 GHz, 5.8 GHz Understand about frequency interference
		Cabling	Be familiar with cross and straight cabling Be familiar with fiber optic
		Network Topology	Plan network topology that will be used by client or in Point of presence (branch)

4) PT. Media Sarana Data

Table 12 presents the data obtained from PT. Media Sarana Data based on an interview with Mr. Dwi, Technical Manager.

Table 11 Interview with Mr. Dwi, Technical Manager

No	Code	Question	Answer
1.	DP5	Then, emm for example so we have some PC that need to connect to the internet and then from the internet to LAN and LAN is connected to the internet, so are such skills also required? We are talking in the small scope first, Sir.	Yes it is required, especially in cable crimping between PC (the switch) and connector is required.
2.	DP7	Then for the matters of LAN-WAN, they have ISO or OSI layer, how about the skill for that, Sir?	For a knowledge it doesn't matter, I also learn ISO, but for a detail knowledge itself, I think it's not too necessary, for example layer 1 for something, it is just for knowledge, and here for the engineering division itself, the implementation of learning ISO is rare, and maybe for NOC division it is necessary, they have 1-2 layer.
3.	DP14	Whether for the installation itself, what skills must be mastered by the students, Sir?	First, they must be brave to climb up, it is absolute. Second, the basic skill of operating computer, then, they must have a desire to learn in order to develop their skill.
	DP17	What skills are required for server setting from here? Maybe from IP address concepts.	If IP address is a must, then usable mass, how much the usable, it is a must too. Then from here the NOC can be slashed.
	DP18	Then about the matter of LAN, WAN, and MAN, is	Yes it is necessary for backup

No	Code	Question	Answer
		it required from local loop of ISP itself? For example inter-BTS must be connected to one another.	
	DP19	Then, underneath there must be a router, so from above or wireless then surely go down to the router, nah what router skill is required for the students to set up?	It is a specification for customer needed, for example the customer have many users like game net, the specs of router the must be higher, if it is for personal user, I can use the lowest router specs.
	DP20	It is like IP masqueradee or IP nat, isn't it?	Yes, those are for the router, in router custom network, masquerade, the limiter, the firewall and the filter.
	DP21	What is the mean of Network Administration?	For example these IP is allowed or not to access, referring to the firewall.
	DP23	Then, is the installation of LAN devices also required?	LAN device installation is necessary.
	DP24	Is a secure gateway needed to connect the switch or Hub?	It is needed; essentially we also handle projects, projects for hotel hotspot for example. We start from the beginning of building a hotel hotspot infrastructure, and we must know the topology. Where its access point should be, where the LAN should be, and usually the LAN is asked to be separated from the hotspot. We need a switch side or not, it is required.
	DP25	Then sometimes hotspot also has a limiter, who could and who couldn't access it. Previously, it is known as CILLISPOT, and now it has many types of the program, how about that Sir?	Yes, it's available here, like user manager, so the client can write their users by using DHCP for limiter systems and they also can use WPA for logging in.

According to the interview transscript above, it can be concluded as the following presented in Table 12.

Table 12 Competence Required by PT. Media Sarana Data

No	Working Level	Competence	
1.	Junior Technical	Internet Protocol (IP) Address	IPV4 IPV6
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin.
		Cabling	Be familiar with cross and straight cabling Be familiar with fiber optic
		Network Topology	Be familiar with types of computer network topology, such as bus topology, star topology.
		Operating system	Be familiar with Windows, Linux, and Mikrotik Bee able to install Windows, Linux, and Mikrotik
	Senior Technical	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment IP address allocation
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin. Be familiar with

			frequency and channel Be familiar with Frequency 2.4 GHz, 5.7 GHz, 5.8 GHz Understand frequency interference
		Cabling	Be familiar with cross and straight cabling Be familiar with fiber optic technology especially at Fiber to The Home (FTTH)
		Network Topology	Plan network topology that will be used by client or in point of presence (branch)
		Managed Switch	Manage kinds of Switch such as Cisco, Hp, Alcatel
		Protocoling	Has ability in Domain Name Server, Network Management System (NMS), and Simple Management Transfer Protocol (SMTP)

5) PT. Global Prima Utama (UII NET)

Table 13 presented the data obtained from PT. Global Prima Utama which were collected through an interview with Mr. Taufik M Heriawan, the Chief of Engineering.

Table 13 Competence Required by PT. Global Prima Utama

No	Code	Question	Answer
	TI2	Yesterday, we went to Axioo, in there we wanted to dig up the curriculum in order to Vocational School graduates in the majors of Network and Communication Engineering can be absorbed by industry. Nah, for computer engineering itself, we were picked up from Axioo, the Education Centre is located in Bandung. Then for computer network we were picked up around of Yogyakarta. The company has already become the national company, and also has some branches in Indonesia, that's the important thing. Yesterday, Axioo focused on the computer systems. Then in Mr. Bino, we talked about the wireless, later in	I cannot answer it directly. If we talk about the technical requirements for recruitment of vocational students, usually we selected a student who had internship here. So during the internship program, we can see and directly involve them in the field work programs, such as routing programs, and from its way, we can see the potential that they had. Afterwards, when they are involved in occupation, we give them a practical addition. But for a vocational student who recently joined, I can answer if they have not been 100% able to work properly, they should need something new for themselves. I don't know if they did not teach a practical skill in their school or they can't imagine what they have to do in fieldwork and just received knowledge from school. Then the second is mentality for working, because the average age when they graduate is between 18-19 year old, and I think that age is not mature yet, so they have not a seriousness in fieldwork and desire to survive in the field is lack. So I have 2 reasons, ability and mentality.

		Global media and LDP we talked about the networks, and in Global Prima, it was also about the networks. For review, whether in LDP or Global Media, we talked about the necessary skills, but we found that intelligence skills were rarely found. Thus, if they wanted to route, they only needed to master the IP route, not the statics, dynamics, etc. So, What skill are required for vocational students if they want to participate in Global Prima, Sir?	
	TI3	What do they need to master a hard skill competency, Sir?	So, if we talk about ISP the important thing actually is the Seventh LAYER concepts, because my basic skill in computer and network is SEVENTH LAYER concepts. So if they face some device or problems, the easiest way to solve them is by understanding how the layer is. Sometimes, they just know about router because they are just familiar with microtic teaching, and lack when they discover a new concepts. Then the most basic skill is subnetting TCP/IP, it was important. So, I think that they are lack and actually both skills above are the vital things. I reflected on my job career, when I've mastered both skills, it helps me to reach a higher level.
	TI4	Then, how about the wireless Mr. Taufik?	(1) Explain the difference between 2 main network types: peer-to-peer and client-server. (2) Demonstrate and

			explain the concepts of a Local Area Network (LAN) and a Wide Area Network (WAN). (3) Configure a network operating system, including protocols, accessibility, and layering. (4) Demonstrate a basic understanding of routers and their functions.
	TI5	What types of layer application should be mastered by vocational students Sir?	For me, if we now talk about layer application, the most needed at this time is bandwidth management. Talking about bandwidth setting means that we talk about LAN; and for paid internet, we should controll how much output will be given from the internet to the client, calculate CIR or used by client and Broad a useless things, I think those skills are required. It means that we shouldn't talk about ISP level and ,because we don't set the bandwidth, it becomes a problem for us, how much quota we want certainly will be running out. Then also for QOS, for example in a level where someone who doesn't have a company or is poor, he/she just wants to use the internet as their benefit, in the afternoon they use it for browsing in Youtube or Facebook. Nah how they as technician can apply what they have done using some tools, so they have skills to approach it technically. I think it is necessary. Then about security, like operating firewall, blocking port, whether it will be accepted or denied.
	Software		Able to comprehend the booting process on closed and open source operating systems Able to practice the installation of closed source operating system Able to use word processing Able to use spread sheet Able to use Database application Able to use presentation application
	TI6	Does operating systems depend on	If we talk about operating systems in network, it is actually only for the

		Windows or Linux Sir?	client. If we talk about OS in Backend or server almost all of the client were operating Windows. But if we talk about Operating system used in server network, the only choice is just Windows, Linux, and others. It is difficult because the main system was different, almost all ISP used Linux, and several used Windows. But Linux is more preferable. I think if we have operated Linux, because its QUEUE is more complex and has better concept, it means that it was easier for us to operate Windows.

According to interview the script above, it can be concluded as presented in Table 14:

Table 14 Competence Required by PT. Global Prima Utama

No	Competence	Description
	Hardware	Installing mainboard Installing processor and fan Installing memory card Installing hard disk drive Installing graphic card Installing sound card Installing network interface card Installing power supply Bridging between processor and monitor Installing keyboard and mouse Install scanner Installing, configuring, and providing assistance for customer in using software Performing hardware upgrade Being able to comprehend the semiconductor memories (RAM, ROM, PROM, EPROM, EEPROM, EAPROM)
	Software	Being able to comprehend the booting process on closed and open source operating systems

		Being able to practice the installation of closed source operating system Being able to use word processing Being able to use spread sheet Being able to use Database application Being able to use presentation application
	Networking	Explaining the difference between main network types: peer-to-peer and client-server Demonstrating and explaining concepts of a Local Area Network (LAN) and a Wide Area Network (WAN). Configuring a network operating system, including protocols, accessibility, and layering. Demonstrating a basic understanding of routers and their functions.

Based on the in depth-interview with 5 Computer and Network Engineering companies, it can be concluded as follows:

Table 15 Result of the in depth-interview with industry

No	Working Level	Competence	
1.	Junior Engineer	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand about Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin.
		Cabling	Be familiar with cross and straight cabling Be familiar with fiber optic
		Network Topology	Be familiar with type of computer network topology, like bus topology, star

			topology.
		Operating system	Be familiar with Windows and Linux Be able to install Windows and Linux
	Senior Engineer	Internet Protocol (IP) Address	Sub netting IP Address Public IP Address Private IP Address IP address Assignment IP address allocation
		Wireless LAN	Implement Internet Protocol (IP Address) to Wireless router Understand about Antenna's Line of Sight (LOS) Be familiar with GPS tools like Garmin. Be familiar with frequency and channel Be familiar with Frequency 2.4 GHz, 5.7 GHz, 5.8 GHz Understand about frequency interference
		Cabling	Be familiar with cross and straight cabling Be familiar with fiber optic
		Network Topology	Plan network topology that will be used by client or in Point of presence (branch)

b. Data from International and National Competence Standards

1) Electronic Technician Association

Data collection through documentation is done against ETA by accessing the official website of ETA (www.ETA-I.org)

Table 16 List of competence from Electronic Technician Association

Competence	Sub-competence	Description
Operating System	FUNCTION, STRUCTURE, OPERATION, AND FILE MANAGEMENT	1. Explain the primary functions of an OS 2. Describe procedures for installing an OS 3. Explain the function and importance of required and optional system files 4. Explain how to configure an OS boot order 5. Explain the differences and advantages of various file types and naming conventions 6. Explain the use of basic disk and OS Commands 7. Explain procedures for working with Directories 9. Describe and list procedures for using file commands 10. Explain the need and use of File Management software 1.1. Explain how to properly format a hard disk in accordance with file type 1,12, Explain how to make a formatted disk bootable 1.13. Explain how to automate OS Commands Introduction to Microsoft and Linux 1.2.1 Explain the differences and system requirements between various OS's: 1.2.1.1 Windows 7 1.2.1.2 XP Home 1.2.1.3 XP Pro 1.2.1.4 Windows Vista 1.2.1.5 Windows 8 1.2.1.6 Red Hat 1.2.1.7 open SUSE 1.2.1.8 Knoppix 1.2.2 Identify procedures for starting an OS

		1.2.2.1 Boot Process 1.2.2.2 Location of Key (MS only) 1.2.2.3 Logging on 1.3 Describe attributes and characteristics of using an OS 1.3.1 Windows 7, Windows Vista, Windows XP, Windows 8: 1.3.1.1 The Start Button and Taskbar 1.3.1.2 Deleted items 1.3.1.3 My Computer 1.3.1.4 Explorer 1.3.1.5 Shortcuts 1.3.1.6 Canceling a Print Job 1.3.1.7 Permissions 1.3.2 Linux 1.3.2.1 Shells and Utilities 1.3.2.2 Basic Shell 1.3.2.3 Kernel 1.3.2.4 The Search Path 1.3.2.5 The Directory Path 1.3.2.6 Permission 1.3.2.7 Regular expressions and Meta characters 1.3.2.8 Explain how to properly shut down an OS
	Installation, Configuration/ Upgrading and Memory Management	2.1 Explain memory management requirements for Windows 7, Windows XP, Windows Vista, Windows 8 and Linux: 2.1.1 Main memory overview 2.1.2 Optimizing memory 2.1.3 Minimum and maximum memory allocation 2.1.4 Upgrading memory 2.1.5 System resources 2.1.6 Virtual memory settings 2.1.7 Optimizing your system 2.2 Explain how to install, configure, and customize the following for Windows 7,

		Windows Vista, Windows XP, Windows 8 and Linux: 2.2.1 Pre-Installation procedures 2.2.2 Installation procedures 2.2.3 Installing new applications 2.2.4 Changing system settings 2.2.5 The registry 2.2.6 Customizing the OS at boot-up 2.2.7 Hide control panel icons 2.2.8 Hide the taskbar 2.2.9 Recreate standard group folders 2.2.10 Setting up a printer 2.2.11 Changing or re-installing a printer driver 2.2.12 Installing software 2.2.13 Creating a new startup disk 2.2.14 Installing hardware drivers 2.2.15 Change and configuring video
	Diagnosing and Troubleshooting	Explain Operating System recovery methods and functions of an anti-virus: 3.1.1 Data recovery software 3.1.2 Backup utilities/software 3.1.3 Anti-virus software 3.1.4 Troubleshooting the OS boot configuration 3.2 Identify and describe troubleshooting techniques: 3.2.1 Installation troubleshooting 3.2.2 Error messages 3.2.3 Generic troubleshooting 3.2.4 Improving overall performance: 3.2.5 Troubleshooting specific startup errors 3.2.6 Bypassing startup files 3.2.6.1 Explain how to perform a clean boot

		3.2.7 Booting with Diagnostic Switches 3.2.8 System Properties Troubleshooting 3.2.9 Using Help Troubleshooters 3.3 Explain how to resolve application compatibility issues: 3.3.1 Windows 7 3.3.2 Windows Vista 3.3.3 Windows XP 3.3.4 Windows 8 3.3.5 Linux 3.4 Explain how to determine proprietary driver corruption and failure determination: 3.4.1 Printing Problems 3.4.2 Video Problems 3.5 Describe the methods of troubleshooting involved for programs that have not closed or terminated correctly
	Safety and Preventive Maintenance	Explain the reasons for safety in the following areas: 3.1.1 Electrical safety 3.1.2 Electrostatic Discharge (ESD) 3.1.3 Electromagnetic Interference (EMI) 3.1.4 Fire safety 3.1.5 Physical safety 3.1.6 Fiber optics cable 3.1.7 Magnets 3.1.8 CD-ROM or DVD-ROM safety and maintenance
Hardware	Motherboard / Processors / Memory	Identify the following functions of Motherboard Components: 4.1.1 Central Processing Unit (CPU) 4.1.2 Numeric Processing Unit (NPU) 4.1.3 Basic Input/Output System

		(BIOS) 4.1.4 CMOS 4.1.5 Main memory (RAM) 4.1.6 System timer (system clock) 4.1.7 Real time clock/calendar 4.1.8 Expansion bus 4.1.9 Expansion cards 4.1.10 I/O ports 4.1.11 North Bridge/Memory Controller Hub 4.1.12 South Bridge/Input Output Controller Hub 4.1.13 PATA and SATA connectors 4.1.14 SATA to PATA adapters 4.2 Compare and contrast CPUs and BUSES 4.2.1 Types of CPUs 4.2.2 Clock speed 4.2.3 CPU speed 4.2.4 Data path 4.2.5 CPU performance 4.2.6 CPU cache 4.2.6.1 L1 4.2.6.2 L2 4.2.6.3 L3 4.2.7 CPU voltages 4.2.8 Sockets and slots 4.2.9 CPU operating modes 4.2.10 Expansion BUS architecture 4.2.11 BUS performance 4.2.12 BUS mastering 4.3 Identify and describe characteristics and differences in semiconductor memory: 4.3.1 RAM/ROM 4.3.2 Memory chips 4.3.3 Memory organization 4.3.4 Parity 4.3.5 Access time 4.3.6 Memory installation rules 4.3.7 SIMM/DIMM capacities 4.3.8 Cache 4.3.9 Types of RAM 4.3.10 Flash drives and other

		types of memory sticks issues
	Basic Networking	6.1 Identify the major types of networks 6.2 Describe the various network topologies: 6.2.1 Bus 6.2.2 Star 6.2.3 Ring 6.2.4 Mesh 6.2.5 Peer-To-Peer 6.2.6 Client/Server 6.2.7 Hybrid 6.2.8 Tree 6.3 Describe various Nodes: 6.3.1 Backbone 6.3.2 Gateway 6.4 List Network design and architecture: 6.4.1 Access methods 6.4.2 Communication 6.5 Define connecting network components: 6.5.1 Transmission media 6.5.2 Common characteristics 6.5.3 Signal transmission 6.5.4 Primary cable types 6.5.5 Common network problems 6.6 Describe hardware considerations: 6.6.1 Buses 6.6.2 RAM 6.6.3 Network Interface Card (NIC) 6.6.4 Hubs 6.6.5 Hard drives 6.6.6 Antivirus protection 6.6.7 Bottlenecks

2) Indonesian National Board of Professional Standards

Table 17 List of Competences of Indonesian National Board of Profesional Standards

General Competence for Computer Technical Support	1.1. Preparing Proposals 1.2. Preparing Presentations 1.3. Following the procedure of Health and Safety 1.4. Using the Measure Tool or Tools for Maintenance and Repair 1.5. Identify the computer hardware specifications 1.6. Replacing the warranty label on computer 1.7. Packing and complements the user manual, warranty card and CD Driver 1.8 Conducting an inventory software 1.9 Creating a work report : assembly, maintenance and repair, Following Procedure of Intellectual Property Rights Protection
Core Competence for Computer Technical Support	2.1. Formulate the user needs (user requirement) 2.2. Designing specification in keeping with the functions and needs of the users (user specification) 2.3. Choosing Casing and Power Supply 2.4. Selecting Monitor 2.5. Selecting Hard Disk 2.6. choosing a Motherboard 2.7. Installing Interface Card 2.8 Installing the Hard Disk 2.9. Installing the Optical Drive 2.10. Installing Electrical Wiring On Motherboard 2.11. Installing Memory 2.12. Installing the Processor 2.13. Installing Computer Supplies 2.14. Test results in hardware assembly 2.15. Setting the BIOS 2.16. Configuring the Hard Disk 2.17. Installing Operating System 2.18. Installing Driver Motherboard 2.19. Install a 2.20. Printer Driver 2.21. Install VGA Driver Card 2.22. Install Sound Card Driver 2.23. Operate the USB-Port 2.24. Prepare CD RW

	2.25. Operate the CD RW 2.26. Install Modem Test your computer's performance 2.27. Install a software application 2.28. Configure the application software 2.29. Analyze the care needs 2.30. Determine the scope of maintenance activities 2.31. Make a schedule of maintenance activities 2.32. Care CPU Perform 2.33. Maintain Hard Disk 2.34Uuse network tools care 2.35. Perform maintenance network peripheral 2.36. Upgrade Hardware 2.37. Upgrade Software 2.38. Fix hard disk bad sectors 2.39. Fix and diagnose hard disk failure, operation failure 2.40. Fix invalid partition table

Based on the documentation from Electronic Technician and Indonesian National Standarisation, it can be concluded as follows:

Table 18 Competence required by Electronic Technician and Indonesian National Standarisation

Competence	**Sub-competence**	**Description**
Operating System	Function, structure, operation, and file management	1. Explain the primary functions of an OS 2. Describe procedures for installing an OS 3. Explain the function and importance of required and optional system files 4. Explain how to configure an OS boot order 5. Explain the differences and advantages of various file types and naming conventions 6. Explain the use of basic disk and

		OS Commands 7. Explain procedures for working with Directories 9. Describe and list procedures for using file commands 10. Explain the need and use of File Management software 1.1. Explain how to properly format a hard disk in accordance with file type 1,12, Explain how to make a formatted disk bootable 1.13. Explain how to automate OS Commands Introduction to Microsoft and Linux 1.2.1 Explain the differences and system requirements between various OS's: 1.2.1.1 Windows 7 1.2.1.2 XP Home 1.2.1.3 XP Pro 1.2.1.4 Windows Vista 1.2.1.5 Windows 8 1.2.1.6 Red Hat 1.2.1.7 open SUSE 1.2.1.8 Knoppix 1.2.2 Identify procedures for starting an OS 1.2.2.1 Boot Process 1.2.2.2 Location of Key (MS only) 1.2.2.3 Logging on 1.3 Describe attributes and characteristics of using an OS 1.3.1 Windows 7, Windows Vista, Windows XP, Windows 8: 1.3.1.1 The Start Button and Taskbar 1.3.1.2 Deleted items 1.3.1.3 My Computer 1.3.1.4 Explorer 1.3.1.5 Shortcuts 1.3.1.6 Canceling a Print Job 1.3.1.7 Permissions 1.3.2 Linux 1.3.2.1 Shells and Utilities 1.3.2.2 Basic Shell 1.3.2.3 Kernel

	Installation, Configuration/ Upgrading and Memory Management	1.3.2.4 The Search Path 1.3.2.5 The Directory Path 1.3.2.6 Permission 1.3.2.7 Regular expressions and Meta characters 1.3.2.8 Explain how to properly shut down an OS 2.1 Explain memory management requirements for Windows 7, Windows XP, Windows Vista, Windows 8 and Linux: 2.1.1 Main memory overview 2.1.2 Optimize memory 2.1.3 Minimum and maximum memory allocation 2.1.4 Upgrade memory 2.1.5 System resources 2.1.6 Virtual memory settings 2.1.7 Optimize your system 2.2 Explain how to install, configure, and customize the following for Windows 7, Windows Vista, Windows XP, Windows 8 and Linux: 2.2.1 Pre-Installation procedures 2.2.2 Installation procedures 2.2.3 Install new applications 2.2.4 Change system settings 2.2.5 The registry 2.2.6 Customize the OS at boot-up 2.2.7 Hide control panel icons 2.2.8 Hide the taskbar 2.2.9 Recreate standard group folders 2.2.10 Set up a printer 2.2.11 Change or re-installing a printer driver 2.2.12 Install software 2.2.13 Create a new startup disk 2.2.14 Install hardware drivers 2.2.15 Change and configure video Explain Operating System recovery methods and functions of an anti-

	Diagnosing and Troubleshooting	virus: 3.1.1 Data recovery software 3.1.2 Backup utilities/software 3.1.3 Anti-virus software 3.1.4 Troubleshoot the OS boot configuration 3.2 Identify and describe troubleshooting techniques: 3.2.1 Installation troubleshooting 3.2.2 Error messages 3.2.3 Generic troubleshooting 3.2.4 Improve overall performance: 3.2.5 Troubleshoot specific startup errors 3.2.6 Bypass startup files 3.2.6.1 Explain how to perform a clean boot 3.2.7 Boot with Diagnostic Switches 3.2.8 System Properties Troubleshooting 3.2.9 Use Help Troubleshooters 3.3 Explain how to resolve application compatibility issues: 3.3.1 Windows 7 3.3.2 Windows Vista 3.3.3 Windows XP 3.3.4 Windows 8 3.3.5 Linux 3.4 Explain how to determine proprietary driver corruption and failure determination: 3.4.1 Printing Problems 3.4.2 Video Problems 3.5 Describe the methods of troubleshooting involved for programs that have not closed or terminated correctly Explain the reasons for safety in the following areas: 3.1.1 Electrical safety 3.1.2 Electrostatic Discharge (ESD) 3.1.3 Electromagnetic Interference (EMI) 3.1.4 Fire safety

Hardware	Safety and Preventive Maintenance	3.1.5 Physical safety 3.1.6 Fiber optics cable 3.1.7 Magnets 3.1.8 CD-ROM or DVD-ROM safety and maintenance Identify the following functions of Motherboard Components: 4.1.1 Central Processing Unit (CPU) 4.1.2 Numeric Processing Unit (NPU) 4.1.3 Basic Input/Output System (BIOS) 4.1.4 CMOS 4.1.5 Main memory (RAM) 4.1.6 System timer (system clock) 4.1.7 Real time clock/calendar 4.1.8 Expansion bus 4.1.9 Expansion cards 4.1.10 I/O ports 4.1.11 North Bridge/Memory Controller Hub 4.1.12 South Bridge/Input Output Controller Hub 4.1.13 PATA and SATA connectors 4.1.14 SATA to PATA adapters
	Motherboard / Processors / Memory	4.2 Compare and contrast CPUs and BUSES 4.2.1 Types of CPUs 4.2.2 Clock speed 4.2.3 CPU speed 4.2.4 Data path 4.2.5 CPU performance 4.2.6 CPU cache 4.2.6.1 L1 4.2.6.2 L2 4.2.6.3 L3 4.2.7 CPU voltages 4.2.8 Sockets and slots 4.2.9 CPU operating modes 4.2.10 Expansion BUS architecture 4.2.11 BUS performance 4.2.12 BUS mastering 4.3 Identify and describe characteristics and differences in semiconductor memory: 4.3.1 RAM/ROM 4.3.2 Memory chips

	Basic Networking	4.3.3 Memory organization 4.3.4 Parity 4.3.5 Access time 4.3.6 Memory installation rules 4.3.7 SIMM/DIMM capacities 4.3.8 Cache 4.3.9 Types of RAM 4.3.10 Flash drives and other types of memory sticks issues 6.1 Identify the major types of networks 6.2 Describe the various network topologies: 6.2.1 Bus 6.2.2 Star 6.2.3 Ring 6.2.4 Mesh 6.2.5 Peer-To-Peer 6.2.6 Client/Server 6.2.7 Hybrid 6.2.8 Tree 6.3 Describe various Nodes: 6.3.1 Backbone 6.3.2 Gateway 6.4 List Network design and architecture: 6.4.1 Access methods 6.4.2 Communication 6.5 Define connecting network components: 6.5.1 Transmission media 6.5.2 Common characteristics 6.5.3 Signal transmission 6.5.4 Primary cable types 6.5.5 Common network problems 6.6 Describe hardware considerations: 6.6.1 Buses 6.6.2 RAM 6.6.3 Network Interface Card (NIC) 6.6.4 Hubs 6.6.5 Hard drives 6.6.6 Antivirus protection 6.6.7 Bottlenecks

3) Indonesian Vocational High School Curriculum 2013

Based on the documentation obtained in 2 vocational high schools (SMKN 2 Yogyakarta and SMKN 1 Pacitan), the data about courses and competence are presented in Table 19.

Table 19 List of competence data from vocational high school

Course	Competence
Computer System	Able to comprehend the number systems (Decimal, Binary, Octal, Hexadecimal) Able to use the number systems (Decimal, Binary, Octal, Hexadecimal) in solving the conversion problems Able to comprehend the logic relation and basic gate function (AND, OR, NOT, NAND, EXOR) Able to plan the adder and subtractor circuit by logic gates (AND, OR, NOT, NAND, EXOR) Able to comprehend the arithmetic system Able to perform the Arithmetic Logic Unit trial (Half-Full Adder, Ripple Carry Adder) Able to comprehend the Arithmetic Logic Unit (Half-Full Adder, Ripple Carry Adder) Able to apply the arithmetic and logic operation on Arithmetic Logic Unit Able to comprehend the Multiplexer, Decoder, Flip-Flop and Counter circuit Able to plan and create the counter up and counter down Able to comprehend the computer organization and architecture

	Able to present the structure sketch of Von Neumann Able to comprehend the external data storage media (magnetic disk, RAID optical disk and magnetic tape) Able to distinguish some alternative usage on multiple data media storage (semiconductor, magnetic disk, RAID, optical disk and magnetic tape) Able to analyses the memory based on the memory system characteristics (location, capacity, unit, access method, performance, physique types, and physique characteristics) Able to present the concept of idea for assembly the memory in computer system Able to comprehend the semiconductor memories (RAM, ROM,PROM) Able to apply the number systems on semiconductor memories (address and data)
Computer Assembly	Able to comprehend the development of computer technology Able to present the observation data result of computer Able to comprehend the input and output device components Able to present the observation data result of various input and output device components Able to comprehend the process device components and storage media Able to present the observation data result of various process device components and storage media Able to comprehend the layout map of computer

	components Able to create the layout map of computer components Able to comprehend the types of computer case Able to present the classification result of computer case Able to comprehend the tools and materials that used in assembling computer Able to present the tools and materials classification result that used in assembling computer Able to comprehend the place and work safety
Computer Network Basic	Able to comprehend the computer network concept Able to present the network needs of an organization Able to comprehend the OSI model on computer network Able to present the concept and function of each OSI layers Able to comprehend the network topology Able to present the simple network using topology Able to analyze the appropriate media in data communication networks Able to make sense of appropriate media type in data communication network Able to comprehend the network protocols Able to present the use of network protocols

	Able to comprehend the network addressing protocols Able to present the use of addressing protocols in networks Able to comprehend the network hardware Able to present the network hardware in accordance with requirements Able to comprehend the network application in computer operating systems Able to present the network application in computer operating systems Able to comprehend the horizontal simple network deployment Able to present the result of horizontal simple network deployment
Network Operating System XI	Able to comprehend the types of network operating systems Able to present the types of network operating systems Able to analyses the server device needs Able to present the analysis result of server device needs Able to comprehend how to install the network operating systems Able to present the installation result of network operating systems Able to comprehend the administration of network operating systems Able to present the administration result of network operating systems Able to analyses the service process and event of network operating systems

	Able to present the observation result of service process and event on network operating systems Able to comprehend the ways of scheduling process Able to present the result of scheduling process Able to comprehend the backup system and recovery Able to present the result of backup system and local recovery Able to comprehend the hard disk management on server Able to present the result of hard disk management on server Able to comprehend how to perform the user and group management on network operating systems Able to present the result of user and group management on network operating systems Able to comprehend how to perform the user quota, application and capacity management on network operating systems Able to present the result of user quota, application and capacity management on network operating systems Able to comprehend the troubleshooting on network operating systems Able to present the troubleshooting result on network operating systems Able to comprehend how to configure the DNS Server Able to present the DNS Server Configuration Able to comprehend how to configure the DHCP server

	Able to present the DHCP server Configuration Result
Network Operating System XII	Able to comprehend the computer network administration resources Able to present the result of network administration resources Able to comprehend the network security operating systems Able to present the result of network and system security Able to comprehend the process of server audit Able to present the audit result of network server Able to comprehend how to perform the configuration of operating system and network integration (internet) Able to present the configuration result of operating system and network integration (internet) Able to comprehend how to install software for network monitoring Able to present the network monitor result using software Able to comprehend the ways of traffic and bandwidth management on network Able to present the configuration result of traffic and bandwidth management on network
Server Administration XI	Able to analyses the server needs to did a traffic on computer application networks Able to present the analysis result of server needs to did a traffic on computer application networks Able to comprehend the Admin's role and responsibility

	Able to think about the Admin's role and responsibility Able to comprehend the working principle of client server communication Able to think about the working principle of client server communication Able to comprehend the installation of operating system for server Able to present the result of operating system installation for server Able to comprehend the file system and user access administration on Linux Able to present the result of file system and user access administration on Linux Able to comprehend a various network services Able to present a various network services Able to comprehend the backup and recovery management on Linux Able to present the backup and recovery management on Linux Able to comprehend the remote access management Able to present the Remote Access Management Result Able to comprehend how to configure the DHCP Server Able to present the DHCP Server Configuration Result Able to comprehend how to configure the DNS Server Able to present the DNS Server Configuration Result Able to comprehend how to configure the WEB/HTTP Server Able to present the WEB/HTTP Server Configuration Result

	Able to comprehend how to configure the FTP Server Able to present the FTP Server Configuration Result Able to comprehend how to configure the Mail Server Able to present the Mail Server Configuration Result Able to comprehend how to configure the Web Mail Server Able to present the Web Mail Server Configuration Result Able to comprehend the configuration of Remote Server (Telnet, SSH) Able to present the Remote Server (Telnet, SSH) Configuration Result Able to comprehend how to configure the NTP Server Able to present the NTP Server Configuration Result Able to comprehend how to configure the Proxy Server Able to present the Proxy Server Configuration Result
Server Administration XII	Able to comprehend how to configure the Samba Server Able to present the configuration result of Samba Server Able to comprehend how to configure the VPN Server Able to present the configuration result of VPN Server Able to comprehend how to configure the multimedia streaming server Able to present the Multimedia Streaming Server Configuration Result

	Able to comprehend how to configure the securing Web / HTTP server Able to present the Securing Web / HTTP Server Configuration Result Able to comprehend how to configure the securing FTP Server Able to present the result of securing FTP Server Able to comprehend how to monitor and control the performance of server Able to present the monitoring and controlling result of server's performance
Network Design XI	Able to comprehend the connection of computer to network Able to think about the connection of computer to network Able to comprehend how to connecting internet via ISP Able to present how to connecting internet via ISP Able to comprehend the network addressing Able to present the network addressing Able to comprehend the network services Able to think about the network services Able to comprehend about the Internet and its utilization Able to think about the internet and its utilization Able to comprehend the help desk Able to think about the help desk Able to comprehend the planning of network updates Able to analyses the planning of network updates Able to comprehend the addressing structural designs Able to analyses the addressing structural

	designs Able to comprehend the configuration of network tools Able to present the development result of simple networks Able to comprehend the computer networks routing Able to analyses the computer networks routing Able to comprehend about ISP services Able to analyses about ISP services Able to comprehend the service and responsibility of ISP Able to think about the service and responsibility of ISP Able to comprehend the enterprise networks Able to think about the enterprise networks Able to comprehend the infrastructure exploration in enterprise networks Able to think about the infrastructure exploration in enterprise networks Able to comprehend the switching in enterprise networks Able to think about the switching in enterprise networks

Network Design XII	Able to comprehend the addressing in enterprise network Able to think about the addressing in enterprise network Able to comprehend the routing protocol types of distance vector in enterprise networks Able to think about the routing protocol types of distance vector in enterprise networks Able to comprehend the routing protocol types of link-state Able to think about the routing protocol types of link-state Able to comprehend the implementation of enterprise WAN links Able to think about the implementation of enterprise WAN links Able to comprehend the traffic filter using Access Control List (ACL) Able to think about the traffic filter using Access Control List (ACL)
Network Security	Able to comprehend the network usage policies Able to present the various network usage policies Able to comprehend the threat and attack of the network security Able to present the various threat and attack on network security Able to comprehend the needs of network security systems Able to present the needs of network security systems Able to comprehend the steps of host hardening Able to comprehend the steps of host hardening Able to comprehend the firewall in host and server Able to present the analysis result of firewall in host and server

	Able to comprehend the needs of tools requirement to build a firewall server Able to think about the needs of tools requirement to build a firewall server Able to analyze the report / log work of firewall server Able to present the analysis report / log work of firewall server Able to analyses the security protocol on network tools Able to present the analysis result of security activation on network tools Able to analyses the testing protocol of network security, host and server Able to present the testing result of network security, host and server Able to comprehend the function and working of authentication server Able to present the function and working of authentication server Able to comprehend the needs of tools requirement to build an authentication server Able to think about the needs of tools requirement to build an authentication server Able to analyses how the detection system working and preventing from the threat / attack incoming to a network Able to present the analysis result of the detection system and preventive from the threat / attacks incoming to a network Able to analyses the report/ log work of detection and preventive from network attacks Able to present the report analysis/ log work of detection and preventive from network attacks Able to analyses the functions and protocols of server security on network services Able to present the analysis result of security server functions and protocols on the network services

	Able to comprehend the procedure for securing data communication using cryptographic techniques Able to think about the procedure for securing data communication using cryptographic techniques
Computer System XI	Able to comprehend the input-process-output systems Able to plan and create the input-output devices using I/O Programmed module Able to comprehend the external/ peripheral devices Able to form the external device using console units Able to comprehend the structure and Bus interconnection Able to use structure and bus interconnection to create a network Able to comprehend and analyses the principle and symbols used in flowchart or struktogram Able to use the principle and symbols used in flowchart or struktogram to solving the problems Able to comprehend the organization of processor, register and cycle instruction (fetching, decoding, executing) Able to use the organization of processor, register and cycle instruction (fetching, decoding, executing) Able to comprehend the structure and function of CPU Able to make the CPU internal circuit Able to comprehend the instruction set characteristics (operand and operation) Able to use the instruction set (operand and operation) to solving the problems Able to comprehend the addressing mode and format Able to use the addressing mode and format to solving the problems

Applied Computer	Able to comprehend the technology concept of applied computer networks Able to present the technology concept of applied computer networks Able to comprehend the needs of applied computer for application data communication networks Able to present the needs of applied computer for application data communication networks Able to comprehend the network peripheral types on applied computer networks Able to present the network peripheral types on applied computer networks Able to comprehend the communication protocol of applied computer network Able to present the communication protocol description of applied computer network Able to comprehend the I/O bus performance of applied computer networks Able to present the I/O bus performance result of applied computer networks Able to comprehend the software that used in applied computer networks Able to present the software applying result of applied computer networks Able to comprehend the performance testing methods of applied computer networks Able to present the performance testing result of applied computer networks Able to comprehend the maintaining procedure of applied computer network Able to present the maintaining result of applied computer network

2. Analysis

a. Similar competence between 5 industries and 2 national and international standards

Based on the data obtained from 5 industries, 1 document from international standard, and 1 document of national standard, the industrial similar competence analysis can be shown in table 20 (AX= Axioo, BO= Indoakses, JW= Lintas Data Prima, DW= Global Media, TF= Globa Prima Utama, ETA= Electronic Technician Assosciation, IN= Indonesian National Board of Professional Standards)

Table 20 Similar competence from 5 industries and 2 documents from national and international standards

No	Competence	Code	Similar Competence	Description
1	Hardware	AX1, AX2, ETA2, ID2 (Hardware)	Input Device Process Device Output Device Storage Device Installing Mainboard Installing Processor and Fan Installing Memory Card Installing Hard disk drive Installing Graphic Card Installing Sound Card Installing Network Interface Card	

			Installing Power supply Bridging between processor and Monitor Installing keyboard and mouse Installing display Installing speaker Installing Daughter Board Installing Motherboard Installing Hotkey Button Board Installing Power Button Board Removing Logic Upper Installing Keyboard Installing Optical Disc Drive (ODD) Installing Hard Disk Drive (HDD) Installing Wireless LAN and Bluetooth as combo module Installing Memory Module Installing Central Processing Unit (CPU) Installing	

			Thermal Module Installing Battery pack	
2	Software	ET2 (Operating System), TI	function, structure, operation, and file management, booting process, installation Operating system, word processing, spread sheet, database application, presentation aplication	(1) Explain the primary functions of an OS (2) Describe procedures for installing an OS (3) Explain the function and importance of required and optional system files (4) Explain how to configure an OS boot order (5) Explain the differences and advantages of various file types and naming conventions (6) Explain the use of basic disk and OS Commands (7) Explain procedures for working with Directories (8) Describe and list procedures for using file commands (9) Explain the need and use of File Management software 1.1. Explain how to properly format a hard disk in accordance with file type

				1,12, Explain how to make a formatted disk bootable 1.13. Explain how to automate OS Commands Introduction to Microsoft and Linux 1.2.1 Explain the differences and system requirements between various OS's: 1.2.1.1 Windows 7 1.2.1.2 XP Home 1.2.1.3 XP Pro 1.2.1.4 Windows Vista 1.2.1.5 Windows 8 1.2.1.6 Red Hat 1.2.1.7 open SUSE 1.2.1.8 Knoppix 1.2.2 Identify procedures for starting an OS 1.2.2.1 Boot Process 1.2.2.2 Location of Key (MS only) 1.2.2.3 Logging on 1.3 Describe attributes and characteristics of using an OS 1.3.1 Windows 7, Windows Vista, Windows XP, Windows 8: 1.3.1.1 The Start Button and Taskbar 1.3.1.2 Deleted items 1.3.1.3 My Computer 1.3.1.4 Explorer

				1.3.1.5 Shortcuts 1.3.1.6 Canceling a Print Job 1.3.1.7 Permissions 1.3.2 Linux 1.3.2.1 Shells and Utilities 1.3.2.2 Basic Shell 1.3.2.3 Kernel 1.3.2.4 The Search Path 1.3.2.5 The Directory Path 1.3.2.6 Permission 1.3.2.7 Regular expressions and Meta characters 1.3.2.8 Explain how to properly shut down an OS 2.1 Explain memory management requirements for Windows 7, Windows XP, Windows Vista, Windows 8 and Linux: 2.1.1 Main memory overview 2.1.2 Optimizing memory 2.1.3 Minimum and maximum memory allocation 2.1.4 Upgrading memory 2.1.5 System resources 2.1.6 Virtual memory settings 2.1.7 Optimizing your system 2.2 Explain how to

				install, configure, and customize the following for Windows 7, Windows Vista, Windows XP, Windows 8 and Linux: 2.2.1 Pre-Installation procedures 2.2.2 Installation procedures 2.2.3 Installing new applications 2.2.4 Changing system settings 2.2.5 The registry 2.2.6 Customizing the OS at boot-up 2.2.7 Hide control panel icons 2.2.8 Hide the taskbar 2.2.9 Recreate standard group folders 2.2.10 Setting up a printer 2.2.11 Changing or re-installing a printer driver 2.2.12 Installing software 2.2.13 Creating a new startup disk 2.2.14 Installing hardware drivers 2.2.15 Change and configuring video Explain Operating System recovery methods and functions of an anti-virus:

				3.1.1 Data recovery software 3.1.2 Backup utilities/software 3.1.3 Anti-virus software 3.1.4 Troubleshooting the OS boot configuration 3.2 Identify and describe troubleshooting techniques: 3.2.1 Installation troubleshooting 3.2.2 Error messages 3.2.3 Generic troubleshooting 3.2.4 Improving overall performance: 3.2.5 Troubleshooting specific startup errors 3.2.6 Bypassing startup files 3.2.6.1 Explain how to perform a clean boot 3.2.7 Booting with Diagnostic Switches
	Networking	AX, JW, BO, DP, TI, ID	Internet Protocol (IP) Address Wireless LAN	Sub netting IP Address Public IP Address Private IP Address IP address Assignment Implement Internet Protocol (IP Address) to Wireless router

				Understand about Antenna's Line of Sight (LOS) Familiar with GPS tools like Garmin Implement Internet Protocol (IP Address) to Wireless router Understand about Antenna's Line of Sight (LOS) Familiar with GPS tools like Garmin. Familiar with frequency and channel Familiar with Frequency 2.4 GHz, 5.7 GHz, 5.8 GHz Understand about frequency interference Familiar with Cross and straight cabling Familiar with Fiber optic Familiar with type of computer network topology, like bus topology, star topology
			Cabling Network Topology	

b. Dissimilar competence between 5 industries and 2 national and international standards

According to the requirments of 5 industries and standards from Electrical and Technical Association and Indonesia Standard, there are found some dissimilarities as shown in Table 21.

Table 21 Dissimilar competence between 5 industries and 2 national and international standards

No	Industry / Standard	Dissimilarity	Description
1	Axioo	Disassembly Notebook	Removing Battery Pack Removing Thermal Module Removing Central Processing Unit Removing Memory Module Removing Wireless LAN and Bluetooth Module Removing Hard Disk Drive Module Disassembly Optical Disk Drive Removing keyboard Removing Logic upper Removing power button board Removing hotkey button Removing Mainboard Removing daughter board Removing speaker Disassembly display
		Quality Control	Introducing Notebook Quality control Trial and error notebook Finishing
2.	CV. Indoakses		
3.	PT. Media Sarana Data		

4	PT. Global Prima Utama		
5	PT. Lintas Data Prima		
6	Electrical Technical Assosiciation	Installation, Configuration/ Upgrading and Memory Management	Explain memory management requirements for Windows 7, Windows XP, Windows Vista, Windows 8 and Linux: Main memory overview Optimizing memory Minimum and maximum memory allocation Upgrading memory System resources Virtual memory settings Optimizing your system Explain how to install, configure, and customize the following for Windows 7, Windows Vista, Windows XP, Windows 8 and Linux: Pre-Installation procedures Installation procedures Installing new applications Changing system settings The registry Customizing the OS at boot-up Hide control panel icons Hide the taskbar Recreate standard group folders Setting up a printer Changing or re-installing a printer driver Installing software Creating a new startup disk Installing hardware drivers
7	Indonesian Competence Standards	General competence for Computer Technician	1.1.Preparing Proposals 1.2. Preparing Presentations 1.3. Following the procedure of Health and Safety 1.4. Using the Measure Tool or Tools for Maintenance and Repair

			1.5. Identify the computer hardware specifications 1.6. Replacing the warranty label on computer 1.7. Packing and complements the user manual, warranty card and CD Driver 1.8 Conducting an inventory software 1.9 Creating a work report : assembly, maintenance and repair, Following Procedure of Intellectual Property Rights Protection 2.1. Formulate the user needs (user requirement) 2.2. Designing specification in keeping with the functions and needs of the users (user specification) 2.3. Choosing Casing and Power Supply

3. Findings

Different subjects have the same competence; the researcher identified different subject matter that had the same competence. The subject matter that had similarities with the competence of the other subjects can be seen in Table 22.

Table 22. Similar competences between Computer Assembly and Operating System

Subject Matter		Information
Computer Assembly	Operating System	
Able to comprehend the operating system installation procedure based on GUI	Able to comprehend the closed source operating system	The competence discusses the operating system installation based on GUI. Closed source used here refers to the Microsoft Windows (GUI).
Able to present the result of operating system installation based on GUI	Able to perform the closed source operating system installation	
	Able to comprehend the open source operating system installation	
	Able to perform the open source operating system installation	

Table 23 Same competences between Basic Network and Network Design X

Subject Matter		Information
Basic Network	Network Design X	
Able to understand the network hardware	Able to understand the configuration of network equipment	Discuss the problem of network hardware
Able to present the network hardware in accordance with requirements	Able to present the development result of simple network	
Able to understand the network protocols	Able to understand the addressing network	Discuss the network addressing

Able to present the utilization of addressing protocol in networks	Able to present the addressing network	

Table 24 The same competences between Networking Operating System XI and Server Administration XI

Subject Matter		**Information**
Networking Operating System XI	Server Administration XI	
Able to analyze the needs of server devices	Able to analyze the server needs to traffic and computer network applications	It has a similarity on subject matter that is a discussion of required server hardware
Able to present the analysis result of server device needs	Able to present the result of server needs to traffic and computer network applications	It has a similarity on subject matter
Able to comprehend how to install the network operating systems	Able to comprehend the operating system installation for server	
Able to present the installation result of network operating systems	Able to present the result of operating system installation for server	The basic competence discusses the administration of server in connection to
Able to comprehend the administration of network operating systems	Able to comprehend the file system administration and user access on Linux	
Able to present the administration result of network		

operating systems	Able to present the result of file system administration and user access on Linux	user, group, quotas, disk management
Able to present the administration result of network operating systems		
Able to comprehend the hard disk management on server		
Able to present the result of hard disk management on server		
Able to comprehend how to perform the user and group management on network operating systems		
Able to present the result of user and group management on network operating systems		
Able to comprehend how to perform the user quota management, application and capacity on network operating systems		
Able to present the result of user quota management, application and capacity on network operating systems		
	Able to comprehend the	

	remote access management	Repetition of Subject Matter
	Able to present the result of remote access management	
	Able to comprehend how to configure the Remote Server (Telnet, SSH)	
	Able to present the result of Remote Server configuration (Telnet, SSH)	
Able to comprehend way to configure the DNS server	Able to comprehend how to configure the DNS server	Repetition of Subject Matter
Able to present the result of DNS server configuration	Able to present the result of DNS server configuration	
Able to comprehend way to configure the DHCP Server	Able to comprehend how to configure the DHCP Server	
Able to present the result of DHCP server configuration	Able to present the result of DHCP server configuration	
Able to comprehend the backup system and recovery	Able to comprehend the backup management and recovery on Linux	Repetition of Subject Matter
Able to Present the results of backup system and local recovery	Able to present the backup management and recovery on Linux	

Table 25 The same competences between Networking Operating System XII and Network Design X

Subject Matter		Information
Networking Operating System XII	Network Design X	
Able to comprehend how to configure the operating system with network integration (internet)	Able to comprehend the connecting of internet via ISP	
Able to present the configuration result of operating system with network integration (internet)	Able to present the connecting of internet via ISP	
	Able to comprehend the Internet and its utilization	

B. Discussions

Related to the Electronic Technician Association, industrial needs, Indonesian standard of competence, and 2013 Curriculum, the alternative curriculum can be used as complementary curriculum. The alternative curriculum complements industrial demand, Indonesian standard of competency, and International Standard (ETA, Electronic Technician Association) in 3 levels. In the first level, the students must compete in computer system, computer assembly, operating system, basic electronics, and basic network as illustrated in Table 18 and 19.

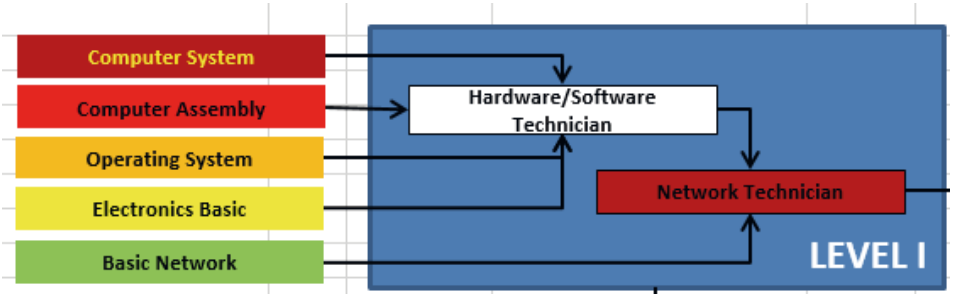

Figure 8 Level 1 Network Technician

Table 26 Competence at computer system, computer assembly, and operating system

Competence		
Computer System	Computer Assembly	Operating System

Competence		
Computer System	Computer Assembly	Operating System
Able to comprehend the development of computer technology Able to present the observation data result of computer technology development Able to comprehend the computer organization and architecture Able to present the structure sketch of Von Neumann computer systems Able to comprehend the external/ peripheral devices Able to form the external device using console units Able to comprehend the input and output device components	Able to comprehend the place and work safety Able to present the needs result of place and work safety Able to comprehend the tools and materials that used in assembling computer Able to present the tools and materials classification result that used in assembling computer Able to comprehend the layout map of computer components Able to create the layout map of computer components Able to comprehend the types of computer case Able to present the classification result of computer case	Able to comprehend the closed source operating systems Able to present the data development of closed source operating systems Able to comprehend the development of open source operating systems Able to present the data development of open source operating systems Able to understand the installation of closed source operating systems Able to practice the installation of closed source operating systems

Competence		
Computer System	Computer Assembly	Operating System
Able to present the observation data result of various input and output device components Able to comprehend the process device components and storage media Able to present the observation data result of various process device components and storage media Able to comprehend the external data storage media (magnetic disk, RAID optical disk and magnetic tape) Able to distinguish some alternative usage on data media storage (semiconductor, magnetic disk, RAID, optical disk and magnetic tape)	Able to comprehend the procedure of computer disassembly Able to present the result of computer disassembly Able to understand the BIOS configuration Able to present the result of BIOS configuration Able to comprehend the testing procedure on assembling result Able to present the testing and assembling result Able to comprehend the computer interconnection Able to present the computer interconnection result Able to understand the error basic result on computer	Able to comprehend the booting process on closed source operating systems Able to present the booting process on closed source operating systems Able to comprehend the structure of closed source operating systems Able to present the structure of closed source operating systems Able to comprehend the error search procedure on closed source operating systems

Competence		
Computer System	Computer Assembly	Operating System
Able to analyze the memory based on the memory system characteristics (location, capacity, unit, access method, performance, physique types, and physique characteristics) Able to present the concept of computer memory Able to comprehend the semiconductor memories (RAM, ROM, PROM, EPROM, EEPROM, EAPROM) Able to apply the number systems on semiconductor memories (address and data) Able to comprehend the number systems (Decimal, Binary, Octal, Hexadecimal)	Able to present the error basic result of identification on computer Able to understand the error result on computer hardware Able to present the error result on computer hardware Able to comprehend the error result on computer peripheral equipment Able to present the error result on computer peripheral equipment Able to understand about the computer maintenance procedures Able to present the computer maintenance results	Able to present the error searching procedure on closed source operating systems Able to comprehend the installation of open source operating system Able to perform the installation of open source operating systems Able to comprehend the booting process on open source operating systems Able to present the booting process on open source operating systems Able to comprehend the structure of open source operating systems

Competence		
Computer System	Computer Assembly	Operating System
Able to use the number systems (Decimal, Binary, Octal, Hexadecimal) in solving the conversion problems		Able to present the structure of open source operating systems Able to comprehend the administration of open source operating systems Able to present the administration result of open source operating systems Able to comprehend the procedure of operating system installation based GUI Able to present the result of operating system installation based GUI Able to comprehend the operating system administration

Competence		
Computer System	Computer Assembly	Operating System
		Able to present the result of operating system administration Able to comprehend the procedure of peripheral installations Able to present the result of peripheral installations Able to understand the procedure of application program installations Able to present the result of application program installations Able to comprehend the installation procedure of utility program Able to present the result of utility program installation Able to comprehend the error searching procedure on open source operating systems Able to present the error searching procedure on open source operating systems

Competence		
Computer System	Computer Assembly	Operating System
		Able to comprehend the backup process and restore systems Able to present the backup result and restore systems

Table 25 Competence at Basic Electronics and Basic Network

Competence	
Basic Electronics	**Basic Network**
- Alternating Current - Direct Current - How to measure the ac/ dc electric current - Changing the ac into dc - Ohms Law - Comprehending the Symbol of Electronics Components - Comprehending the Function of Electronics Components - Calculating and Measuring the Resistance Value - Calculating and Measuring the Capacitance Value - Measuring the Transistor - Comprehending of Electronics circuit - Rule of drawing the electronics circuit - Drawing the Electronics Circuit - Changing the scheme into PCB - PCB rule-making - PCB dissolution technique - AND Logic Circuit - OR Logic Circuit - NOR Logic Circuit - XOR Logic Circuit - NOT Logic Circuit - Half Adder Circuit - Full Adder Circuit - Describe the definition of microcontrolle microprocessor - Describe the part of microcontroller - Describe the architecture of microcontroller - Describe the feature of microcontroller - Describe and Draw the block diagra microcontroller - Explain the types of oscillator microcontrolle - Explain the memory position of microcontrol - Comprehending BUS Input C Microcontroller - Implementation of Binary, Hexadecim microcontroller - Data Communication RS232, RS485, Ethernet, Wi-Fi	Able to comprehend the computer network concept Able to present the network needs on an organization Able to comprehend a network topology Able to comprehend the connection of computer to network Able to think about the connection of computer to network Able to present the simple network using topology Able to comprehend a various network services Able to present a various network services Able to comprehend the OSI model on computer network Able to present the concept and function of each OSI layers Able to analyze the appropriate media in data communication networks Able to make sense of appropriate media type in data communication network Able to comprehend the network protocols Able to present the use of network protocols Able to comprehend the network addressing

- Peripheral USART, SPI , ADC, DAC - Register on Microcontroller - Timer function - Programming Library - Program Compilation - Write program	protocols Able to present the use of addressing protocols in networks Able to comprehend the network addressing Able to present the network addressing Able to comprehend the network hardware Able to present the network hardware in accordance with requirements Able to comprehend a network application in computer operating systems Able to present a network application in computer operating systems Able to comprehend the computer network administration resources Able to present the result of network administration resources Able to comprehend the horizontal simple network deployment Able to present the result of horizontal simple network deployment

Student at level 2 must compete in Network Operating System and Server Administration to be a network administrator.

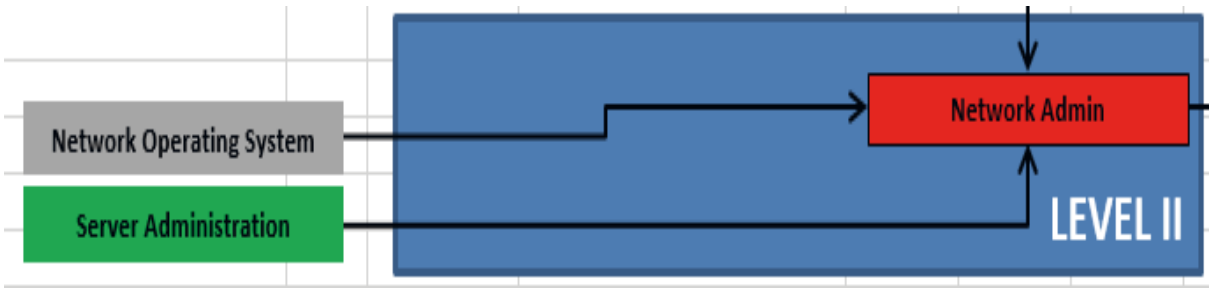

Figure 9 Level II Network Administrator Competence

Table 26 shows the required competence at network operating system and server administration.

Table 26 Competence at Network operating system and Server Administration

Competence	
Network Operating System	**Server Administration**
Able to comprehend the types of network operating systems Able to present the types of network operating systems Able to comprehend how to install the network operating systems Able to present the installation result of network operating systems Able to comprehend the installation of operating system for server Able to present the result of operating system installation for server Able to comprehend the hard disk management on server Able to present the result of hard disk management on server Able to comprehend the administration of network operating systems	Able to analyses the server device needs Able to present the analysis result of server device needs Able to analyze the server needs to did a traffic on computer application networks Able to present the analysis result of server needs to did a traffic on computer application networks Able to comprehend the Admin's role and responsibility Able to think about the Admin's role and responsibility Able to comprehend the remote access management Able to present the Remote Access Management Result Able to comprehend the configuration of Remote Server (Telnet, SSH)

Able to present the administration result of network operating systems Able to comprehend how to perform the user and group management on network operating systems Able to present the result of user and group management on network operating systems Able to comprehend how to perform the user quota, application and capacity management on network operating systems Able to present the result of user quota, application and capacity management on network operating systems Able to comprehend the file system and user access administration on linux Able to present the result of file system and user access administration on linux Able to analyse the service process and event of network operating systems Able to present the observation result of service process and event on network operating systems Able to comprehend the ways of scheduling process Able to present the result of scheduling process Able to comprehend the backup system and recovery Able to present the result of backup system and local recovery Able to comprehend the backup and recovery management on linux	Able to present the Remote Server (Telnet, SSH) Configuration Result Able to comprehend how to configure the DHCP Server Able to present the DHCP Server Configuration Result Able to comprehend how to configure the DHCP server Able to present the DHCP server Configuration Result Able to comprehend how to configure the FTP Server Able to present the FTP Server Configuration Result Able to comprehend how to configure the securing FTP Server Able to present the result of securing FTP Server Able to comprehend how to configure the Samba Server Able to present the configuration result of Samba Server Able to comprehend how to configure the WEB/HTTP Server Able to present the WEB/HTTP Server Configuration Result Able to comprehend how to configure the securing Web / HTTP server Able to present the Securing Web / HTTP Server Configuration Result Able to comprehend how to configure the Mail Server Able to present the Mail Server Configuration Result Able to comprehend how to configure the Web Mail Server Able to present the Web Mail Server Configuration Result Able to comprehend how to configure the DNS Server

Able to present the backup and recovery management on linux Able to comprehend the troubleshooting on network operating systems Able to present the troubleshooting result on network operating systems	Able to present the DNS Server Configuration Result Able to comprehend how to configure the DNS Server Able to present the DNS Server Configuration Able to comprehend how to configure the NTP Server Able to present the NTP Server Configuration Result Able to comprehend how to configure the Proxy Server Able to present the Proxy Server Configuration Result Able to comprehend how to configure the VPN Server Able to present the VPN Server Configuration Result Able to comprehend how to configure the multimedia streaming server Able to present the Multimedia Streaming Server Configuration Result Able to comprehend how to monitor and control the performance of server Able to present the monitoring and controlling result of server's performance

Student at level 3 must compete in Data Communication, Wireless Network, Network Security, and Network Design.

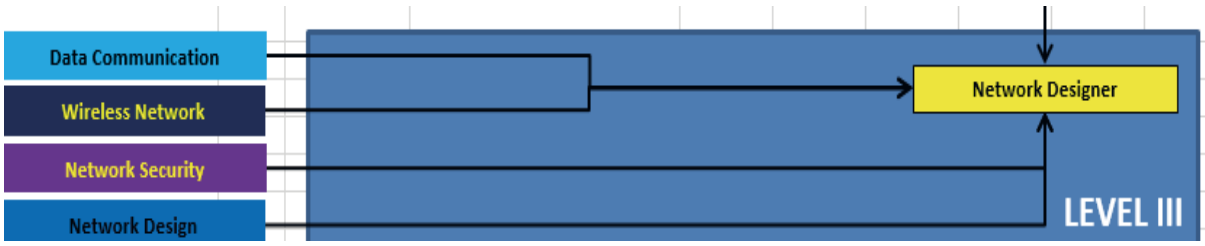

Figure 10 Network Designer

Table 27 shows the needed competence in Network Security and Network Design.

Competence	
Network Security	**Network Design**
Able to comprehend the policies by using network Able to present the various policies by using network Able to comprehend the threat and attack possibilities towards the network security Able to present the various threat and attack possibilities towards the network security Able to comprehend the needs of network security systems Able to present the needs of network security systems Able to comprehend the steps of host hardening Able to comprehend the steps of host hardening Able to comprehend the firewall in host and server Able to present the analysis result of firewall in host and server Able to comprehend the needs of tools requirement to build a firewall server	Able to comprehend the internet and its utilization Able to think about the internet and its utilization Able to comprehend the ISP services Able to analyze the ISP Services Able to comprehend the role and responsibility of ISP Able to think about the role and responsibility of ISP Able to comprehend how to connecting the internet via ISP Able to present the internet connecting via ISP Able to comprehend about the planning of network updates Able to analyze the planning of network updates Able to comprehend the addressing structural designs

Able to think about the needs of tools requirement to build a firewall server Able to comprehend the traffic filter using Access Control List (ACL) Able to think about the traffic filter using Access Control List (ACL) Able to analyze the report / logs work of firewall server Able to present the analysis report / logs work of firewall server Able to analyze the security protocol on network tools Able to present the analysis result of security activation on network tools Able to analyze the testing protocol of network security, host and server Able to present the testing result of network security, host, and server Able to analyze how the detection system working and preventing from the threat / attack incoming to a network Able to present the analysis result of the detection system and preventive from the threat / attacks incoming to a network Able to analyze the report/ log work of detection and preventive from network attacks Able to present the report analysis/ log work of detection and preventive from network attacks Able to analyze the functions and protocols of server security on network services Able to present the analysis result of security server functions and protocols on the network services Able to comprehend the function and working of authentication server Able to present the function and working of authentication server Able to comprehend the needs of tools requirement to build an authentication server Able to think about the needs of tools requirement to build an authentication server	Able to analyze the addressing structural designs Able to comprehend the configuration of network tools Able to present the development result of simple networks Able to comprehend the computer networks routing Able to analyze the computer networks routing Able to comprehend the routing protocol types of distance vector in enterprise networks Able to think about the routing protocol types of distance vector in enterprise networks Able to comprehend the routing protocol types of link-state Able to think about the routing protocol types of link-state Able to comprehend the enterprise networks Able to think about the enterprise network Able to comprehend the infrastructure exploration on enterprise network Able to think about the infrastructure exploration on enterprise network Able to comprehend about the addressing in enterprise network

Able to comprehend the procedure of securing data communication using cryptographic techniques Able to think about the procedure of securing data communication using cryptographic techniques	Able to think about the addressing in enterprise network Able to comprehend about the switching in enterprise network Able to think about the Switching in enterprise networks Able to comprehend the implementation of enterprise WAN links Able to think about the implementation of enterprise WAN links Able to comprehend the help desk Able to think about help desk

CHAPTER V

CONCLUSIONS AND RECOMMENDATION

A. Conclusions

From the research that has been done, several conclusions can be drawn as follows:

1. 2013 Curriculum of Computer and Network Engineering Major that is Currently Implemented

Based on the 2013 Curriculum, the productive subject matters in vocational high school are: a) computer system; b) computer assembly; c) operating system; d) computer network basics; e) network operating system; f) server administration; g) network design; and h) network security. In addition, there are three additional subjects outside the 2013 Curriculum namely a) web design; b) visual programming; and c) real-time system.

2. Computer and Network Engineers Required by Industrial Needs

The competences required by industrial work are a) computer system; b) computer assembly; c) computer system; d) computer assembly; e) operating system; f) network security; g) server administration; h) network design; and i) wireless network.

3. The Working Area of Computer and Network Engineers

Based on the Indonesian standard of competence, Electronic Technician Association, and the required competence from industry, the working area of Computer and Network engineers are as: a) hardware technician; b) software technician; c) computer network technician including network design and wireless network; and d) computer network security technician.

4. The Curriculum of Computer and Network Engineering that is Appropriate with Industry Demand

The curriculum of Computer and Network Engineering major that is appropriate with industry demand is in 3 levels:

a. Level 1 is Hardware / Software Engineer competence as the basic for network technician, including 5 subject matters: 1) computer system, 2) computer assembly, 3) operating system, 4) basic eletronics, and 5) network basics.
b. Level 2 is Network Administration, consisting of 2 subject matters: 1) network operating system, and 2) server administration.
c. Level 3 is Network Designer competence, involving 4 subject matters: 1) data communication, 2) wireless network, 3) network security, and 4) network design.

B. Research Limitation

This research effort had been made and carried out in accordance with the scientific procedure, but still it has limitations. The limitations in this research were:

1. Limitations of time and place of the study when collecting the data. The researcher could not collect data from all vocational high schools and companies, so there was the possibility of other competencies that were taught and required.
2. Limitation of samples. Not all samples from industry could be used because not all industries were willing to provide the data for research purposes.
3. Limitation of research scope. The research was held only in Yogyakarta, Central Java, and East Java province; therefore the scope was limited.

REFERENCE

A. Willi Petersen, C. W. (2004). *Guidelines for ICT Training and Curriculum Development.* Belgium: Office for Official Publications of the European Communities.

Ahmed, F. M. (2010). *Technical and Vocational Education and Training Curricula Reform in Bangladesh. Qualification Requirements, Qualification Deficits and Reform Perspectives.* Stutgart: Institut fur Erziehungswissenscaft und Psychologie Universitat Stutgart.

APJII. (2013). Retrieved Juni 20, 2013, from Asosiasi Pengusaha Jasa Internet Indonesia: http://www.apjii.or.id/v2/index.php/read/faq.html

Atherthon, J. (2013). *Learning and Teaching; Curriculum [On-line: UK]*. Retrieved Juli 17, 2013, from http://www.learningandteaching.info/teaching/curriculum.htm

Atherton, J. S. (2013). *Learning and Teaching; Currciulum [On-line: UK]*. Retrieved July 3, 2013, from http://www.learningandteaching.info/teaching/curriculum.htm

Boyatzis, R. (1982). *The competent manager: A model for effective performance.* New York: Wiley.

Braslavsky, C. (2005). *International Beureo of Education.* Retrieved June 19, 2013, from UNESCO: http://www.ibe.unesco.org/fileadmin/user_upload/archive/AIDS/doc/cecilia_e.pdf

Braslavsky, C. (n.d.). *The Curriculum.* Retrieved July 06, 2013, from http://www.ibe.unesco.org/fileadmin/user_upload/archive/AIDS/doc/cecilia_e.pdf

Cedefop. (2010). *Learning outcomes approaches in VET curricula*. Retrieved April 16, 2013, from http://www.cedefop.europa.eu/EN/Files/5506_en.pdf

Cedefop. (2011). *The benefits of vocational education and training*. Retrieved May 17, 2013, from http://www.cedefop.europa.eu/EN/Files/5510_en.pdf

Cedefop. (2012). *Curriculum reform in Europe.* Retrieved June 20, 2013, from http://www.cedefop.europa.eu/EN/Files/5529_en.pdf

Commision, E. (2013, 05 08). *European Qualification Framework*. Retrieved 06 30, 2013, from http://ec.europa.eu/eqf/home_en.htm

Curriculum Evaluation. (n.d.). Retrieved August 17, 2013, from Sagepub: http://www.sagepub.com/upm-data/44333_12.pdf

Curtis R. Finch, J. R. (1999). *Curriculum Development in Vocational and Technical Education.* Virginia: A Viacom Company.

Djojonegoro, W. (1998). *Pengembangan Sumberdaya Manusia Melalui Sekolah Menengah* . Jakarta: PT. Jayakarta Agung Offset .

Dr. Sukamto, M. (1988). *Perencanaan dan Pengembangan Kurikulum Pendidikan Teknologi dan Kejuruan.* Jakarta: Departemen Pendidikan dan Kebudayaan.

Dubois, D. (1993). *Competency-based performance improvement: A strategy for organizational change.* HRD Press, Inc.

E.Norton, R. (2008). *DACUM HANDBOOK.* Columbus, Ohio : Center on Education and Training for Employment College of Education & Human Ecology The Ohio State University.

Ebert II, E. S., & Culyer III, R. C. (2012). *School an Introduction to Education.* Cengage Learning.

Emes, C., & Cleveland-Innes, M. (2003). A Journey Toward Learner-Centered Curriculum. *The Canadian Journal of Higher Education*, 47-70.

F. Holton, E., & Jr, J. T. (1996). TRENDS TOWARD A CLOSER INTEGRATION OF VOCATIONAL EDUCATION AND HUMAN RESOURCE DEVELOPMENT . *Journal of Vocational and Technical Education*.

Germany's Dual System of Vocational Education And Training. (2013). Retrieved June 20, 2013, from WorldSkills Leipzig 2013: http://www.worldskillsleipzig2013.com/en/education/germany_dual_system/

Irma Dolores, N. y. (2007). From curriculum to syllabus design: The different stages to design a program. *MEMORIAS DEL III FORO NACIONAL DE ESTUDIOS EN LENGUAS* , 276.

Jan Van den Akker, D. F. (2010). *Curriculum persepctive on plurilingual education.* Netherlands: Council of Europe.

Kassel, C. U. (2005). *Selecting and Structuring Vocational Training Contents.* Mannheim: Capacity Building International, Germany.

Kelly, A. (2009). *The Curriculum: Theory and Practice.* London: Sage Publications Limited.

Khalid Malik. (2013). *Human Development Report.* New York: UNDP.

(2012). *Laporan Kompilasi Hasil Pilot Project Tahun 2011.* Jakarta: Kementerian Pendidikan Nasional.

Lattuca, L. R., & Stark, J. S. (2009). *Shapping The College Curriculum, Academic Plan in Context p.4.* 989 Market Street, San Fransisco, CA 94103-1741: Josey-Bass A Wiley Imprint.

Litosseliti, L. (2007). *Using Focus Groups in Research.* New York, USA: Continum.

Mccombs, B. L., & Miller, L. (2009). *The School Leader's Guide to Learner-Centered Education.* California: Corwin Press, Inc. A Sage Company.

Norton, R. E. (2008). *DACUM HANDBOOK.* Columbus, Ohio: Center on Education and Training for Employment College of Education & Human Ecology The Ohio State University.

Nunan, D. (1988). *Syllabus Design p.6.* New York: Oxford University Press.

Panduan Umum KTSP. (2006). Retrieved 05 07, 2013, from BSNP: http://bsnp-indonesia.org/id/wp-content/uploads/kompetensi/Panduan_Umum_KTSP.pdf

PEACE. (2007). *Indonesia and Climate Change : Current Status and Policies.*

Pengangguran Terbuka Menurut Pendidikan Tertinggi yang Ditamatkan 2004 - 2012. (2013). Retrieved May 13, 2013, from Badan Pusat Statistik: http://www.bps.go.id/tab_sub/view.php?kat=1&tabel=1&daftar=1&id_subyek=06&notab=4

Peraturan Pemerintah (PP) No 29 tahun 1990. (1990). Indonesia.

Peraturan Pemerintah No 19 tahun 2005. (2005). Indonesia.

Prihadi, S. F. (2004). *Assessment Centre Identifikasi, Pengukuran, dan Pengembangan Kompetensi.* Jakarta: PT Gramedia Pustaka Utama.

Print, M. (1998). *Curriculum Development and Design.* 83 Alexander Street Crows Nest NSW 2065 Australia: Allen & Unwin.

Prosser, C. &. (1979). *Vocational Education in a Democracy.* Chicago, Illinois: American Technical Society.

Rauner, F., & Maclean, R. (2008). *Handbook of Technical and Vocational Education and Training Research.* Springer Scinence+Business Media B.V.

Raven, J. &. (2001). *Competence in the learning society.* New York: Peter Lang.

Regulation, I. M. (2012). *President Regulation on Indonesian National Qualification Framework .* Jakarta.

(2010). *Rencana Strategis Kementerian Pendidikan Nasional 2010 - 2014.* Jakarta: Kementerian Pendidikan Nasional .

RI, K. T. (n.d.). *Pedoman Penyelenggaraan Sistem Pelatihan Kerja Nasional di Daerah.* Jakarta: KEMENTRIAN TENAGA KERJA DAN TRANSMIGRASI RI.

S.S., C., & K.Sharma, R. (2004). *Sociology of education.* New Delhi: Atlantic Publishers and Distributors.

Sagepub. (n.d.). Retrieved July 17, 2013, from http://www.sagepub.com/upm-data/25972_Chapter_1_Defining_Effective_Curriculum_Leadership.pdf

Schwab, K. (2012). *The Global Competitiveness Report 2012 - 2013.* Geneva: World Economic Forum.

Seema, S. (2007). *The Handbook of Competency Maping : understanding, designing and implementing competency models in organizations 2nd ed.* New Delhi: Sage India.

Spencer, J., & Spencer, S. L. (1993). *Competence at Work. Models for Superior Performance.* New York: Wiley & Sons.

Takatchov, O., & Pollnow, S. K. (2012). *A Pratical Guide To Teaching and Learning p.19.* Estover Road, Playmouth PL 6 7PY, United Kingdom: Roman & Littlefield Education.

Tim Penyelarasan Pendidikan dan Dunia Kerja Republik Indonesia. (2012). *Penyelarasan Pendidikan dan Dunia Kerja Republik Indonesia.* Retrieved Februari 1, 2013, from http://penyelarasan.kemdiknas.go.id/uploads/file/Materi%20Sosialisasi%20Penyelarasan.pdf

Training, I. I. (1987). *A Guide for Evaluation of Technical and Vocational Education Curricula.* Turin, Italy: UNESCO.

Undang-Undang Nomor 20 tahun 2003. (2003). Indonesia.

University, O. S. (n.d.). *DACUM*. Retrieved June 20, 2013, from DACUM: http://www.dacumohiostate.com/DACUM-flyer.pdf

UUSPN. (1989). *Undang-undang Sistem Pendidikan Nasional No 2.* Indonesia.

William F.Pinar, W. M. (2008). *Understanding Curriculum.* New York: Peterlang Publishing, Inc.

William, B., & Hiebert, B. (2002). *Understanding the Context of Technical and Vocational Educatioan and Training.* Retrieved from Unesco: http://unesdoc.unesco.org/images/0013/001310/131005e.pdf

Zhao, Z., & Rauner, F. (2014). *Areas Of Vocational Education Research.* Verlag Berlin Heidelberg: Springer.