Experience on “Networking I” course using simulation software and real devices for practices

DOI: 10.46932/sfdjdv3n6-059

Received in: November 10th, 2022
Accepted in: December 16th, 2022

Daniel Arias Figueroa  
PhD Informatic Sciences, Network Simulation  
Institution: Universidad Nacional de Salta  
Address: Av. Bolivia, 5150, Campus Universitario, Campo Castañares  
E-mail: daaf@cidia.unsa.edu.ar

Loraine Gimson  
Magister en Ingeniería de Software  
Institution: Universidad Nacional de Salta  
Address: Av. Bolivia, 5150, Campus Universitario, Campo Castañares  
E-mail: loraine@cidia.unsa.edu.ar

Ernesto Sánchez  
Magister en Redes de Datos  
Institution: Universidad Nacional de Salta  
Address: Av. Bolivia, 5150, Campus Universitario, Campo Castañares  
E-mail: esanchez@cidia.unsa.edu.ar

Alvaro Gamarra  
Graduated in Data Network Engineering  
Institution: Universidad Nacional de Salta  
Address: Av. Bolivia, 5150, Campus Universitario, Campo Castañares  
E-mail: alvaroig@cidia.unsa.edu.ar

ABSTRACT
The use of simulation software tools has demonstrated to be very useful in computer network teaching and learning processes for so long. Many advantages can be enumerated, but the outstanding one is a significant reduction in network devices acquisition cost such as routers, switches, wiring. Moreover, there is a time reduction on conventional physics laboratories launch (start-up). This article describes a study done in a Networking course context. It was organized by the Telecommunication Engineering Faculty at the Salta Catholic University (UCASal) in Argentina. The main study goal was to compare and contrast learning between students using laboratories with simulation software tools and those with real equipment.

Keywords: simulation, networking teaching, virtualization.

1 INTRODUCTION
Network concepts and fundamentals are difficult to assimilate. That is because of the complexity of the involved processes that are not always visible [1], [2], [3] and [4]. Specific equipment required to
stand up a network laboratory are very expensive. Besides, scarce resources are a common reality in most argentine national universities located in provinces. In this context, simulation software tools emerge as a possible solution to make the most of the students’ practices by making, also, possible the use of these tools out of classes’ schedule (Virtual laboratory).

According to what has been stated before, the difficulties can be summarized as follows:

- The teacher has to adequate work practices to the characteristics of the equipment available. Equipments are generally scarce.
- The number of students is normally high. Nearly 20 students take “Networking I” course each year.
- Network devices (routers, switches, wiring, etc) are expensive. Their updating and maintenance involve high costs. That is the reason why there is usually only one or at least two devices per students group. This makes real equipment laboratories unviable.
- Not all topics can be tackled with a real environment practice
- The learning curve to manage devices in real laboratories is high. The same occurs with physical links in order to define a certain topology because there are available different kinds of interfaces such as Ethernet, FastEthernet,
- Serials and Consol Ports. This makes impossible the access to the network hardware difficult for many groups

2 CONTEXTUAL FRAME

The experience was carried out with all the students that were taking “Networking I” course. This course was part of the telecommunications engineering degree curriculum at the Engineering Faculty at the Salta Catholic University.

Students performed for each topic a simulation practice using a simulation tool and a real practice using real equipment (with the limitations stated before). The topics covered by the course were Application Layer, Transportation Layer, Network Layer for the TCP/IP Model.

The main objective of this studio was to make students compare and contrast the same practice activity working with real equipment and with Packet Tracer and GNS3 simulators. A survey divided in three parts was given to the students. The first part inquired about the simulator use and its ease to configure a topology, configure devices, check functionality and track events. The second part presented the same questions but related to a real devices laboratory. The last part examined the possibility of replacing real equipment laboratory with simulators when the objective is teaching network concepts and fundamentals. Clearly, computer network teaching in careers related to systems areas is different from the
specific training that network technicians need because for them it is crucial to work with real equipment from different providers.

3 DATA STATISTIC ANALYSIS

The arithmetic average for these data exceeds, in all cases, at least the scale medium value (3,00). That confirms the content validity of all items included in the survey.

The Cronbach’s alpha coefficient calculated is 0.731. This value surpasses the 0.7 value therefore questionnaire reliability grade can be confirmed. Consequently, high polarization in reliable answers from students can be appreciated.

Below, data statistic analysis for each part of the survey is presented.

![Table showing data analysis](image1.png)

Figure 1: Analysis working with simulation tools
Here, 90% of the students considered that topology configuration was simple with simulators, 70% considered that devices configuration and events tracking were simple with the simulator, and, 60% considered that functionality verification was simple.

<table>
<thead>
<tr>
<th>Prácticamente</th>
<th>Nada (1)</th>
<th>Poco (2)</th>
<th>Lo suficiente (3)</th>
<th>En Buen Medida (4)</th>
<th>En Gran Medida (5)</th>
<th>Σ</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Config. topología simple</td>
<td>1x 10,00</td>
<td>5x 50,00</td>
<td>3x 30,00</td>
<td>1x 10,00</td>
<td>- -</td>
<td>2.40</td>
<td>0.84</td>
</tr>
<tr>
<td>Config. dispositivos simp...</td>
<td>4x 40,00</td>
<td>1x 10,00</td>
<td>3x 30,00</td>
<td>1x 10,00</td>
<td>1x 10,00</td>
<td>2.40</td>
<td>1.43</td>
</tr>
<tr>
<td>Lab. adecuado para fund...</td>
<td>- -</td>
<td>1x 10,00</td>
<td>5x 50,00</td>
<td>1x 10,00</td>
<td>3x 30,00</td>
<td>3.60</td>
<td>1.07</td>
</tr>
<tr>
<td>Verif. funcionalidad simp...</td>
<td>- -</td>
<td>6x 60,00</td>
<td>3x 30,00</td>
<td>1x 10,00</td>
<td>- -</td>
<td>2.50</td>
<td>0.71</td>
</tr>
<tr>
<td>Seguimiento de eventos...</td>
<td>- -</td>
<td>5x 50,00</td>
<td>3x 30,00</td>
<td>2x 20,00</td>
<td>- -</td>
<td>2.70</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Figure 2: Analysis working with real equipment

In this situation, 60% of the students considered that topology configuration was not simple using real equipment. 50% considered that devices configuration was not simple.

60% considered that functionality verification and events tracking were not simple using real equipment.
Part 3. When the objective is teaching network concepts and fundamentals not training networking technical, Do you consider that simulation can replace the real equipment practice?

60% of the students considered that simulation can replace real equipment laboratory when the main goal is teaching fundamentals.

4 STUDENT’S COMMENTS AND SUGGESTIONS

Bellow, there are quoted the opinions made by students related to the experience they had while working with simulation.

- We need more practice and time to 100% understands networking simulation programs. It is didactic but it needs to be developed more.
- The use of simulation tools is very convenient because real equipments are difficult to get. When it is possible, I would be convenient to perform the practice using a simulation tool and also using real equipment in order to observe that is practically the same
- When we do not have real equipments and we have to do some practices, it is very interesting to work with simulation tools, in order to visualize how our topology and its functionality are going to be.

5 CONCLUSIONS

It could evince in the analysis made, that students understood that simulation simplified the topology and devices configuration process as well as the functional verification and event tracking. Also, they have considered that practices with simulation can replace practices with real equipment when the objective is to learn network concepts and fundamentals. It should be pointed out that the results obtained
present similarity with others made by teachers of network subjects from different universities of Argentina in 2016 [13]. In that work, teachers considered that the topology and devices configuration learning curve is short working simulation software; but it is long when working with real equipment. Most of them considered that it is possible to replace real equipment practice with simulation practice when the objective is teaching network fundamentals.
REFERENCES


