Studies on the effectiveness of students' technical competency using hands-on-approach in network analysis and design course at UTeM

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ABSTRACT – Integrations of hands-on-approach and theory are the main component in teaching and learning in UTeM and TVET education. The aim of this study is to assess the effectiveness of the hands-on-approach implemented in the Network Analysis and Design course offered to UTeM's students. The result shows that more than 70% of the respondents have agreed that they have achieved the three course learning outcomes. Thus, the effectiveness of hands-on-approach in improving the students' understanding and technical competency in analyzing and designing computer networking related to their proposed project is proven and can be a benchmark for future implementation in teaching and learning course.

1. INTRODUCTION

TVET is part of an education system that integrates education with practical training (hands-on-approach) and skills development [1]. It has become one of the main components in teaching and learning in UTeM [2]. UTeM has become part of the Malaysian Technical University Network (MTUN) which requires both elements (theory and practical) to be implemented in each course. Furthermore, UTeM has stated this commitment in one of its general education goals which are to produce graduates who are well equipped with relevant knowledge, technical competency and soft skills [3].

The aim of this study is to identify the effectiveness of the hands-on-approach in improving the students' understanding of the Network Analysis and Design course. It is offered only to Bachelor of Computer Science (Computer Networking) (BITC) students at FTMK, UTeM. It has fourteen-week lectures and labs offered yearly with the purpose of enabling the students to understand and implement the concept, guidelines and practice on computer networking design related to their proposed projects. This study however only focuses on the recent implementation of the course, during this semester of 2021.

2. COURSE IMPLEMENTATION

The course covers fourteen-week on lectures of requirement analysis, flow analysis, logical design related to technology choices, interconnection mechanism, network management and security, physical design and, addressing and routing as depicted in Figure 1. Each hands-on/practice in lab sessions shall be parallel to the lecture's topic in lecture sessions.

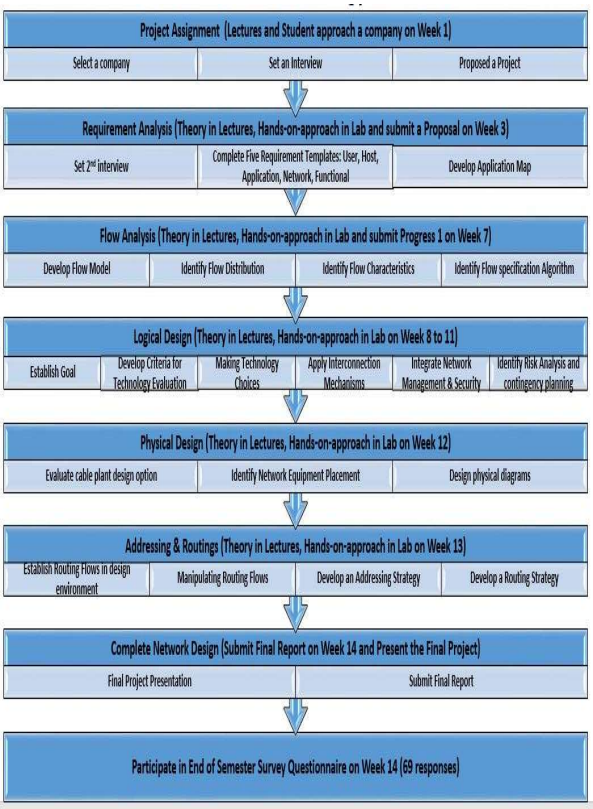

Figure 1 Process Flow of course implementation

The concept and guidelines are delivered during lectures according to knowledge gained in [4]. However, the hands-on/practice is based on the lecturer's strength/expertise in guiding the student to complete their proposed project. The knowledge transfer was implemented in student-centred learning approach. The lecturers shall give instruction to the student, with the objectives of developing the students who are then capable to manipulate the concept and guideline of each topic in their proposed project. Students are encouraged to discuss their ideas and finding in the interactive discussion during lab sessions [5]. Due to this Covid-19 pandemic, the lab sessions were successfully implemented using the WebEx platform and WhatsApp application.

A simple exercise related to each lecture's topic is designed to enable the student to implement the concept and guideline gained during lectures in their proposed

project. Moreover, this exercise can test the student's understanding of the concept and guidelines of each topic, while promoting an active learning environment [6].

Students were assigned in a group of five to eight to prepare a report for the design, procurement and implementation of a Local Area Network and Wide Area Network connectivity for an organization of their choice. The organization can be a company, a university, a college, a factory or a government department.

In Figure 1, the project was briefed in week 1 of the semester and they were given a timeframe of three weeks to submit a proposal of an organization of their choice. Once the proposal is approved by the lecturer, students are later on need to set an interview session with the person-in-charge of their proposed organization.

During the interview sessions, the student needs to gather information of requirements related to systems components which are user, application, host, network and functional. The concept and guidelines of these requirements were delivered in topics related to requirement analysis in the three weeks' lectures and labs session. Five templates related to these requirements were provided to assist the student in filling up the information that they have gained during the interview session.

Later on, students need to analyse the requirement and develop the application map of the organization. The applications flow was analysing in the flow analysis topic in weeks 4 to 6. Both requirement analysis and flow analysis are compiled in Progress 1 Report and submitted in week 7. Topics are related to logical design, physical design and addressing and routing were developed during week 8 to week 13. Each topic was implemented and consulted by the lecturer in lab sessions related to the student's proposed project. Gradually, the weekly lab exercises were compiled in a final project report and presented in the final project presentation session in week 14 after it has been properly modified as commented by the lecturer. Minimum facilitations were given to the student during designing application map, designing flow analysis, creating the logical design, creating physical design and, addressing and routing to indoctrinate problem-solving and teamwork skills [7].

This study only involves 69 students taking this course and the data collected using questionnaire survey which only focusing on the achievements of the learning outcomes of this course and it is answered by students at the end of the semester.

3. ASSESSMENT AND EVALUATION

This project has a value of 30% out of 70% of the total coursework marks. The project is implemented with an intention to ensure that the student can fully understand the topics lectured and enable them to implement the concept and guideline in their proposed project. The assessment was based on the student's project proposal, progress 1 report, final project report and final project presentation. Teamwork skill and presentation skill is also considered as part of the assessment. 100% out of 69 students enrolled in this course have passed this coursework. Other than WebEx and WhatsApp platforms, this course also utilised an e-learning portal for notes, recorded lectures and lab videos, information sharing and also for lab and assignments submissions.

An end-of-semester survey is conducted using a google form to gauge the students' perception of their achievements on each of the learning outcomes (LO) of this course using a five-point Likert scale (1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree and 5=Strongly agree). According to the teaching plan, by the end of the semester, the student will be able to achieve the objectives of these three LO.

- LO1: Manipulate the understanding of issues related to current computer network design, processes, tools and techniques.
- LO2: Perform the methodology for effective computer networking design.
- LO3: Propose the analysis and design of specific projects related to an organization proposed by students.

The response for LO1, LO2 and LO3 are shown in Figure 2, Figure 3 and Figure 4 respectively. Based on responses for LO1 in Figure 2, 81.1% of students agreed that they have achieved the objective of LO1 and 17.4% neither agree nor disagree, while 1.4% disagree.

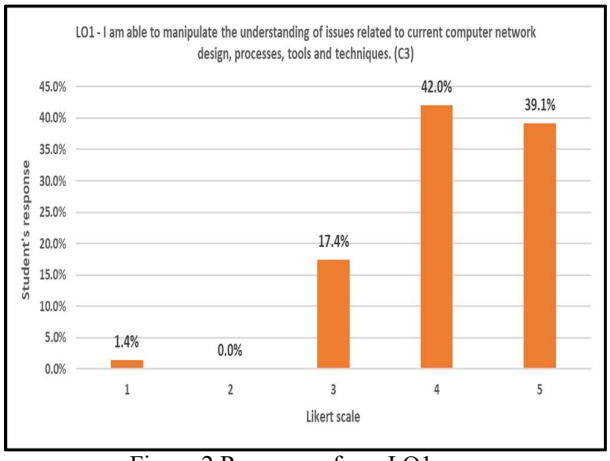

Figure 2 Responses from LO1

Followed by responses for LO2 in Figure 3, 73.9% of students agreed that they have achieved the objective of LO2 and 24.6% neither agree nor disagree, while 1.4 % disagree.

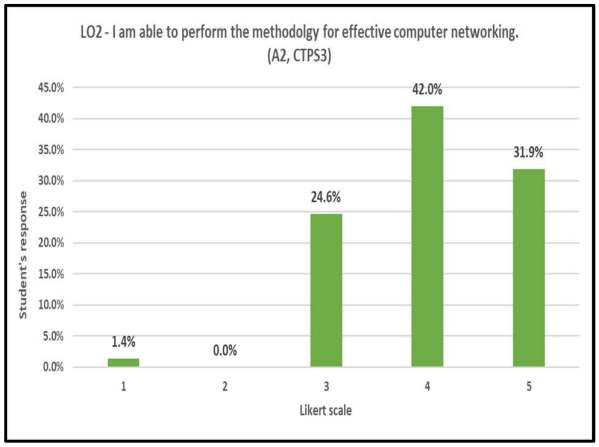

Figure 3 Responses from LO2

Refer to responses for LO3 in Figure 4, 75.3% of students agreed that they have achieved the objective of LO3 and 21.7% neither agree nor disagree, while 2.8% disagree.

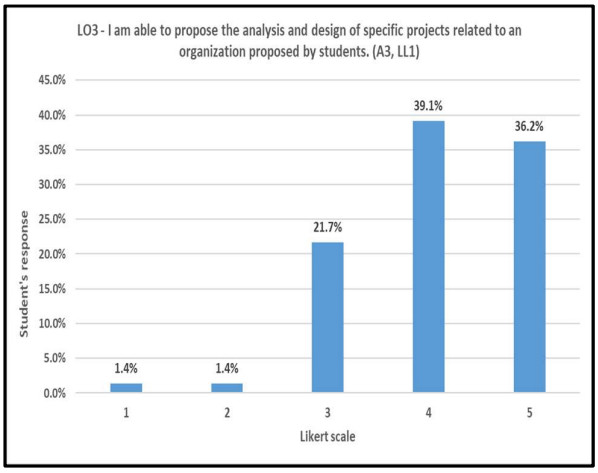

Figure 4 Responses from LO3

The summarization of the responses obtained from LO1, LO2 and LO3 are depicted in Table 1. It shows that more than 70% of the respondents have agreed on achieving the three learning outcomes of this course, which is the important factor in determining the effectiveness of the hands-on-approach in teaching and learning.

Table 1 Summarization of responses to all LOs

LO / Likert-scale	Agree	Neither Agree nor disagree	Disagree
LO1	81.1%	17.4%	1.4%
LO2	73.9%	24.6%	1.4%
LO3	75.3%	21.7%	2.8%

Using the same Google form survey, students were also asked to give general comments related to this course. There are few suggestions from students to give them extra notes related to samples of logical and physical design. Here were some positive comments were given by the students.

- I think this subject makes you understand the topics. As for the lab session, we will be given the task that needs you to understand what the lecturers taught. To me, it is effective.
- This subject gives me an understanding about how to propose to a company, to know what device that we should use depending on company problem. I also learn about logical and physical design that we should give for the future network to our company.
- Generally, doing a project that has been given early in the semester helps me a lot on how to understand networking works. Some of the tasks given required us to do a lot of research in designing networks because, during this pandemic, we cannot learn physically. The time given for this subject help us boost our knowledge regarding designing the network.

4. CONCLUSIONS

The integration of theory and practical training (hands-on-approach); as shown in Figure 5, has effectively improved the student's understanding and technical competency in analyzing and designing computer networking related to their proposed project. Moreover, this integration is aligned with TVET education. This study can be a benchmark and useful experience for other academicians to pursue teaching and learning for their course. In future, technical videos related to this course shall be introduced to train the students to be more independent in completing their project.

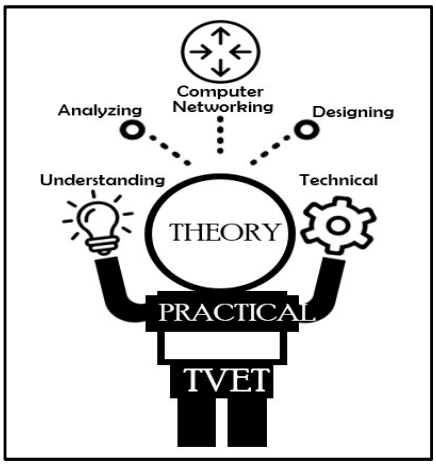

Figure 5 Integration of theory and practical in TVET

5. ACKNOWLEDGEMENT

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