DEVELOPING SKILL BASED TEACHING APPROACHES FOR COMPUTER NETWORKING COURSES IN POLYTECHNIC MERSING

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Abstract

The ultimate goal of the Malaysia Polytechnic as a prominent Technical and Vocational Training Institution (TVET) in Malaysia is to produce a marketable graduates. A well-structured curriculum is developed to be align with the requirements of 9 pillars of Industrial Resolution (IR) 4.0. Undoubtedly, active learning approaches like Skill-Based teaching able to develop significant skills and potentials in students. Students are nurtured to be an independent learner through active learning approaches. This paper outlines the skill-based approaches in teaching computer networking courses in polytechnic. The sustainability of this approach depends on the commitments of lecturers and students throughout of the learning process. Leveraging on TVET 4.0 Framework Action Plan, especially through the collaboration with the leading IR 4.0 Industry, adaptation of Skill-Based Approach in teaching computer networking courses will be much easier.

Keywords: *Skill Based Teaching, Polytechnic, Active learning, TVET 4.0, Learning processes, computer networking.*

I. INTRODUCTION

Switching and Routing, Basic Routing Technology, Advanced Routing and Connecting WAN are core courses offered for Diploma in Information Technology (Digital Technology) Networking polytechnic students. The curriculum development and instructional method for this courses are based on Outcome Based Education (OBE).

Student's attainment is measured through Course Learning Outcome (CLO), Programme Learning Outcome and Program Educational Objectives (PEO) (Zakaria, N, Raub Khan, M.Z, and Othman, M.D, 2013). OBE for these core networking courses focused not only cognitive and psychomotor but also generic skills attributes. Here, the concept of Student-Centered Learning (SCL) is also been applied.

In the polytechnic system, a lots of imperative instructional approaches have been conducted aligned with immerse of technology, industrial needs and learning pattern of Generation Z students. Gen-Z students prefers more rewarding, attractive and fast learning method either inside or outside of the classroom. In a survey conducted by The Harris Polls among 2587 adults and teenagers, Gen-Z prefers YouTube, in person group activities and learning application as a learning tools. In the same polls, 71% prefer to try and figure out problems on their own first through the Internet, textbooks and classmates rather than asking a teacher for help (The Harris Polls, 2018). This shows that, personalized e-learning have to be cultivated in learning process nowadays. Learning tools and technology such as Online Blended Learning, Massive Open Online Course (MOOC), Flipped Learning, Web 2.0, Augmented Reality and Artificial Intelligence are in trending.

Moreover, a balanced theory and practical knowledge is needed to ensure Polytechnic Malaysia's graduates have the skills needed to thrive in Industrial Resolution (IR) 4.0 and as well as to raise the standard of TVET ("Are Our Student," 2019). According to Prof Datuk Dr Mohd Ismail Abd Aziz, industry-driven curriculum will be implemented in Polytechnics and Community Colleges. This curriculum amended professional certificates, competencies or skills into existing teaching, learning and evaluation process into a TVET 4.0 system ("Ensuring polytechnics and community colleges, 2019"). Students have to participate themselves inindustry-led competitions, internship or projects to

strengthen their skills. They have to go beyond from what is been taught in the classroom and syllabus to fit themselves into industries later. Here, oral and written communication skills, critical thinking and problem solving skills is necessary. Furthermore, social skills and responsibility includes in packages too. Critical thinking and problem solving skills for instant, shows that the students are capable in project handling. The absent of this affective domain skills are linked to the higher rates of Malaysian graduates unemployment. In fact, there are employers proclaim that polytechnic students are enable to generate ideas to solve work-related problems (Noni, N.S & Abdullah, A.B, 2018). This skills can be developed by tuning conventional learning into Skill Based Learning.

Computer networks, lays as a foundation for the core IR 4.0 emerging technologies such as internet of things, big data, cybersecurity and cloud computing. In teaching computer networking courses, most of lecturer faces challenges to ensure students achieve all the skillset needed. Through the experience of teaching these courses for more than three semester, adaptation of Skill-Based Teaching found to be beneficial. Skill-Based Teaching and Learning will be a complete skillset learning method. This method of teaching complies with the need of programme structure and syllabus requirement of the Polytechnic Information and Communication Technology Department.

II. LITERATURE REVIEW

A. Importance of Skill-Based Learning and Teaching

Skill-Based Learning is an approach that actively engaged the students in solving course related problems. Students are expected to implement knowledge that they have attained through the self-learning or classroom lectures. Interactive-notes, videos, games, reading materials and activity can be used in delivering the theoretical content of the course. Materials should be developed according to the requirement of the curriculum as a guideline on how depth the mandatory knowledge is required for the course. In a skill-based learning, learning is triggered problem based task, practical task or real-world scenario which needs constructive solutions. A greater impact of this approaches is when thelecturer plays role in planning, questioning and providing feedback so students can have a depth understanding of the course content. Inventively contrived questions is the most effective strategy to evaluate understanding of students in relating theory, ideas and real-world examples to the given task. Students will be more focused and directed to higher level thinking when the lecturers eliminate irrelevant answers or providing them more ideas (Kipper.H&Ruuthmann.T, 2013).

The idea behind this Skill-Based Learning is to create an active learner who thinks independently rather than receive only and everything been taught in classroom. Here,students will analyse, observe, rationalize, compare, relate and apply the theory in order to find the solutions. Furthermore, validation of knowledge and skill can be done during presenting the findings and solutions. Students able to identify causes, draw conclusions, determine evidence, share opinions and recommendations(Kipper.H et al., 2013). Such approaches is advantageous as students are exposed on how real-world projects is been handled.The learning process which is triggered by doubt, might not end with correct solution at the very first trial. However, the process activate collective knowledge and resources finding between peers which can lead to a better solution in a further attempt (Elaine & Karen, 2016).

B. Comparison of Conventional and Skill-Based Teaching Method.

This comparison is made based on the studies of the previous paper and feedback of the peer lecturers.

Area	Conventional teaching method for networking courses in polytechnic	Skill-Based Teaching method for networking courses in polytechnic

Objectives	Develop technical and non-technical skills.	Develop technical, non-technical skills and provide real work-based practices.
Lesson structure	Theoretical and Practical lesson is conducted with lecturer's involvement whether inside or outside of class.	Theoretical and Practical lesson is initiated by lecturer, learning process is done through self-learning.
Process	1. Formulating learning objectives.	1. Lecture clarify learning objectives and task/problem to solve.
	2. Lecture session done through interactive notes, videos, games, exercises or class activities.	2. All the learning materials including interactive notes, video, games, exercises and lab sheets needed to attain the learning objectives is provided.
	3. Practical session through simulator (packet tracer) or real device is guided by lecturer and lab sheets.	3. Students will perform project/task management to settle the task.
	4. Sharing or reporting the result.	4. Presented the results individually to the lecturer.
Knowledge	Memorization and application of knowledge.	Acquisition of knowledge.

Learning process	Guided or self-learning, practising and apply.	Self-learning, practising, investigate, rationalize, compare and come out with proper solution for the problem given.
		Question and answering session between lecturer and students.
Assessment	Individual or group assessment.	Individual assessment.
Evaluation	Ability to complete the assessment as required.	Ability to complete the assessments and how effective the solution is.
Hands-on implementation	Simulator (Packet Tracer) or Real Device.	Simulator (Packet Tracer) for self-learning and real-device for evaluation.
Time Allocation	Fixed according timetable. Full fill the curriculum requirement.	Flexible. Full fill the curriculum requirement.
Team Work	Students discuss, brainstorm and deliver the end product/solution as a team work.	Students discuss and brainstorm the ideas as a team work. Perform and deliver the end product/solution as individual.
Time and Resources.	Consume less time and device facilities have to be shared with huge number of students in group.	Consume a lot of time, students have be competitive among themselves to use the lab facilities. First come first served. Students have to manage time and

		resources effectively in order to finish their task before the deadline.

III. RESEARCH BACKGROUND

A. Problem Statement

Student's result was the ultimate reason that initiate this research. Students of networking track of Polytechnic Mersing is facing difficulties in attaining good results in final examination. The failing rate of students in the courses like Connecting WAN, Advanced Routing and Basic Routing Technology have to be reduced. This situation not only affecting the qualities of graduates but also demotivates other students from selecting networking track as their preferred specialization. There is many factors that contribute to this problem. However, from the perspective of a lecturer it is important to have deliberate effort inimprovising teaching approach. An efficient approach are required to reduce the impact of following issues in teaching networking courses;

1) Lots of conceptual, protocols and commands to be memorized by students.

2) Unable to relate the theory with the practical skills and real networking problems.

3) Lack of lab facilities and devices for an individual hand-on experiences.

4) Huge number of students in class makes interaction between lecturer and students limited.

5) Fixed scheduled time table, students not able to complete lab session on time.
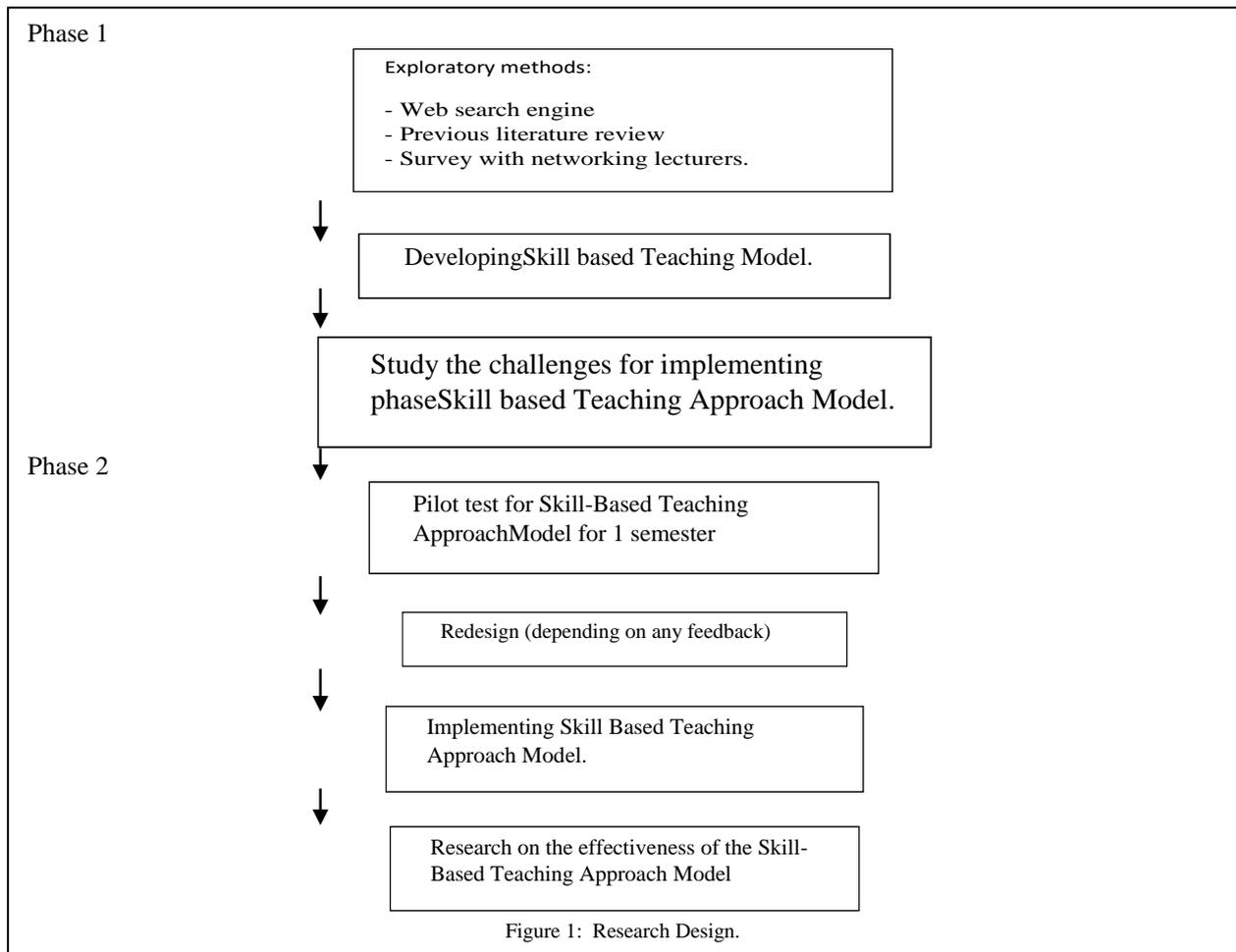
B. Research Objective

This research articles has three objectives. Firstly, to identify the trending teaching and learning method which is fit for current generation students. Secondly, to propose a suitable method for teaching networking courses in polytechnic. Finally, to identify the solution for the challenges to be met by implementing that proposed method.

C. *Research Design*

This study uses exploratory methods in researching in depth on skill based teaching approach. Web search engine, previous literature review and the opinion of computer networking lecturers and students are been used to generate this writing. The exploratory method is suitable in order toidentify current happenings and trends, to find new idea and to generate a new hypotheses or idea from the previous research. This research will outline the necessity of Skill-Base Teaching, the model of Skill-Base Teaching for computer networking students and the benefits and challenges to be overcome by implementing Skill-Base Teaching.

The development of Skill-Base Teaching Model for computer networking courses consist of two phases. First phase is on planning and designing of the model. For the second phase, the model will be pilot test for the period of the one semester (6 months). Modification and redesigning of this model according to the feedback of the respondents will be conducted. The second phase will be documented in next volume to outline the improvised version and the results of Skill-Base Teaching Model's effectiveness. For these, data will be collected among Polytechnic Mersingstudents and from other various polytechnic who are using other approaches.

Phase 1

Exploratory methods:

- Web search engine
- Previous literature review
- Survey with networking lecturers.

DevelopingSkill based Teaching Model.

Study the challenges for implementing phaseSkill based Teaching Approach Model.

Phase 2

Pilot test for Skill-Based Teaching ApproachModel for 1 semester

Redesign (depending on any feedback)

Implementing Skill Based Teaching Approach Model.

Research on the effectiveness of the Skill-Based Teaching Approach Model

Figure 1: Research Design.

IV. FINDINGS AND DISCUSSION

A. Model development

Development of this Skill-Based Teaching Approach model is based on curriculum and Course Learning Outcomes of computer network courses. This model can be used for Switching and Routing, Basic Routing Technology, Advanced Routing and Connecting WAN courses with slight modification according to the course content and domain levels. This intention of this model is to develop vast computer networking conceptual understanding rather than memorize and apply. Through the deep understanding, students can apply the reasonable methods, procedures or networking technologies according to the requirement. This model encourage collaborative work during learning process but required each student perform individually while presenting their reflections.The success of this model is correlate with an effective Self-Learning components.

B. Proposed Skill-Based Teaching ApproachModel for Computer Networking Courses.

Through a deep researches on efficient deployment of Skill-Based Teaching approach in other education field, this model have been created. This model is an output of exploratory method through research, own experience in teaching and responses from other peer lecturers. Adapting the requirements of curriculum and the nature of computer networking into the existing Skill-Based Teaching Approach, a five stages model have been developed. This model consist information gathering, solving, creating, troubleshooting and reflecting. At the first stage, students gather information by self-learning or brainstorming. This may be conducted individually or ina small group of students to identify the problems. Through this process, students will come out with a list of ideas, questions or problems which will lead them into future deep investigation. After that, students will

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plans a strategy to find the solutions. Here, they will develop hypothesis, select the best method of solving, collect data or information and perform the analysis.

These information gathering and solving stage, can be illustrated through McKinsey's strategic problem solving model as shown in Figure 1 (Iliyana, 2018). According to McKinsey, team and time management are very important in problem solving. A proper task distribution among team members and efficient time management can give a greater impact of learning.
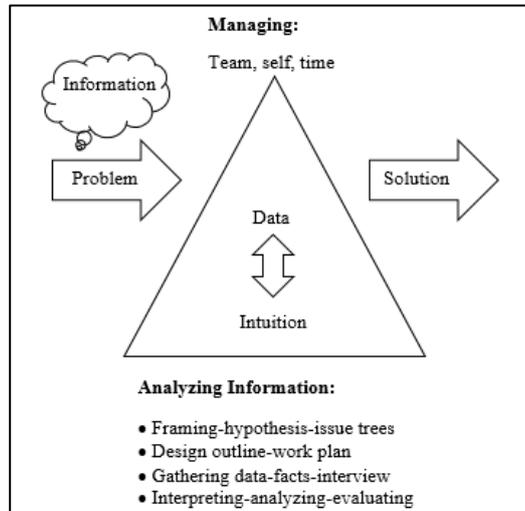

Figure 2: McKinsey Model

Lecturers plays a role as a tutor or mentor in guiding and validate the findings. This is important in order to make sure students are in the right track and can prevent them in wasting time by focusing in a wrong direction of solving. A full guide on the area of study and course content to be covered through specific task have to be given to the student.

Once the analyses have been done, students will create a solution for the network problems. This includes subnetting, internet protocol addressing allocations, device selections, configuration, protocols and all other network configuration needed to solve the task. Rationalize and finding a proper solution according to the scenario given is the biggest challenge here. For example, students have to find which routing protocols to be used for given network scenario. Using simulator such as Packet Tracer, students can test whether the solutions gives the needed output. In this, students can develop the network topology exactly as if using a real device. Students able to do all the configuration and test the result. If there is any mismatch or error in output, they can conduct troubleshooting. This is exactly, the main reason why skill-based learning is been proposed for networking students. Students will come out with variety of designs and configuration errors. Time taken for troubleshooting fluctuates according to their skills and competence levels.

Through this teaching model, learning process will happen individually outside the classroom. So that, the lecturer have to aware of student learning time (SLT) as stated in course syllabus. This is important, to ensure the time allocation for this course does not exceed SLT. If students able to complete the simulation successfully, they can deploy the same configuration in real device inside the laboratory. All they have to do is cabling devices, copy and load the configuration from simulator into the real device and verify the output. This reduce the configuration time during evaluation. Lecturer will evaluate the configuration and validate whether the solution is correct for the task given. Finally, during presentation, lecturer plays role again to test the understanding of students on the proposed solution. The question and answering session is aimed to evaluate the depth of understanding on the chapter. This is the crucial part, where student relate their practical skill with the theoretical knowledge. Figure 2 shows the flow chart of Skill-Based Teaching Approach Model for computer networking students.
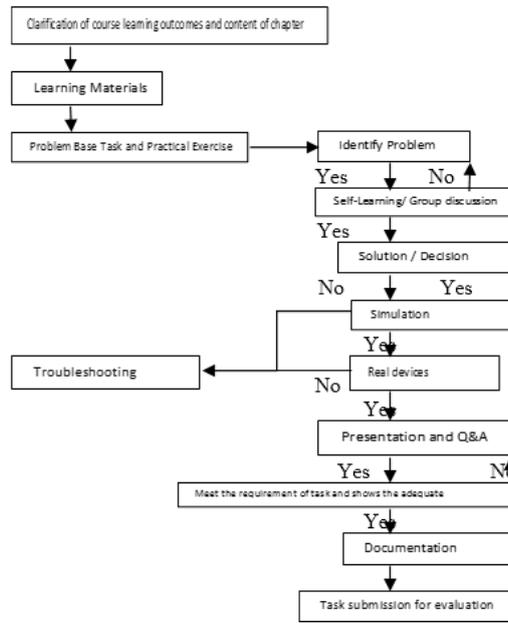
Figure 3: Skill-Based Teaching Approach Model

C. Challenge in Implementing Skill-Based TeachingApproach model.

There are few challenges in implementing Skill-Based Teaching Approach. As this method requires lecturers to provide students with the real networking problems, the lecturers must have the required skill or industrial experiences. Lecturers must be aware of the evolving technology in networking field. An industrial attachment programs and collaboration between industries and polytechnic would be beneficial. Apart from that, top management involvement, commitments and fund allocation are needed. Training, Industrial Placement programs and Life Long Learning programs should be provided to the lecturer to upskill them with latest technology. For the students, the challenges is in developing their self-motivation to strive for the task completions. They must able to participate actively in self-learning in order to provide a very good outcomes. Finally, time constrain will be a factor of dropping an idea of implementing this method. Lecturers have to provide generous amount of time for each students especially during presentation. Each student should be accessed for their understanding of the task. To overcome this problem, number of students for each class have to reduce according to the availability of facility.

V. CONCLUSION

Invariably, teaching is bound to face a lot of challenges. Continuous improvisation in teaching method is needed in creating a nimble education system. The role of lecturers, in accruing depth knowledge and skill required by the course are very important. As this learning approach intends to expose students with actual networking field's problems, lecturers should find opportunity to be part in industrial project through collaboration or internship programme. Commitment, time and involvement of lecturer are very important to ensure the success of this teaching approach. Skill-Based Teaching approach in teaching computer networking will provide a complete skillset needed by a networking students. It is suggested, for future research can be conducted on innovative method of delivering knowledge skills through self-learning for networking students.

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