Dynamic Routing Protocol Configuration Using Multiuser Practical Activity in Networking Class

Virakwan A/P Hai Kelian
Department of Information Technology and Communication, Politeknik Seberang Perai,
Pulau Pinang, 13500, Malaysia.

Abstract: The objective of this study is to introduce the teaching and learning method by using multiuser practical activity in the dynamic routing protocol topic for the networking class. A multiuser practical activity created by using Cisco Packet Tracer provides an opportunity for more interactive practical learning. The problems of lecturers during teaching routing protocol topics are difficult to assess the student's configuration skills and work progress in the laboratory class. The multiuser function that used the concept of remote relay server using one-to-many allows lecturers to control and assess many students directly at one time. In this study, the multiuser activity was created and used through existing LAN connection provided in the classroom. The activity focuses on the configuration of the dynamic routing protocol- Routing Information Protocol (RIP) on the router. This activity used in the laboratory classed which enable lecturers to create a large group based interactions. During the implementation of the activity, lecturers are able to assess the progress of the students and to ensure every student is taking part in the activity. The result of implementing this approach, it is able to enhance students' understanding of the RIP routing protocol concept and student progress can be monitored easily on the lecturer side. By using this teaching method, the lecturer can track students' configuration skills directly and ensure the participation each student in laboratory class. The lecturer can give feedback to the students to immediately complete the given task by themselves and encourage students to provide a solution with their creativity. The findings from this study can be used to implement the multiuser practical activity approach in another topic in networking class.

Keywords: *Teaching methods; practical learning; configuration; Routing Information Protocol; multiuser activity*

INTRODUCTION

A routing protocol is one of the important topics to understand by students in networking class. It is the important part after students set up the network and have done the basic configuration. A routing protocol will specify how routers communicate with each other, distributing information that enables them to select routes between any two nodes on a computer network. Each routing protocol has different features, performance, architecture, and algorithms to achieve the data communication and reliability [1]. Thus, it is important for students to understand the theoretical concepts and the configuration of the routing protocol. This is also accordance with the syllabus for networking courses at Polytechnic in Malaysia which are designed to teach students with theoretical knowledge and practical skills. Therefore, students will learn the theoretical knowledge through the lecture in the class, while for the practical part students will learn in the laboratory class. The lecturer will teach the theory concepts of the routing protocol in theory class and will do the practical in the laboratory class. Students need to understand the characteristics of each routing protocols and how they learn the neighbour route information. Furthermore, in practical class, students must be able to configure routing protocol in the router. However, students usually find networking subjects' technical and boring because it consists of the complex and evolving topic [2]. According to Airi and

Corresponding Author: Virakwan A/P Hai Kelian, Department of Information Technology and Communication, Politeknik Seberang Perai, Pulau Pinang, 13500, Malaysia., +6017-478 0730

Anderson [3], students who study networking must be able to explain the fundamentals of how computer networks function.

To achieve the learning outcome, students and lecturers have to spend many hours involved in practical applications designing, configuring and implementing a computer network. Furthermore, to assess the students understanding and to ensure students are achieving the course learning outcomes, lecturer need to conduct the assessment according to the assessment tasks stated in the syllabus. Basically, examination will be conducted to test their theory knowledge and practical skills. However, for the practical part, it is difficult for the lecturer to assess and to evaluate the understanding of the students. It is very important for the lecturer to ensure that all students are able to perform a configuration on network devices correctly. During the networking class, especially when teaching the routing protocol topic, most of the lecturers will face the problem such as students are not fully engaging in the networking class, difficulty to assess the student progression in practical skill and students use a long time to complete the routing protocol configuration.

Thus, to overcome these problems, lecturers need to find various ways to enhance the student's abilities, especially in practical skills. According to Maor and Fraser [4], improvement of the technical aspects of the learning environment likely stimulates students to be engaged in higher order thinking skills and become more reflective learners. According to the previous research by Sun et al. [5], simulation software is one of the tools that can solve the problems in the teaching of routing and switching lessons that more too abstract and no visualization. In the meanwhile, Cisco Packet Tracer is one of the network simulation tools that offer more services than other simulations [6]. Furthermore, multiuser features in the Packet Tracer provided great interactive activities to enhance students' interest in the technical topics [7]. This finding also suggested for improving the quality and user experience offered by multiuser activities such as to modify the instructions in order to change the difficulty of the activities [7-8]. Due to that, the objective of this study is to use the multiuser feature in Packet Tracer to create in-class interactive learning activities that would enhance students' understanding of routing protocol concepts. The configuration of

Routing Information Protocol (RIP) activity was created as a first implementation of the activity. This paper will discuss the function of multiuser and implement routing protocol multiuser activity in class as a teaching and learning tool and the last section is the conclusion and future work in multiuser activity.

LITERATURE REVIEW

Multiuser Functionality

The multiuser connection is one of the features in Packet Tracer that allows multiple point-to-point (peer) connections between multiple instances of Packet Tracer. Lecturers are able to create a variety of activities for students to learn in groups that will facilitate greater social interaction between students. The multiuser feature enables exciting collaborative and competitive interactions, providing the option to progress from individual to social learning and features opportunities for collaboration, competition, remote instructor and student interactions, social networking and gaming [9]. This feature allows users to use a simple drag and drop cloud icon to connect to a peer cloud. Each multiuser cloud supports one-to-one, many-to-one and many-to-many peer connection configurations. The multiuser activity file involved two sides which are server or client architecture. The main file will host on a server or lecturer PC and the client or student side file is used by each student to connect to the main Packet Tracer file hosted on the lecturer PC. The multiuser capabilities allowed the client connection of up to 60-75 users simultaneously to a single activity over the same connected LAN network [10].

Routing Information Protocol (RIP)

A Routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network [11]. Routers use the routing protocol to share routing information with other routers to dynamically build global routing tables [12]. There are two main groups of routing protocol, static routing and dynamic routing. Static routing is manually configured by network admin on the router to determine the route path. Whereas, dynamic routing dynamically allows routers to select the best path when there is a real-time logical network layout change. Routing Information Protocol (RIP) is one of the most dynamically routing protocols that use

a distance vector algorithm to determine the best path from the source to the destination. It is the first dynamic routing protocol to be used in an internetwork. For the syllabus in networking class such as in course Switching and Routing Essentials, it is a basic standard of dynamic routing protocol that will learn by students. It is important for students to understand the theory concepts and able to configure. Most of the issues when students configure the RIP are missing routing information and wrong network commands. Therefore students must understand this two aspect to avoid RIP not functioning.

MULTIUSER PRACTICAL ACTIVITY IN THE CLASS

The course chose for implementation of the multiuser activities was Switching and Routing Essentials. This course comprises of 20 students from semester 3. The syllabus in Switching and Routing Essentials included the basic standard of dynamic routing protocol that will learn by the students. Due to that, this course and students were chosen as a respondent in this research. The observation by lecturer and pre-post questionnaire are used to get students viewpoint of their experience using multiuser practical activity to learn the dynamically routing protocols and Routing Information Protocol (RIP). The questionnaire adapted from Smith [13] and Šimandl [14] and based on the indication from problem occurs during previous class. The questionnaire is an intention to assess students understanding in Routing Information Protocol (RIP) for theory concept and configuration, the students' confidence level to complete the activities, students' productivity to finish each activity as well as their participation in the activities.

Before the implementation of the multiuser practical activities, students taught about the basic of dynamically routing protocols and Routing Information Protocol (RIP) for theory concept and configuration. The theory concept taught during the two hours theory class and the configuration is conduct during 3 hours practical class according to the lesson timetable allocated. The configuration task was conducted using the regular Packet Tracer and also using the real devices. The pre-test questionnaire immediately distributed to the students after finished the lab activity to assess the students' understandings after each activity. Each student used the majority of the time,

with an average of thirty minutes remaining to enable the students to complete the questionnaire.

For the next lesson of practical class, a multiuser single activity file was used for all the students' connection and a single lecture file was used that would accept all the connections. The RIP configuration activity was used as an activity in practical class to promote students' participation in lectures and to enhance understanding of students. All the 20 students were given the multiuser student's file simultaneously. The lecturer explained the details instructions on how students can connect to the lecturer file and the configuration tasks that they have to complete. The time estimate for students to complete the tasks is within 3 hours.

Two network topology client-server environment was created. Server network topology is for lecturer side use to conduct the students. While the client network topology is on student's side. The students can start a multiuser Packet Tracer activity on their respective desktop or laptops by establishing connections to the lecturer side of the activity. The lecturer side will be able to assess the student's configuration and save the student's progress at any point. The network topology for lecturer side was created by connecting routers to the remote network cloud known as Peer to represent one entry point to the student. The number of remote network cloud is according to the how many students in the existing class. The network topology for the student side created by connecting a router to the remote network cloud to allow student side connect to the lecturer side. Another side of the router is connected to the end devices. For this assessment, end devices used are one desktop and a server. While one computer connected to the router on the lecturer side to perform connectivity tests between lecturer side and student side after the configuration done.

To establish the local multiuser connection, both lecturer and student computers must be connected to the same Local Area Network (LAN). As shown in Figure 1, the connection between lecturer and student can be done by matching IP address, port, cloud name and password parameters between lecturer and student. The lecturer must give the student, instructor side IP address, port number and password. To verify the connectivity, the Peer cloud on the student side and the

cloud on the server side will turn to blue colour, as shown in Figure 2. After the short period, the link light between the network devices and the cloud will transition from amber to green. Meanwhile, the multiuser link is now established and ready for testing.

To start the connection, students all together must connect to the lecturer file. The lecturer is able to verify to ensure all students done this task by all the peer cloud in lecturer file all are turning to blue colour.
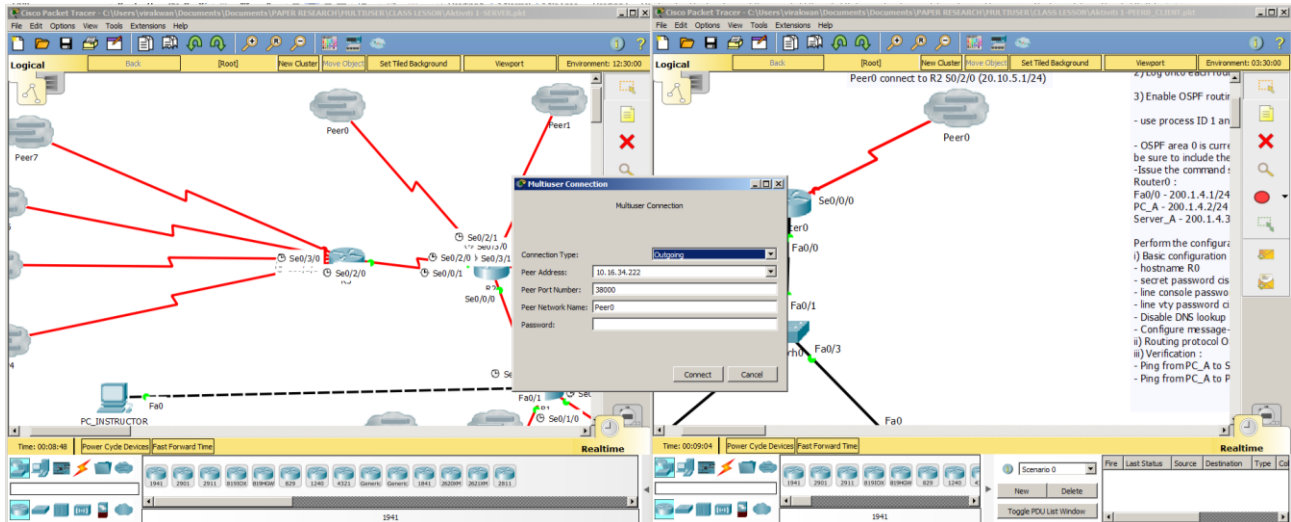

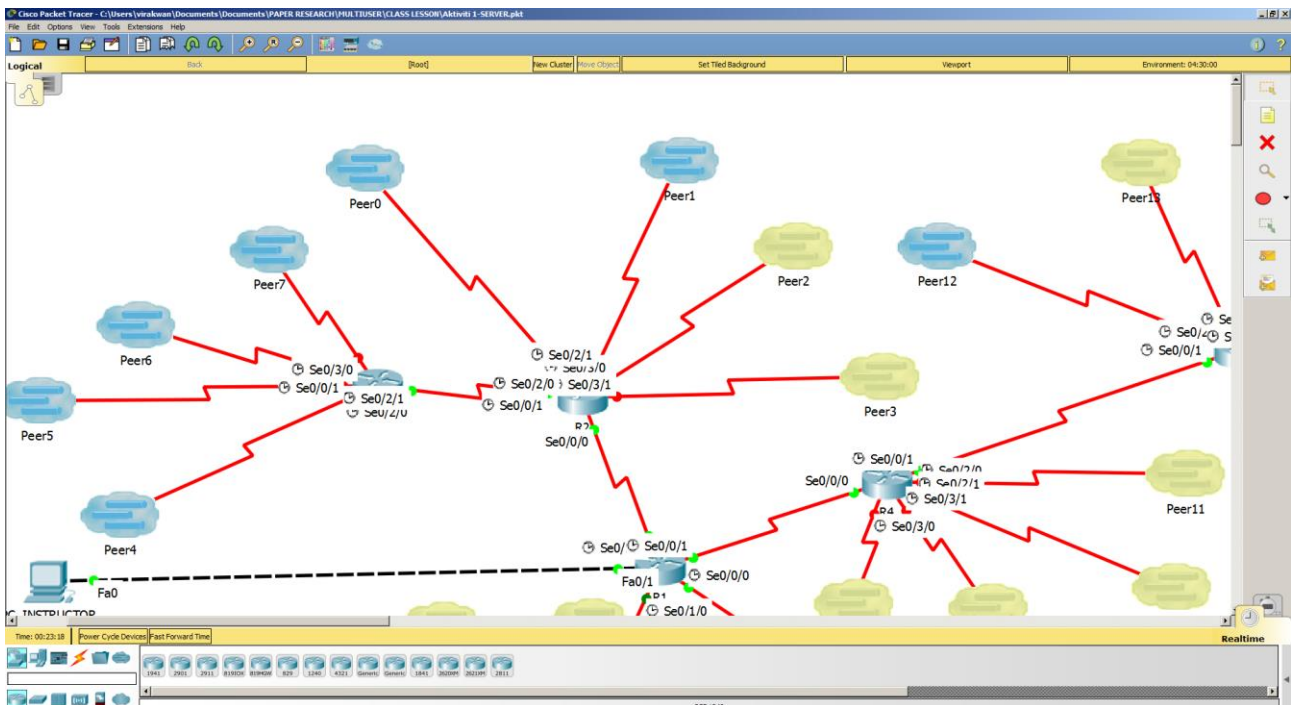Figure 1: Student request to connect to the lecturer side

Figure 2: Connectivity of the student's side to the lecturer side

When students connect to the cloud, there are three tasks that students have to finish. The first tasks are to perform the basic configuration, including configuring the IP address. The second task is students have to

configure the RIP routing protocol in the router. The last tasks are students have to set the IP address of the end devices which are desktop and server. To verify the connectivity, the instructor will perform the *ping*

from PC_INSTRUCTOR to the end devices on the LAN student side. The result should be successful, as shown in Figure 3. To verify the configuration of each student, the instructor will access to each students configuration by Telnet into the router of each student, as shown in Figure 4.
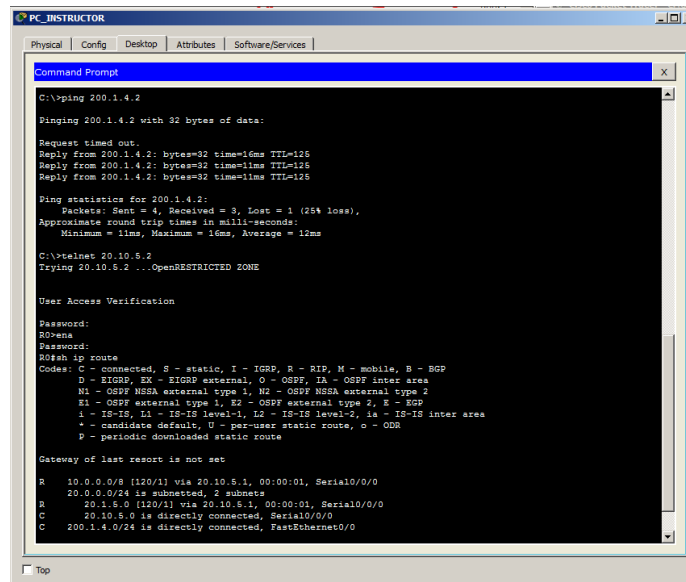

Figure 3: Instructor verifies the connectivity by ping from PC_INSTRUCTOR to the desktop student side
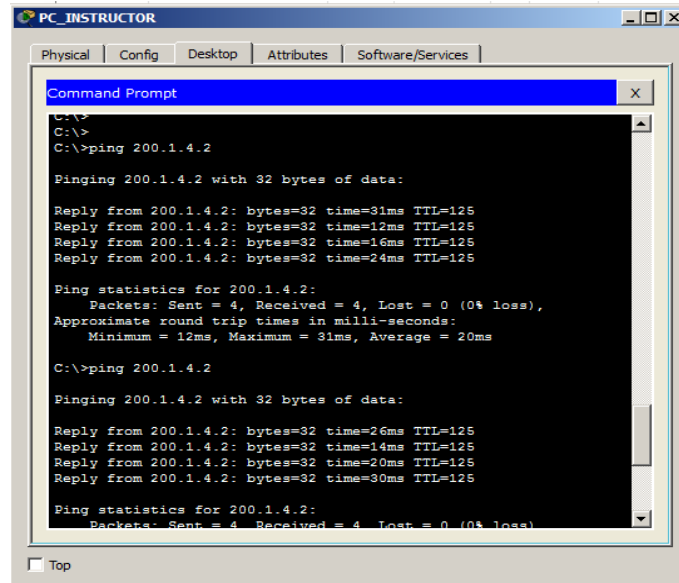

Figure 4: Instructor verify the configuration by Telnet from PC_INSTRUCTOR to the router student side

At the end of the session, the students were asked to complete a post-test questionnaire. Most of the students able to finished the tacks with an average of thirty minutes remaining for them to complete the questionnaire.

RESULT AND DISCUSSION

After the multiuser activity of RIP routing protocol configuration was used as an activity in practical class, it would allow lecturers and students to learn in a more dynamic way and allow lecturers and students to interact in real-time. By having multiuser activity

as part of a networking course would fill a gap of short, interactive, and extensible activity that can be used to promote student participation in lectures. To assess students' feedback after implementing the multiuser activity, observation by lecturers were done and students were given questionnaires at the end of each lesson.

The problems that lecturers usually faced during teaching the networking class, such as students are not fully engaged in the practical activity, difficulty to assess the student progression in practical skill and students use a long time to complete the routing protocol configuration is able to solve. From the observation, students can easily connect to the lecturer side network. The lecturer will make sure all the peer cloud in lecturer side, turn to blue colour. From this, the lecturer can ensure all students are participating in the practical lesson. This mean, multiuser activity can attract students to engage in the learning process in the class. The multiuser activity would promote student participation in class and at the same time it also able lecturer identifies if any students are trying to escape to participating in the activity in the class. This can avoid the problems that some students copied what others that did instead of doing by themselves. Furthermore, lecturer is able to connect to the student's side network and access their configuration. Meanwhile, lecturer can monitor the configuration progress of the students in real time. From the activity, found that 18 or 90 percent students in the class are able to configure RIP routing protocol correctly. This is can verify when lecturer is successfully *ping* to the end devices in student side. The interesting result of the implementation of this activity also is can see the student can finish the tasks on time given. From the observation, usually students unable to complete the lab activity within laboratory class hours due to not remember the configuration command lines, some are the careless mistake in configuration commands and the worst are students are not reading the instruction in the laboratory sheet given. Because of these reasons, students will take more time to finish the tasks. During the multiuser method, instructor is able to monitor the students immediately. So that indirectly it will force students to work rapidly and correctly to solve the problems the fastest in order to complete the given tasks.

Questionnaires were distributed to the students immediately after finishing the multiuser practical session. The questionnaires are based on four (4) aspects that inquire about the understanding of the students, their confidence in configuration, the productivity of the students and student engagement in the class. Students were asked to give the response to the questions by giving answer Yes or No. The questionnaire results are summarized in Table 1 and 2.

Table 1: Students' feedback before implementation of Multiuser activity

CATEGORY	QUESTIONS	YES (%)	NO (%)
Understanding	I properly understand the concepts of RIP routing protocol configuration.	45.0	55.0
Confidence	I can configure the RIP routing protocol on my own.	50.0	50.0
Productivity	I can finish the configuration tasks on time.	55.0	45.0
Engagement	All the Laboratory activities actively encouraged me to fully engage in the configuration laboratory exercise.	20.0	80.0

Table 2: Students' perception after implementation of Multiuser activity

CATEGORY	QUESTIONS	YES (%)	NO (%)
Understanding	I properly understand the concepts of RIP routing protocol configuration.	95.0	5.0
Confidence	I can configure the RIP routing protocol on my own.	100.0	0.0
Productivity	I can finish the configuration tasks on time.	80.0	20.0
Engagement	Multiuser actively encouraged me to fully engage in the configuration laboratory exercise.	100.0	0.0

From the result in Table 2, the dominant feedback implies that the percentage of all aspects understanding, confidence level, productivity and engagement after implementation of multiuser activity increases comparable to before implementation, as shown in Table 1. Which means that the implementation of this activity has contributed to students' understanding RIP routing protocol configuration and directly improving their network practical skills. Furthermore, it also can motivate students to think the solutions to solve the problems efficiently. Feedback gathered from students and through observation found that students had been actively involved and had not tried to avoid problems. Students also showed that they were interested in doing practical activities using the multiuser method. With multiuser activity, they can understand the RIP routing protocol configuration because indirectly they were forced to do correctly by themselves. Thus, they can verify by themselves what they had worked and hadn't. They had been independent and their understanding of the issue had improved. Lecturer is able to monitor the students directly and immediately. The mistake when students configure the RIP such as missing routing information and wrong network commands also can be eliminated and can be early detected by the lecturer. The immediate response from the lecturer to identify the weakness and mistake of the students are able to enhance the quality of teaching and learning process. According to Juwah et al., [15], feedback on performance, in class or on assignments, enables students to restructure their understanding or skills and build more powerful ideas and capabilities.

CONCLUSION

The objective of this study was to use the multiuser feature in Packet Tracer to create interactive practice exercise during networking laboratory class that would enhance students' understanding of routing protocol concepts. By using this method, students can improve their configuration skills, their confidence in configuration and engagement in the class as well as able to increase the speed of configuration. This activity also to ensure all students are involved in the practical activity. This can avoid the problems that some students copied what others that did instead of doing by themselves. The features of multiuser that could allow the lecturer to assess the student's in particular network can help lecturer to identify those students that have a problem and lack of configuration. The impact of this study, the lecturer can give feedback and response to the students immediately. It allows the lecturer to see the progress of the student's in configuration and troubleshooting skills. According to Brookhart [16], good feedback gives students the information they need so they can understand where they are in their learning and what to do next. Furthermore, feedback from the students also shows that the percentage of aspect understanding, confidence level, productivity and engagement after implementation of multiuser activity increases comparable to before implementation. According to Sotnikov et al [8], student feedback is critical to effectively improving activities and bringing them up to the standard of activities offered in the course. This result implies that once the students have been given a configuration activity using the multiuser tool, they are able to engage in a structured activity and able to complete the lab activity tasks. Which means this activity has contributed to students' understanding RIP routing protocol configuration and directly improving their network practical skills. It also able to motivate students to complete the given task by themselves and encourage students to provide a solution with their creativity. From the result can conclude that the multiuser activity is suitable to implement in the class as another method of teaching and learning. In class, lectures can be improved by using interactive activities that foster student participation [8].

The student's themselves evaluated lessons as useful and attractive hence were not much time to be bored. The lecturer also could find more innovative solutions and students were more interested in this course. The findings from this study show the effectiveness of using the multiuser activity in teaching and learning of a RIP routing protocol topic. Compared to regular Packet Tracer activities, by using multiuser allows students to collaborate and work towards a common goal. Multiuser allows the creation of activities that have before been impractical to implements, such as group troubleshooting, capture the flag, and relay race games [8]. Under the right conditions, multiuser activities can be used as another to aid in teaching networking and maintain student interest [7].

Therefore, for the future work, the implementation of multiuser activity in more challenging tasks that involve topics such as advanced EIGRP and OSPF features to evaluate the

troubleshooting skill and the ability of students in critical thinking to solve the problems will be conducted.

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