COMPUTER NETWORK LEARNING STRATEGY IN THE REVOLUTION 4.0 ERA WITH THE WATERFALL METHOD

by Basuki Wibawa

COMPUTER NETWORK LEARNING STRATEGY IN THE REVOLUTION 4.0 ERA WITH THE WATERFALL METHOD

Basuki Wibawa, Suyitno Muslim, Sulfikar Sallu
Education Technology Universitas Negeri Jakarta
Jakarta, Infonesia
sulfikarsallu_tp16s3@mahasiswa.unj.ac.id

Abstract—

The Learning Model is a method used by teachers in conveying messages (knowledge) to students. The purpose of this research is to find a method of learning that can be used in learning computer networks in the era of industrial revolution 4.0 for students who have finished taking this course can have competencies. The method used is combining 14 (fourteen) learning models, namely the global method, the lecture plus method, debate, thought mapping, problem-solving methods, design methods, experimental methods, methods skills training, demonstration method, lecture visit method, discussion method, recitation method, scripts cooperative, discovery method, inquiry method, peer teaching method and team teaching method with using the blended learning model. The result to be achieved is to produce a strategy guide for computer network courses to be used as reference material in the curriculum courses. The combination of these methods can be used as a basis in the computer network learning model because it will produce students who are competent and ready to take international certification exams in the field of computer networking.

Keywords- computer network courses; industrial revolution 4.0; learning methods

I. INTRODUCTION

So far, lecturers provide one-way material at each meeting, the interaction with students is lacking and because of its limited practicum equipment, almost do not carry out practical work either directly or practice using tracer software. [1] Simulation refers to a visual technology aid that is rendered capable in assisting students learning the abstract content which was deemed difficult to grasp through traditional method. Metode pembelajaran yang modern The purpose of Intel® Teach Program is to help "teachers to be more effective educators through professional development focused on how to integrate technology into their lessons, promoting problem solving, critical thinking and collaboration skills among their students. With more than 6 million teachers trained in over 50 countries, Intel Teach is the largest, most successful program of its kind."[2]. A learning model that continues to combine face-to-face learning with online learning Course recommendation systems is applied to help students with different needs select courses in a large range of course resources. However, a student's needs are not always determined by their interests, they are also influenced by teachers, peers, etc [3]. It is becoming increasingly prevalent in digital learning research to encompass an array of different meanings, spaces, processes, and teaching strategies for discerning a global perspective on constructing the student learning experience[4]. Every student must have preparation enough to be qualified. Participants' emergent habitus of resistance was never fully developed from within. Rather, it emerged with the changing social structures. The centrally planned job assignment policy was dismantled in 1996. Since then, the state of China has allowed freedom and autonomy in employment. In sociological terms, the shift in the field of power made it possible for participants to choose EGRT according to their own will, enabling, at least to a certain extent, their habitus of resistance.. [5] The low competency of students who have finished taking computer network courses and not have a graduation standard based on the results of an international computer network certification exam. As in China even though there has been a policy change, students still carry out the educational pattern. Students must have competence[6][7] and can pass the international computer network certification exam. The Total Client Care Assessment Tool aims to assess multiple competencies in an integrated way, mirroring how registered nurses are expected to practice. TCC is a tool designed to assess the student's ability to provide holistic care to a client over a specified period. TCC measures the student's performance around four constructs, these are Communication, Planning and Responding Care Delivery, and Assessing and Evaluating..[8]. To measure the competence of students using measuring tools. To achieve Digital data and literacy can be used as other supporting factors. Student quality of Science education program at the University of Pancasakti Tegal which is prepared to be science teacher candidates in junior high school in the future needs to be enhanced, because they must improve student scientific literacy ability. Students..[9] Combining the needs of the industrial world into the curriculum for computer network courses to be implemented in the teaching and learning process both in universities high as well as in the actual industrial world. Every industrial revolution carries with itself new expectations for human development areas in particular the education sector. Concerning the Fourth Industrial Revolution (4IR), academics and Students often ask themselves if

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there is a need for a new curriculum to graduate relevant students...[10]. Because The industrial world needs digitalization which can have a positive impact on companies. The industry faces the growing need for highly qualified professionals for the ongoing digitalization of the industrial value chain. The major triggers for the industry to go for digitalization are, among other reasons, the expected higher competitiveness through lower production costs, improved efficiency, shorten time-to-market as well as the needs for mass customization and personalization (extreme customization) of production [11]

The purpose of this study in general is to obtain guidance in the form of a combined concept industry needs with a learning model that will be applied to study programs that run courses computer networks.How are learning and innovation linked with each other, and how can a perspective based on complex adaptive (CAS) theory, contribute towards an understanding of the linkage between learning and innovation? [12] Combining 14 models learning to be applied in one semester runs in theory and practice.

By using several teaching methods that will be combined, namely, the Global Method: how to transfer knowledge which provides knowledge to students as a whole material, then students make a resume about the material that they absorb and extract the essence. This method is very effective to use if the course is without practice. Educators guide students in viewing resumes that are made to provide solutions to existing material.

Furthermore, the lecture plus method: how to transfer knowledge that provides knowledge to students with using oral lectures and accompanied by other methods. This teaching method uses more than one method, which way So far, it is used by most of the teaching staff, namely teaching, giving opportunities to ask questions, and giving assignments. Two technology in Debate learning, a way of knowledge transfer that provides opportunities for students to complain about arguments between two parties or preferably individually or in groups. The arguments are discussed solving a problem and making a decision on the problem. Thought Mapping / MIND MAP, how to transfer knowledge that provides knowledge to students by applying a continuous way of thinking to a how can the problem occur until it is resolved Problem Solving Methods / Problem Based Learning, a way of knowledge transfer that provides knowledge and opportunities for students to stimulate discussion group. Then the students expressed the results of the search for material related to the case and discussed in groups. Method Design, how to transfer knowledge that provides knowledge to students to stimulate students to able to create or create a project that will be practiced or will be researched. The trial method, how to transfer knowledge that provides knowledge and opportunities for students to stimulate students through action in the form of practicum or lab experiment. Each student hereby can see the real process and learn directly. Skills Training Methods, a way of transferring knowledge that provides knowledge and opportunities for students to train students' skills or soft skills by making, designing, or utilizing something. Demonstration method, a way of knowledge transfer that provides knowledge and opportunities for students to use objects or teaching materials at the time of teaching. Textbooks will provide a realistic view of what it will be studied, it could also be through the form of practicum either using software or direct practice. Method Lecture visits, how to transfer knowledge that provides knowledge and opportunities for students to take advantage of the environment, location, or places that have a source of knowledge for students. The teaching method is done with assistance from the teaching staff during the visit. Discussion method, how to transfer knowledge provide knowledge and opportunities for students to learn in problem-solving. This method is also commonly conducted in groups or group discussions. Recitation method, a way of transferring knowledge that provides opportunities for students to make a resume about the material that has been delivered by the teaching staff, by writing it on paper and use their own language. Discovery method, a way of knowledge transfer that provides knowledge to participants students to develop student learning methods to be more active, independent, and better understanding. Participants Students are looking for answers to their own questions, so they can be remembered better. This strategy is called the discovery strategy. in this context, global service learning programs are important opportunities for nursing students [13]

Inquiry method, a way of knowledge transfer that provides knowledge to students to be aware of what is in getting while studying. The teaching staff still has an important role in this method, namely by making designs learning experience. Peer Teaching Method is a way of knowledge transfer that provides knowledge to students for discussions, or also with presentations on the results of discussions involving practitioners from industry and government. Script Cooperative, a way of knowledge transfer that provides opportunities for students to verbally sue students to express the essence of the material presented. Team Teaching Method of knowledge transfer provides knowledge and show students how the teaching force works in a group to complete the learning of this course. And in the end an evaluation was carried out, Performance Evaluation can be carried out in greater numbers so that the ratio between the assessed and the assessor gets smaller[14] this is done so that the quality of competence remains good.

II. METHOD

The waterfall method is a method often used by system designers in general. This article makes applications waterfall method in learning design..[15] The essence of the waterfall method is the work of a process/system is done sequentially or linearly. If the first step has not been done, then the second step cannot be done. If the second step has not been done so the third step cannot be done, and so on. The stages of the research carried out were

1. The first stage analyzes the needs of the world of work that exist in the government and the industrial world as material universities will use to formulate teaching materials for computer network courses.

2. The second stage conducts a structured design and learning model of network courses while still involving the industry and government and lecturers from universities.

3. The third stage, the design that has been completed is written in the form of a learning flow in accordance with the conditions that exist in higher education, the learning flow is in the form of a network course curriculum portfolio computers in the era of the industrial revolution 4.0.

4. The fourth stage is conducting applied trials of the results that have been obtained on the internal high school with involving all lecturers in computer networking subjects and alumni who have worked in the industry.

5. The fifth stage which is the final stage is the applied stage in general in the industrial world and the government with keep receiving feedback on what improvements have been made to keep adjusting for what is needed in industry and government
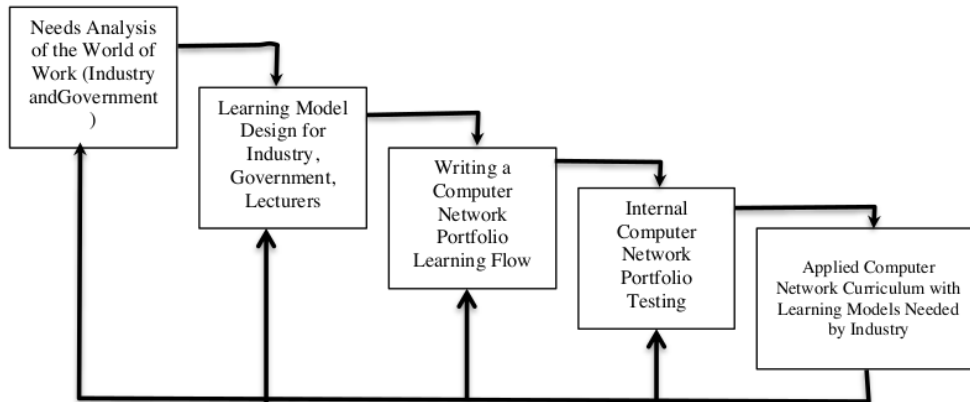
Figure 1. Application of Waterfall Method in Learning Model Design

This study uses a literature review using all existing data in the system study program course information and informatics techniques by combining existing reference reading materials from industrial needs in 2 (two) college. The pattern that is done is to see the lecture guide for computer networks in the form of a plan Semester Lectures. Every semester the number of meetings is 16 (sixteen), then the whole meeting will use 14 learning methods. Each meeting will use some combination of existing pursuit models, for example meeting 1, this meeting is an introductory course, so the method used is, lecture plus, global, mind map, and discussion. Meeting 1 teaching staff will provide complete information related to internal subjects in the form of a lecture plus general questions and answers and mapping the flow of thinking of a computer network model accompanied by discussion and at the end students are obliged to make the conclusions obtained. In general, it will provide the broadest information on the extent of the application of computer networks to both government and industry. The meeting of 2 teaching staff started provides material that leads to an introduction to practicum, more and more methods are being used, namely lectures plus, practice with design methods, keep using mind maps, introducing experimental methods and solving methods questions, discussion, and recitation. In this 2nd meeting, students began to be involved slowly to be involved indirectly.
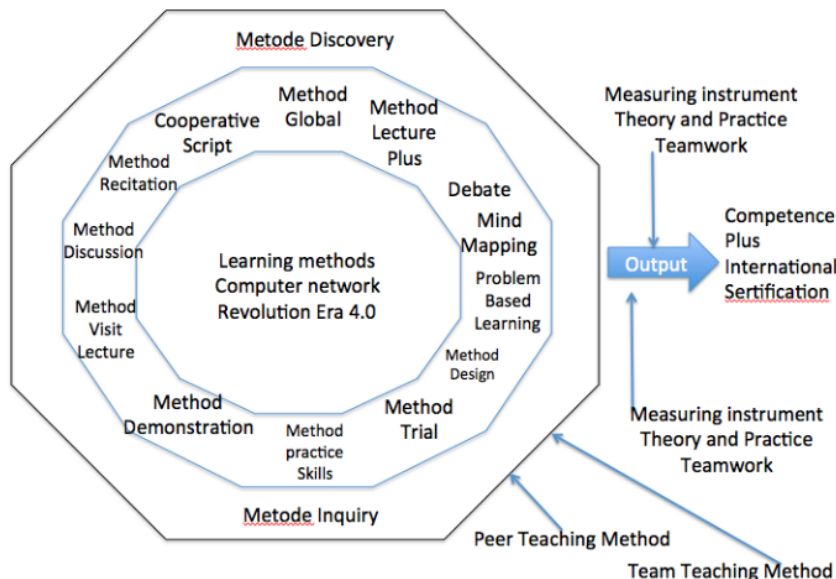.

Figure 2. Research Methodology

This research was conducted in the information system study program semester 3 (three) of the information technology faculty in the 2020 and Informatics engineering study program semester 5 in 2015 at 2 (two) different universities by requesting permission from deans, lecturers, and students studying computer networks. During the 5 (five) years, researchers continued to do so.

Experiment both theoretically and practically to find and apply the most suitable learning model for use in the era of the industrial revolution 4.0. and collaborating with several professional organizations (APTIKOM- Indonesian Computer Science Higher Education Association and ADRI- Experts and Lecturers of the Republic of Indonesia) and practitioners to do an evaluation. The leaders of 2 (two) Faculties, who are in higher education institutions, have given permission to researchers to use data and documents to be published.

The data collection technique used is by conducting direct interviews with deans, lecturers, students who take computer networking courses. The data obtained are then discussed again with 4 (four) components what is in this learning model, namely: universities, lecturers, students, and users both government and private.

Document analysis used is the verification of existing data at universities and users in order to obtain data that is accurate for lecturers to implement and the results are enjoyed by students.

III.   RESULT

The learning model carried out so far is a one-way learning model that focuses on teaching lecturers as teaching staff so that the results obtained in this computer network course do not meet the standards desired by the industrial world. And almost all are carried out in universities in each semester and learning tools are limited. With this learning model that is made, students get a balanced subject matter guide, that is, in the class they get theoretical lessons and practice it directly in places that need both schools, government offices and industry. This learning model will be very effective if overall the related parties provide opportunities to all students to actively and continuously be able to carry out learning both directly and in consultation related to computer network courses. as Innovation of educational technology in the world of education is an absolute requirement required for the development in the digital age[15]

The following table describes the components that are directly involved in the formation of a learning model according to the needs of users and universities can also involve teaching staff who are experts in their fields in producing competent students in computer network courses.

Table 1. Four involving components					
Higher Education	Lecturer		Student		User
	Theory	Practical	Input	Output	
	Lecturers translate the existing curriculum from higher education into textbooks	Lecturers translate the existing curriculum from higher education into modules	Acquire general knowledge as a basis	Have competencies according to the curriculum of user needs	
Make a complete guide in the form of a network course curriculum computers in accordance with the needs of the industrial revolution 4.0 era	The material includes training materials from international certification practitioners	Practice questions module, Microsoft Technology Associate MTA (network fundamental), CCNA Cisco Certified Network Academic, MTCNA Mikrotik Certified Network Academy	Students have a basic understanding which is the focus of problems that often-become questions	Students can solve problems that often become questions so they have experience in solving the problems they will face	Provide a list of the competency requirements needed to be able join (competency requirements) to enter the industrial
Make a Competency Measurement Tool needed in computer network courses	Lecturers translate existing competency measurement tools from higher education institutions into Competency	Demonstrate competency as a measuring tool..	Know the measuring instrument used as a benchmark for competence, so that students prepare their own resources..	Practicing directly through testing completion of measuring instruments	Monitor students' competencies in this computer network course and will provide recommendations if students experience difficulties or misunderstandings in

	Lists for Computer Network Courses				completing measuring instruments.
	The entire learning system is delivered using the blended learning method				

Tabel 2. Model Pembelajatan Dalam Tiap Pertemuan

Weeks-	2	3	4	Learning Methodology	6	7t
1				Lecture Plus Question and answer Discussion Global Giving of Tasks		
2				Global Method Lecture Plus Question and answer Discussion Giving of Tasks Mind Map Design Method Experiment Method Recitation		
3				Global Method Lecture Plus Question and answer Discussion Debate Giving of Tasks MindMap Experiment Method Problem Solving Methods Recitation		
4				Global Lecture Plus Question and answer Discussion Giving of Tasks Skills Training Method College Visit Demonstration Problem Solving Methods Recitation		

5	Global Method Lecture Plus Question and answer Discussion Debate Giving of Tasks MindMap Design Method Experiment Method Problem Solving Methods Recitation
6	Global Method Lecture Plus Question and answer Discussion Debate Giving of Tasks MindMap Experiment Method Problem Solving Methods Recitation
7	Global Lecture Plus Question and answer Discussion Debate Skills Training Method Giving of Tasks MindMap Experiment Method Problem Solving Methods Recitation
8	Mid-term Exam
9	Global Method Lecture Plus Question and answer Discussion Giving of Tasks

10

Skills Training Methode
College Visit
Demonstration
Problem Solving Methods
Recitation

Global Method
Lecture Plus
Question and answer
Discussion
Debate
Skills Training Method
Giving of Tasks
MindMap
Design Method
Experiment Method
Problem Solving Methods
Recitation

11

Global Method
Lecture Plus
Question and answer
Discussion
Giving of Tasks
Skills Training Method
College Visit
Demonstration
Problem Solving Methods
Recitation

12

Global Method
Lecture Plus
Question and answer
Discussion
Debate
Skills Training Method
Giving of Tasks
MindMap
Design Method
Experiment Method
Problem Solving Methods
Recitation

13

Global Method
Lecture Plus
Question and answer
Discussion
Debate
Skills Training Method
Giving of Tasks
Mind Map
Design Method
Experiment Method
Problem Solving Methods
Recitation

14

Global Method
Lecture Plus
Question and answer
Discussion
Giving of Tasks
Skills Training Methode
College Visit
Demonstration
Problem Solving Methods
Recitation

15

Global Method
Lecture Plus
Question and answer
Discussion
Debate
Skills Training Method
Giving of Tasks
MindMap
Experiment Method
Problem Solving Methods
Recitation

16

Final Exam

Table Captions
2. Sub-CP-MK (As the expected final ability)
3. Indicators
4. Criteria and Form of Assessment
6. Learning Materials
7. Weight

Figure 5. Student Applied at Vocational School

On the other hand, students will also have a learning experience in knowledge transfer, which can provide brief computer network training to vocational students

Figure 3. Computer Network Additional Learning Model

Additional learning is carried out if students who still want to increase their knowledge in computer network practicum, lecturers must also provide the time and equipment needed. Because so far the practicum equipment in the two universities does not meet the required requirements.
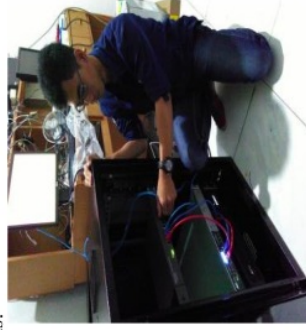
Figure 4. Student Application in Government Offices

For students who already have a basic understanding of the application of computer guidance, the lecturer of the course invites several students to see firsthand the existing conditions

IV. DISCUSSION

Research using a combination of 14 existing learning models using 5 structured steps has given very satisfying results because all the needs of the industrial world and government can be allocated by tertiary institutions supported by adequate lecturer competence in the implementation of the teaching and learning process.

This learning method requires integrated relationships with other fields (government and industry) as part of the computer network learning process. These professional relations are very much dependent on the management of higher education institutions and the existing teaching staff in establishing partnerships with industry and the government.

Because there are several companies that do not want to accept external parties to enter the company system itself due to several factors, as well as in government there are some who do not allow the use of devices that are the main requirement in the teaching and learning process of computer networks, for example entering the server room and seeing installation of an existing computer network installation model.

So this professional relational relationship is also one of the keys to the success that will be achieved by students who will give mutual benefits to all parties, both universities, industry and government.

In its implementation, each meeting will use more than one learning method that is used in the hope that the material presented can be received and understood in detail by students.

For example the first meeting that combines Lecture Plus where educators convey in full the main material the importance of studying computer network courses, the opportunities and challenges to be faced, learning components that need to be prepared, preparation of competencies that must be owned by each student so that the learning process will involve industry and government. A complete explanation of the rules and procedures to be implemented for one semester. If there are students who do not understand the material presented by the computer network lecturer, then a question and answer discussion can be carried out in general. The discussion that was carried out was to invite all students to open insights about what and how computer networks can be used in data processing so that it makes human work easier. The teaching and learning process that took place at the end of this course meeting the teaching staff gave assignments. Each existing assignment must be made in two versions, namely online and in print, meaning that all student assignments must be uploaded on the personal website of each student so that the teaching staff can make an assessment.

The next meeting the teaching staff will use seven learning methods, namely the Global Method, in this method the teaching staff again explains briefly what and how computer networks can work and are connected to other computer networks so that data processing can be carried out, at this meeting the teaching staff began to provide material designing and experimenting to make a simple computer network for students so that their basic thoughts can be formed and at the end of this meeting students are still required to work on assignments and make conclusions about today's meeting material according to their respective perceptions.

The next meeting is to make a lecture visit to government or industrial offices, in this teaching and learning process, the parties visited will provide an overview of computer networks and their actual implementation in the process of data processing work, here students can see directly the applied form of the eye. computer network lectures for various needs. At this meeting, the parties visited by the government and industry showed firsthand the tools and components needed in the world of work. In this meeting, students are also welcome to ask questions if there are technical matters whose practice is not yet known. At this meeting the teaching staff will also provide problems with computer network development and its basic installation as tasks for students to complete, students in this case are still obliged to make conclusions using their respective perceptions. This meeting is a meeting after conducting the first lecture visit to government and industrial offices so that educators are required to explain in detail the material previously obtained by giving assignments starting from designing computer networks trying to design the installation, giving existing problems and students are required to do and collects his assignments in three written online and video formats. All assignments must be uploaded on the student's website. This meeting can also be debated between teaching staff and students as well as students with other students in the perception of the material that has been obtained, so the task of educators is to direct the wrong views of students.

This computer network material lecture will be structured to conduct continuous lecture visits three times as an initial process in building relationships in computer network courses in both government and industry. With the hope that all the needs of the government and industry can be met with the resources that will be generated from higher education so that it will have a positive impact that is mutually beneficial between the two parties.

This learning model does require professional relations among all existing components, both from universities and other parties who will use the resources generated in computer network courses. The role of the government is one of the factors that is indispensable in providing policies for students to be actively involved in the real world of work by providing the facilities and facilities needed in the teaching and learning process as well as the industry that will use resources as internal personnel. support the productivity of existing companies.

In the process of making this measuring instrument, assistance is needed for teaching staff to produce reliable quality measuring instruments according to the needs of the government and industry. Technical Guidance on Teacher Performance Evaluation is carried out with the aim of providing teachers with skills to be able to use the Teacher Performance Assessment instruments to their peers. [14]

Learning strategies that involve universities, government and industry, supported by the ability of lecturers to convey knowledge through the learning process on and off campus, are expected to produce competent alumni of computer network courses..

V. CONCLUSSION

The combination of 14 (fourteen) learning models using the waterfall method can be used as a strategy learning To produce competent students who are ready to take international certification exams in the computer network field

ACKNOWLEDGMENT

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GENERAL COMMENTS

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