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The Implementation of Creative Problem Solving (CPS) in Mobile Ad Hoc Network Course: Simulation and Case Study

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ABSTRACT

In this paper we applied the concept of online discussion to regular meetings and practice meetings. lectures are held by forming discussion groups for mobile ad hoc networking course. Each group discussed different parameters in network simulator made using the NS-2 software. Furthermore, the use of the project-based learning method in this study can improve participants' collaboration and communication skills which is very useful in real work in the future.

Keywords: Mobile ad hoc networking course, Creative Problem Solving (CPS), NS-2 software.

1. INTRODUCTION

The learning and teaching process at a university involves various components including lecturers, students, curriculum, lecture facilities and infrastructure. Lecturers are a very influential component in the learning process, who have responsibilities and are very decisive in achieving the success of the implementation of lectures and students are the main element for the implementation of lectures conducted by the lecturer. The curriculum, facilities and infrastructure for lectures are also a benchmark in achieving a good education process.

Department of Computer Engineering, Faculty of Information Technology, Andalas University has Mobile Networks and Adhoc (Mobile Adhoc Networks) courses offered in the 7th (seventh) semester with a weight of 2 credits. The course's contribution to competency achievement is through discussion of learning topics regarding basic concepts in wireless communication, including development project management, architectural system design, concurrent hardware-software design, system integration, various levels of testing in system development, system validation, etc.

The studies has been carried out on research that has been carried out by other researchers in the implementation of learning methods. The researchers discussed the brain cannot pay attention to all things, lessons that are not interesting, boring or not evocative of emotions, will certainly not be remembered [1]. Furthermore, the concept of Higher Order Thinking (HOT), namely reforms in learning assessment that began to eliminate the habit of memorizing. Students are expected to be able to analyze, interpret, synthesize and evaluate. Students will have a conceptual understanding and they can more easily apply it in understanding the real world, including problem solving [2]. On the other hand, online learning methods are also discussed using Google Classroom to avoid monotonous lectures and create fun and interactive lectures [3]. Distance learning by applying the concept of e-learning the right choice is currently being applied [4]-[7]. In this paper we applied the concept of online discussion for regular meeting and practical meeting.

2. METHODS

This study uses the project-based learning method by conducting simulations by several students in several groups on a topic or case that has been previously directed using online learning methods. The population

used in this study involved 26 students who were divided into 5 small groups randomly to conduct discussions using experimental learning methods. This research was conducted on September 2, 2021, on the Mobile Network and Ad Hoc course majoring in computer engineering, Faculty of Information Technology, Andalas University, Padang, Indonesia. This online learning process in phase one lasted for 8 meetings, wherein the initial 2 meetings, the population would be provided with an initial understanding of learning topics, methods, tools, and projects that they would work on using discussion methods on cases and relevant technology in the present moment. The rest of the next meeting will carry out project work by each group on the cases or topics they want to research based on predetermined directions, specifically focusing on the Ad Hoc on-Demand Distance Vector (AODV) protocol on the Mobile Ad Hoc Network (MANET). Presentations on the progress of their research projects will be assessed by two assessors who are lecturers of the course at each meeting while conducting open discussions in large groups. At the eighth meeting, they will present and report the results of their simulation and research projects by producing a research paper. The project is carried out in the form of a simulation using software through online discussions because it is still under activity restrictions due to the COVID-19 pandemic.

The instrument used in this study to assess the oral presentation and discussion was the rubric for formative assessment which will improve the performance of the participants indirectly. Through the assessment, they will be provided with transparency of the assessment, while helping the participants with their anxiety, also giving feedback through the process so that the participants will improve their self-efficacy.

Figure 1 below will show the flow of the study process in this research. This study was conducted in 8 meetings, each meeting every week. The first two meetings were an introduction stage, in a large and small group, the participants will discussed the overall ad important theory about the course. Each participant will discuss the current approach of the technology and cases about the course and understand the target of the course. The third and fourth meetings are the stage for them in a small group to discuss the topic that they want to choose, simulate, and analyze. Also, they will choose, install, and configure software that will be needed in their project. At this stage, the participant will discuss if their topic is relevant to the specification that given before, and each participant is required to install and try to simulate the research topic that their small group decided on. Through the installation, configuring, and running of the software, they will discuss and solve the error that occurred in the process in their small group and if it cannot be solved

they will discuss it in the large group. In the fifth to seventh meetings, they will present their progress on the project in a large group and discuss it with all the participants with lecturers as a facilitator. In the sixth meeting, each group will present the configuration of their requirement for the research in the simulation software, such as how many nodes, the position of the nodes, the movement of each node, how many packets will be delivered, and other specific conditions, as well as shows the graphical animation of their simulation. In the seventh meeting, each group will present the analysis of the Quality of Service (QoS) of their simulation. Each small group and the participant reflect on their experience after doing presentations and discussions with lecturers and other participants about the progress and the quality of the presentation. At the fifth meeting, each group will present its research topic. Finally, in the eighth meeting, each group will improve their simulation and analysis based on the input from lectures and other participants and present the final result. Also, each small group was required to write a paper as a form of their final report.

3. RESULT AND DISCUSSION

The result of this study shows that using the experimental learning method can improve their knowledge and real experience as well as increase their motivation and boost their ability to do important work. Doing the project in a group will improve collaboration and teamwork. And discussing in a small and large group will make the participants more active and successful in solving complex problems.

In the beginning, the introduction about the course discussed through synchronous method using online meeting platform and asynchronous method using Learning Management System (LMS) and chat group. This results in an active discussion process and can be carried out anytime and anywhere so that it is more open to individual insight and curiosity.
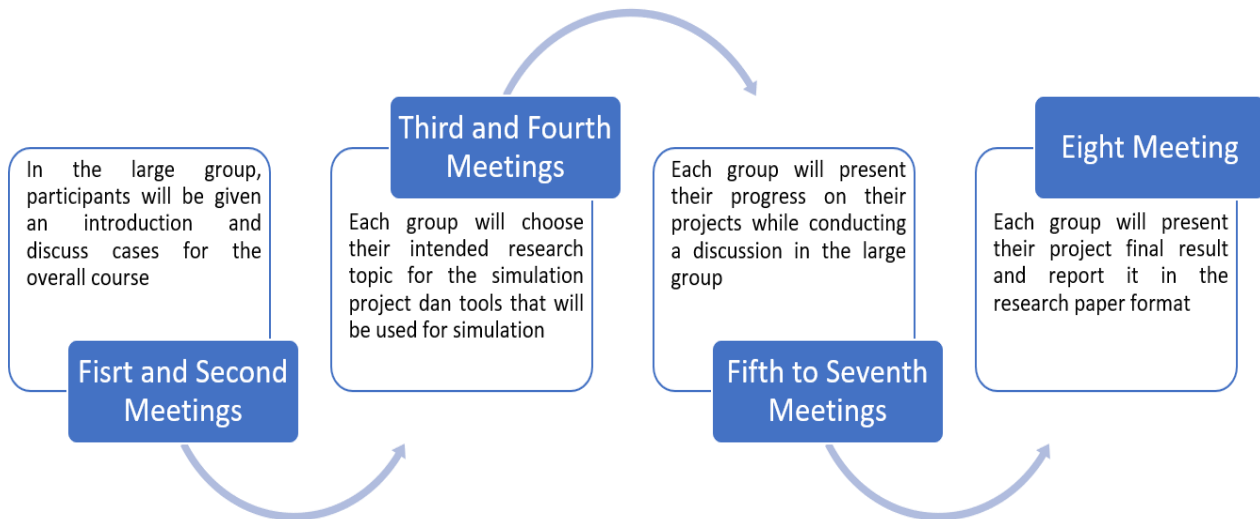
In the large group, participants will be given an introduction and discuss cases for the overall course

Fisrt and Second Meetings

Third and Fourth Meetings

Each group will choose their intended research topic for the simulation project dan tools that will be used for simulation

Each group will present their progress on their projects while conducting a discussion in the large group

Fifth to Seventh Meetings

Eight Meeting

Each group will present their project final result and report it in the research paper format
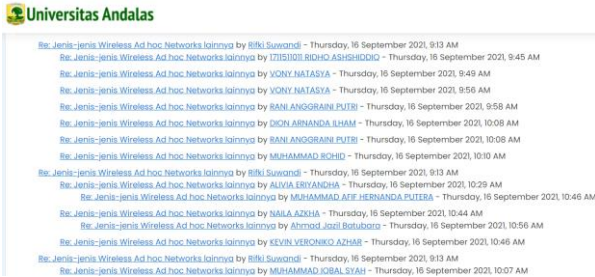
Figure 1. Study Procedure

Figure 2. Snippet of Some Discussion Forums

As for the rest project-based method doing simulation for experimentation using NS2, the figures and tables below will show the result of two samples of the small groups. For the simulation, they configured the conditions using Tool Command Language (tcl), the group 1 will simulate 15 nodes, 30 nodes, and 45 nodes MANET using AODV routing protocol with packets sent from node 2 to node 8 and node 5 to node 0. Group 2 will simulate 15 nodes, 30 nodes, and 45 nodes MANET using AODV routing protocol with packets sent from node 4 to node 12 and node 10 to node 5. They will analyze the effect of increasing nodes for the QoS of the network.
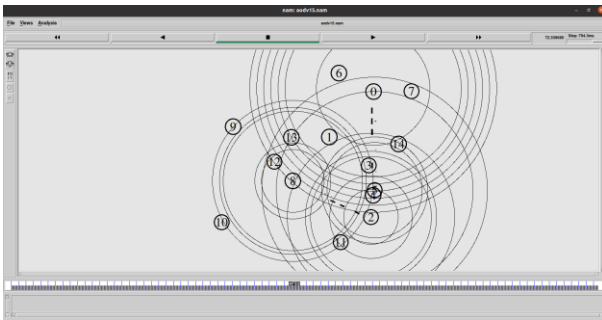

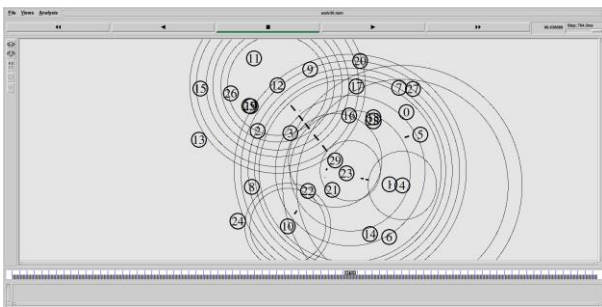**Figure 3. Sample of Simulation by Group 1**

Figure 4. Sample of Simulation by Group 2

Figure 3 and figure 4 show the animation of their simulation using Network Animator (NAM). The animation shows the moving nodes, the signal wave range, and the packet traffic that occurs in the simulation that running well.

Table 1. End-to-end Delay Result

Number of Nodes	End-to-end Delay (ms) by Group 1	End-to-end Delay (ms) by Group 2
15	62.4693	101.889
30	82.0911	103.426
45	89.6484	111.327

Table 2. Throughput Result

Number of Nodes	Throughput (kbps) by Group 1	Throughput (kbps) by Group 2
15	7835.45	6974.63
30	7343.63	6521.55
45	7470.43	6674.98

Table 3. Packet Delivery Ratio Result

Number of Nodes	Packet Delivery Ratio (%) by Group 1	Packet Delivery Ratio (%) by Group 2
15	99.9575	99.8806
30	99.8366	99.7725
45	99.8945	99.7085

Table 1,2 and 3 above shows the result of some QoS parameter, such as end-to-end delay, throughput, and packet delivery ratio of the simulation with increasing the number of nodes done by group 1 and group 2. The result shows that the result may be slightly different because of the randomness of the moving nodes, but the overall result is good, which can be seen in the graphs below.
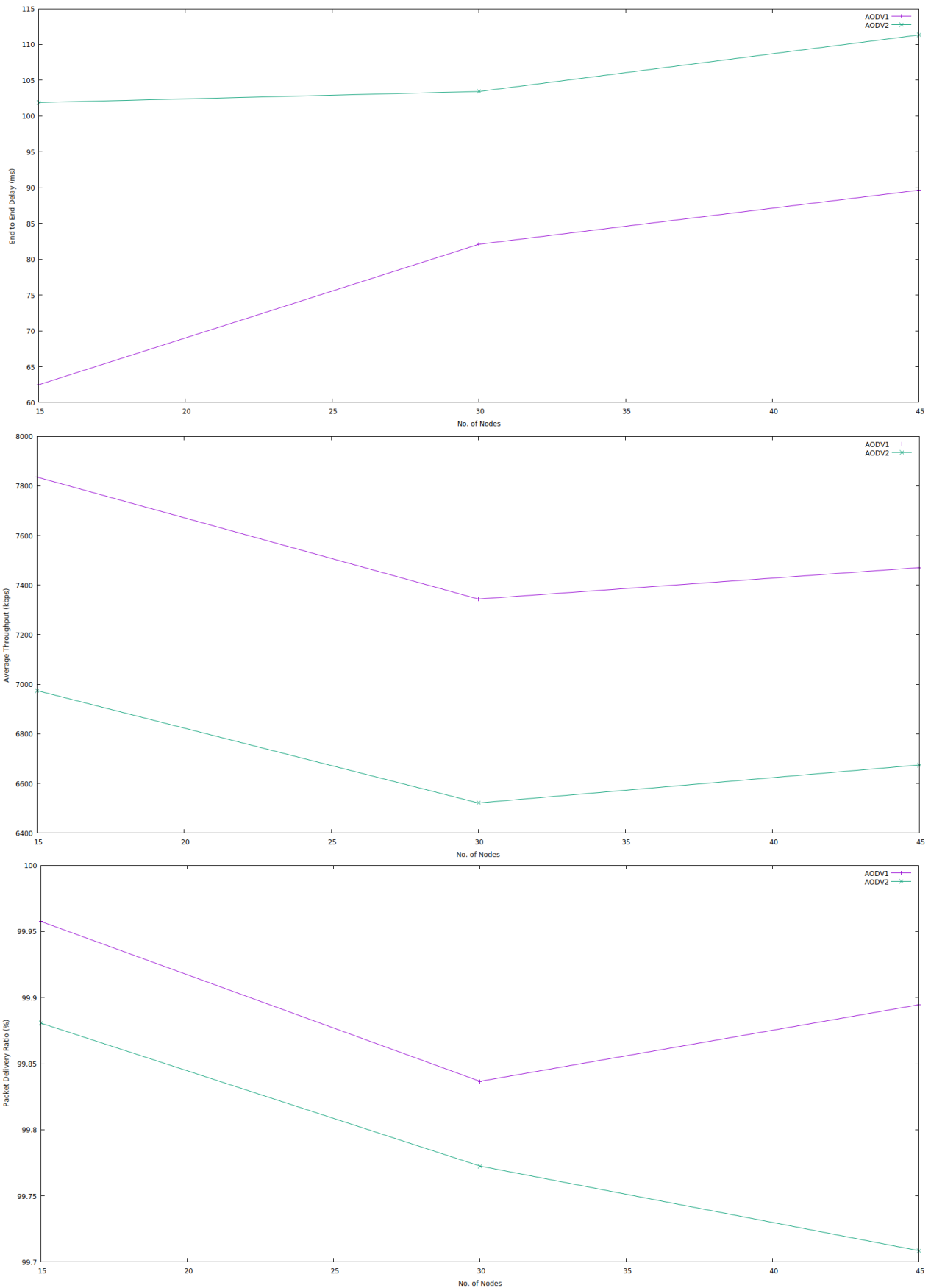
Figure 5. QoS Comparison of Group 1 and Group 2

4. CONCLUSION

The use of the project-based learning method in this study can improve participants' collaboration and communication skills which is very useful in real work in the future. The participant who makes mistakes can learn based on inputs from lectures and other participants while engaging in discussion, producing better results.

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