Teaching Computer Networking Course in Indonesia During Pandemic

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Teaching online in Indonesia, where 3G/4G is the main internet access for the students, should consider their traffic volume consumption. Brawijaya University and Hasanuddin University conducted computer networking courses during the pandemic by minimizing real-time sessions only for important explanations and Q&As. University LMS and a popular messaging application were the choices for interactions related to the hands-on assignments. With this experience, we noted the lessons learned in terms of conducting real-time sessions, class interactions, and the use of tools for such interactions.

CCS Concepts:
• Applied computing → E-learning; Distance learning; Computer-managed instruction.

Additional Key Words and Phrases: teaching computer networking, e-learning, distance learning, pandemic

ACM Reference Format:

1 INTRODUCTION

The coronavirus pandemic revealed the importance of understanding the Internet access situations faced by the students outside the campus where 3G or 4G are their main, if not the only, access to the Internet. A decree by the minister of education to stop face-to-face classes and switch to online learning on March 24, 2020 left the universities and schools struggled on how to deliver classes online with the backdrop of such internet access.

This paper reports the experience of teaching computer network online during the pandemic in two universities in Indonesia: Brawijaya University (UB https://ub.ac.id) and Hasanuddin University (UNHAS https://unhas.ac.id). Both universities are partners of AI³ (Asian Internet Interconnection Initiatives https://www.ai3.net) and SOI (School on Internet) Asia Project (https://soi.asia), which are two related research and education network projects in Asia. We also highlight a series of self-paced hands-on workshops we did in this project, where the experience helped to shape the decisions in teaching during the pandemic.

2 BACKGROUND

We conducted a series of remote hands-on workshops in SOI Asia Project [1] in the past where the participants were instructed to configure servers and routers in a virtual environment. These
workshops are characterized by high-latency between participant’s locations in several Asian countries and Japan, where the virtual environment is located. They provided us with the experience in designing effective workshops, including how to schedule participants and monitor their progress.

In the wake of Covid-19 pandemic, campus lockdowns and orders to switch to online learning came in the 7th week of the 15-week semester in Indonesia. These orders did not come with a complete guidance for online learning, hence many lecturers struggled while slowly adapting to the new environment and they opted to use video conferences to deliver classes. UNHAS and UB both have their own LMS, but they are designed for in-class learning and their use was not mandatory last semester.

Online learning using video conferences is costly for students. They may have to spend around 9 USD per week for 3G/4G internet bills, which is about two days worth of daily allowance for an average UNHAS student. UNHAS subsidized around 11 USD for students’ internet bills. Besides that, major telcos offered internet access plans with free access to university LMS during the pandemic. UB also partnered with the major telcos to subsidize around 8 USD to economically disadvantaged students and shortened the semester a month to reduce the internet access costs.

Some students experience bad 3G connectivity at home (See Figure 2) and they had to go to another location to attend classes and download materials from the LMS. A quick survey to the students after the semester where 32 responded showed that around 65% experienced bad connectivity to the LMS. For the multiple answer question about problems in video conference, 81% complained about unclear or intermittent audio reception, 47% experienced low resolution or freezing video, and 41% had problems in viewing screen share. There was also a report where the video conference application crashed due to weak 3G signal.

Login activities to UNHAS LMS (https://sikola.unhas.ac.id) increased significantly after the campus lockdown order (See Figure 3). Many lecturers created classes and uploaded their materials.
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Fig. 2. Cities with top packet loss rate in receiving 480p WebRTC video in 19,234 UB real-time sessions after lockdown. The lighter blue bars shows the two cities in Java Island, which has the best telecommunication infrastructure in Indonesia, that recorded more than 10% packet loss.

to the Chamilo-based LMS and students subsequently downloaded the materials soon after the order. Login activities gradually decreased as many lecturers may prefer to use other methods of interactions such as email and WhatsApp chats for class related activities.

3 TEACHING AFTER LOCKDOWN

UB offers a computer networking course in the Department of Informatics Engineering, while UNHAS offers it in the Department of Electrical Engineering and the Department of Informatics. Both courses cover the networking fundamentals, including network administration, and in addition, the course in UNHAS also covers wireless network and network security. Both courses reduced the length of real-time sessions and focused on the self-paced hands-on after campus lockdown. For the hands-on assignments, UB used an in-house material using FRRouting (https://frrouting.org) and stored the instructions on GitHub. Meanwhile, UNHAS combined the self-paced materials from Cisco Network Academy (NetAcad https://www.netacad.com) and mininet (https://www.mininet.org) for the hands-on.

3.1 UB: Using FRRouting for Hands-on

The lecturer conducted five Google Meet sessions to discuss important topics in the materials that are uploaded beforehand to the university LMS (Moodle and Google Classroom) and focused on questions and answers on the discussion topics. Each session was kept between 30 and 45 minutes with audio-only and screen sharing when necessary in order to minimize the traffic volume during the session.
The students were required to follow instructions on the LMS, including downloading reading and presentation materials and answering quizzes. The routing lab hands-on materials were made available as a repository on GitHub (See https://github.com/abazh/routing_lab). The students were to complete the hands-on by interconnecting docker instances running FRRouting on their computer and then submit the configuration files and a screenshot to be evaluated (See Figure 4). The lecturer run a similar docker environment with the configuration files and confirmed the network connectivity for the evaluation. A WhatsApp group chat was used for interactions related to the hands-on assignments as it was considered to be more convenient to the students.

3.2 UNHAS: Using NetAcad and mininet for Hands-on

The lecturer conducted three real-time sessions between 40 and 60 minutes each for networking theory explanations, such as Bellman-Ford and Djikstra algorithms and Software Defined Networking (SDN), learning tools demonstrations (NetAcad for most of the course and mininet for SDN), as well as for class coordination. Screen sharing with lecturer’s audio were used to minimize the traffic volume in these real-time sessions (See Figure 5).

Students were required to enroll in the “CCNA Routing and Switching: Routing and Switching Essential” (CCNA-RS) module and to complete all labs, quizzes, and exams in the module. The students used UNHAS LMS for interactions with the lecturer and for discussions among the course attendees. They submitted the packet tracer files to the LMS to be evaluated by the lecturer. The lecturer evaluated these files by running them locally and verifying the network configuration and its connectivity. The learning assessment was based on the CCNA-RS hands-on lab and final exam as well as the networking theory exam using the LMS.

4 LESSONS LEARNED

The campus lockdowns force the lectures and students to use various online learning tools, including the university LMSes. However, as the classes were designed to be conducted face-to-face, many lecturers opted to use video conference tools, which means internet access bills increase for students. This paper shows two cases where the lecturers have experience in distance learning, including
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Fig. 4. Screenshot of an assignment submission to UB LMS. The left window shows the submission form, and the right window shows the results of the student assignment. The lecturer runs the submitted configuration files to check the results.

Fig. 5. The online learning environment for Computer Networking Course in UNHAS. The three real-time sessions covered materials that are important for the self-paced assignments.

hands-on workshops, thus the courses were conducted during the pandemic by considering the class traffic volume for students who are price sensitive and especially for internet-poor students.

Meanwhile, the unfamiliarity with university LMSes and the always-on culture in using messaging applications made class interactions move to WhatsApp, which is the most popular internet chat in Indonesia. Using LMS to handle hands-on assignments related questions proves to be rather difficult for the students as many questions are problems that require back and forth assistance
in debugging them. However, the use of WhatsApp groups proved to be time consuming for the lecturers as the students are very flexible in terms of time of the day.

The three lessons learned from conducting these computer networking courses are as follows. Firstly, lecturers should carefully select which parts of the course that have to be conducted real-time, and should consider minimizing traffic volume and making the real-time sessions available for later access. Secondly, the LMS should be designed for better interactions, such as using offline-first and mobile-first paradigm to serve internet-poor students. This paradigm comes from the web development community, which understands most users access the Internet using mobile devices and they expect that the web, including LMSes, should provide an app-like experience in network outages. And thirdly, lecturers should set a rule of online interactions in WhatsApp groups in order to better manage the self-paced hands-on assignment parts of the course, due to the non-threaded discussions in such groups.

5 SUMMARY
This paper presented two cases of teaching computer networking courses in Indonesia during the pandemic, where the most students are using 3G/4G as their main internet access. Such courses considered the internet access situations, hence the real-time sessions were kept short and did not use video. However, responding to questions regarding the hands-on assignments remains a challenge, and the lessons learned can provide a way forward in teaching beyond the pandemic.

REFERENCES