Simulation As A Teaching Tool-Sharing Experience In Teaching Computer Networks Practicals

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Abstract

Teaching computer networking practical can be daunting task especially when teaching a large class of students of around two hundred (200) and using real network devices that are relatively expensive, requiring careful handling. Letting students start experimenting with the networking devices just after receiving theory may be a recipe of disaster. So many things may happen like corrupting, uninstalling, locking of the software and even physical damage of the devices. The resultant is at the end students will not get enough practice and will not be evaluated.

In this paper we would want to show why the first hand-on practical in computer networking should be done through the use of interactive simulation and then students may graduate to experimenting with real devices. Some authors believe that simulation must be used in order to facilitate the teaching and learning of computer networking concepts [1]. With this general agreement that simulation plays important role in the teaching and learning of networking we then proposed the set-up of networking laboratory that include one section of simulation machines and the other section of real networking devices.

Introduction

It goes without say that in order for students to be motivated to do networking practical they need to have understood the concepts in the textbooks and from lectures. Generally the concepts of networking are mostly in abstract form making it difficulty for most students to comprehend [8, 14,15]. The network course is done in a semester (12-15 weeks) period making it again difficulty for students to learn the terminology, comprehend and apply the concepts. Network practical gives the students the opportunity to master the material and learn how to apply it in the real world. Nowadays when the cost of network components is relatively cheap it is possible to have a real network laboratory. It must be clear from the beginning that having laboratory is one thing and keeping the components working is another thing. Therefore when we talk about cost we must include the maintenance costs of the equipments. We will discuss first the experience we acquired while running a real network laboratory. The second part of our discussion will focus on the introduction of a pseudo-network laboratory section in the network laboratory then finally conclusion.

Literature review and definitions

Definition: Simulation involves using a computer to imitate (simulate) the operation of an entire process or system [5, 6, 8].

The computer as tool: The classroom computer need only have some useful capability programmed into it such as simulation, statistical analysis, super calculation, or word processing. Students can then use it to help them in a variety of subjects [8, 12].

Here we are talking about computer as a tool with simulation software that would help the students to understand the concept of networking. The question that many people ask is that why use simulation when there are real components to use in practical sessions. The following are some of the reason why simulation would be used:

- Cost: Using real components may be extremely expensive due to maintenance and the cost the components.
- Time: Students may practice for as long as they want to.
- Replication: The experiments may be repeated over and over again exactly the same way.
- Safety: Simulation provides a safe environment to the user [2].

It must be noted that in education so many concepts are too abstract, too complex and difficulty for students to understand at different levels of their development [14]. Confronted with this situation a model becomes one way to rescue the situation, to be able to explain such types of concepts. These models may be non-computer based or computer based. In the usage of models the student is delayed from direct confrontation with reality at first. Besides the reasons of using simulation as a teaching tool it has some noted disadvantages that comes with it. One of the disadvantages is that when students have known how to use models they may remain convinced thereafter that they understand the reality as well [14]. It is then useful that after introduction of a model to students that reality should be introduced thereafter if possible.

Teaching Practical

Laboratory practicals are seen as teaching encounters in which students may develop a wide range of skills that is cognitive, psychomotor and affective through familiarization with, and handling of, equipment and apparatus [15]. When teaching practical the lecturer determines his teaching programme with the expected outcome [15]. The practical work is used in some instances to confirm the understanding of theoretical concepts that have already been presented to students. A number of authors have written about the objectives of practical work, most of it related to cognitive matters. This is reinforcement of theoretical concepts or the stimulation of independent thinking [15]. It must be noted that some authors acknowledge that manual skills have some significance in practical work, and in some cases the affective domain is represented despite the problems of assessment that it has. [15]. Smith presented a list of practical work objectives as follows:

- Illumination of lecture material
- Development of experimental skills (follow the recipe practical)
- Insight into subject area domain culture (how people in that area do things)
- Skills in written communication.

So many authors wrote about the learning through practical experience. Ausubel et al (1978) and Novak (1978) indicated two dimensions of learning as follows:

1. Differentiation between rote learning and meanful learning
2. Relates to the way in which the teacher seeks to facilitate learning in students

Meanful learning indicated in 1 is when one relates new knowledge in a logical way to relevant parts of one's conceptual framework

whereas rote is like cramming of information but without grasp of the ways in which these concepts fit into the structure of the discipline. It may be appreciated that the use of simulation if note used correctly then may not produce the required results. The following diagram shows some practical activities located with respect to the rote-meanful reception dimensions.

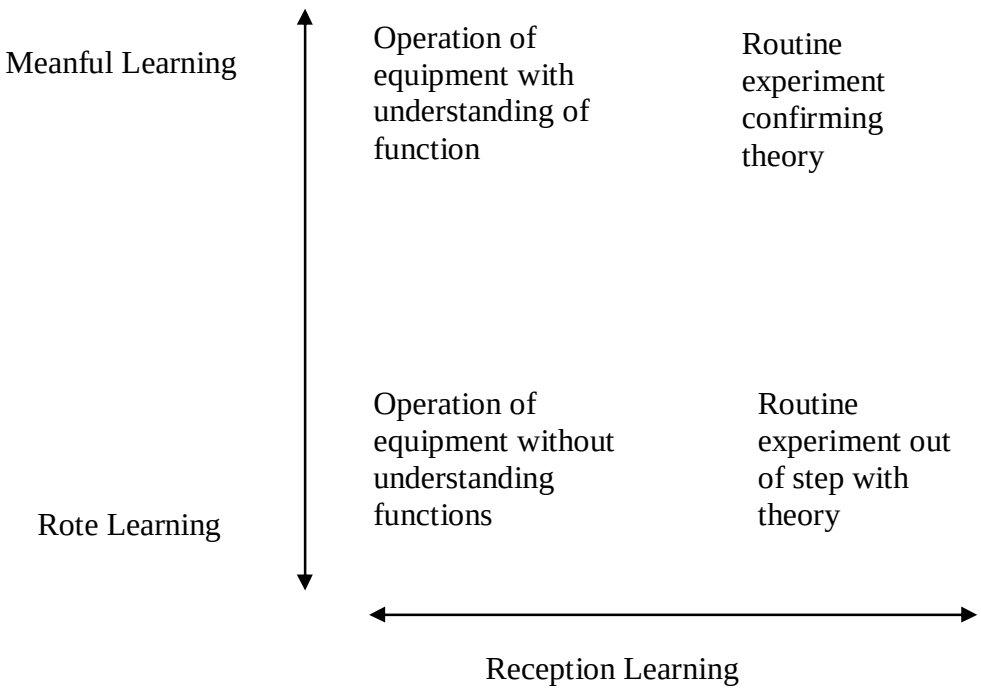

Fig 1.1 Some practical activities located with respect to the "Rote-meaningful" and reception learning dimensions

Sometimes it is very difficulty to measure that meaningful learning took place. The lecturer should lecture first and then appropriate practical exercises given in order to confirm the comprehension of theoretical concepts. The objectives that may be achieved through confirmatory exercise if the learning is not rote in character are:

- Cognitive such as comprehension and (possibly) application can be expected to be attained by students
- Psychomotor regarding the satisfactory use of equipment [15].

Use of real network lab and problems encountered

The practical sessions that we do are done in a real network laboratory. The lab is made up of data terminal equipments (DTEs), data communication equipments (DCEs), cables and other equipments used in the construction of network. The lab can accommodate at most forty (40) students a session. The approximate number of students in the computer-networking course in a semester is around two (2) hundred. This means that we divide them in to groups. The practical exercises are mostly about construction of a network, configuring devices and cables. The students are supposed to practice setting a network using the real network equipment then at the end of a semester they are tested on configuring a certain device/cable. There are guided practical sessions that the students do where they are told the dos and the don'ts in order to make sure that the device/s's life span are/is prolonged. The students are then left alone to practice in a group and those who would be interested to practice individually will have their chance during the evening. With this type of arrangement no practical session may be left uncompleted because other groups will be coming to use the same equipment. It is imperative that students come to the lab well prepared to be able to complete the practical exercises given within the two (2) hour-period.

The problems encountered with this arrangement are that in some cases there are students who would render the equipment unusable consciously or otherwise that the practical cannot go ahead. They would use the same commands that are forbidden, miss handle the hardware, corrupt and/or uninstall the software, etc. This would mean that the equipment needs repair. We expect the repair of the device to take less than a week in order that the practicals would continue smoothly. Lack of specialists in this area would mean that the mean time to repair is a month or more. When most of the equipment is rendered unusable then the lecturer resort to demonstrate what the students were supposed to do. The practical tests would be done theoretically. Our graduate students continued not to satisfy the

industry even after the university have committed money in securing real network practical equipment.

Temporary Solution

When the problem continued we needed to find a solution to our problem. We visited the Internet where we managed to find DEMOs that gave limited time to use. One of the URL: www.dcs.napier.ac.uk/~bill/emulators.html. We then installed the DEMOs on the machines so that students may start practising using the emulators thus the real network equipment would only be used when the student has successfully managed to use the DEMOs. With this arrangement the students need to satisfy the tutor that they have acquired the ability to configure the DEMO before being allowed to use the real equipment. Almost all our problems melted and the real network equipment started to last for a long time. Students complained that the time allowed by the DEMO is too short and each time the time expired they needed to reinstall it again. With this improvement in handling network practical sessions we have come up with a future plan. In doing all this we made sure that we did not sight that learning must take place.

Proposed laboratory

It is out of this experience that we decided to propose an ideal network laboratory that is comprised of two sections, one that is a pseudo-network lab and the other a real-network lab. The laboratory will be set as shown in figure 1.1. We propose that during instrumentation session that the students are shown the real component and the corresponding emulator. The students then do their practical exercises in the pseudo-network lab and should be evaluated as part of the overall practical evaluation. They then graduate to real-network lab where they would use the real network equipment and the other part of evaluation comes from this side. The figure 1.1 shows these partitions of the proposed lab.

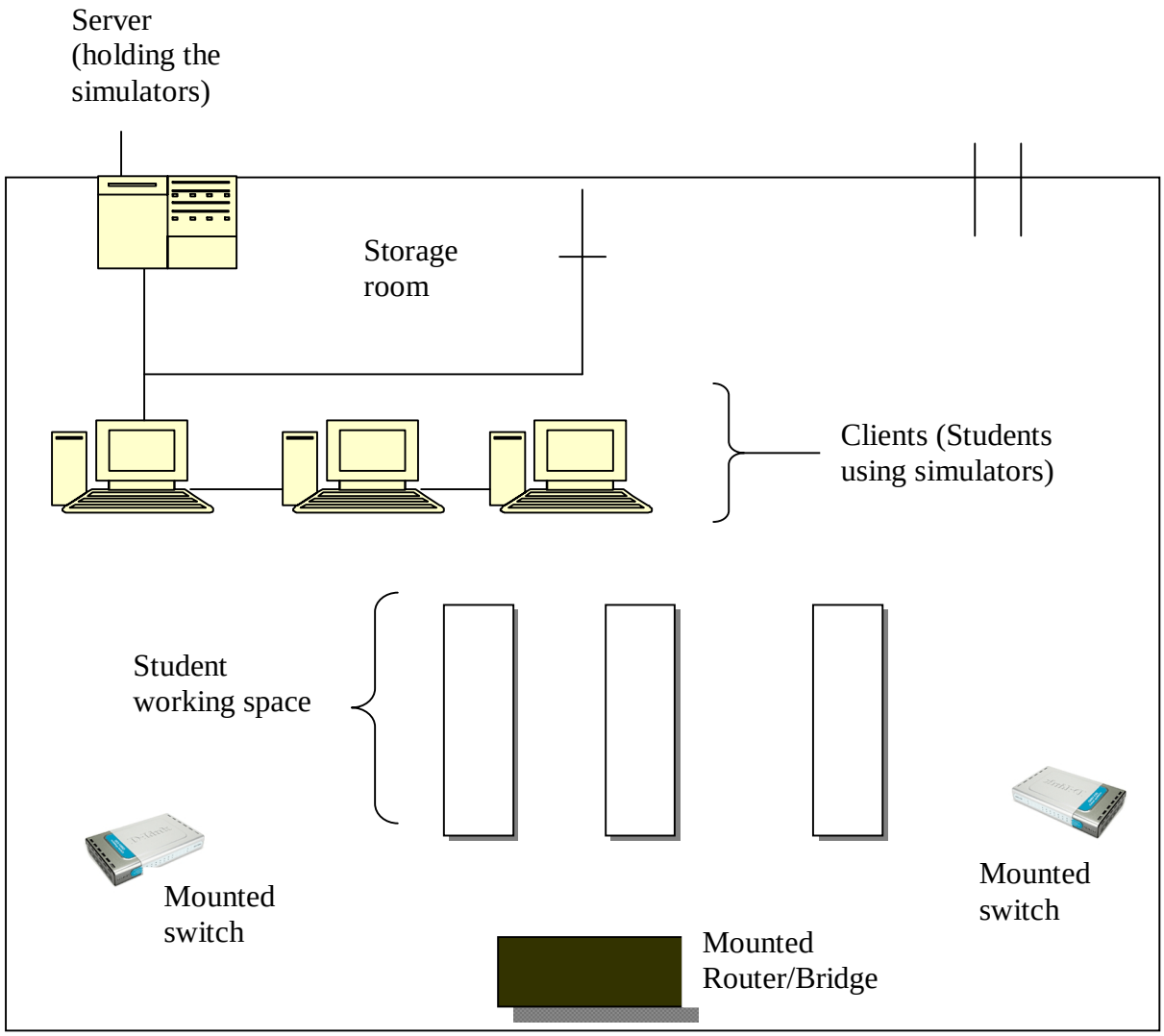

Fig1.2 partitions of the proposed lab

Conclusion

It must be noted that networking is an inherently practical area of study and that students need demanding practical exercises that are challenging. This demand a well-equipped network laboratory that is easy to maintain. That is why it became imperative for us to share our experience in running of a practical networking course. Simulation became our saviour to enable us to perform practical session throughout the academic year without many problems. The real-network lab became cheap to maintain due to the introduction of the pseudo-network lab. In our case students were not so much motivated by the introduction of simulation due to the fact that we were using DEMOS. It must be noted that students have test/exam-driven motivation so at the end it was not a problem to motivate them. The use of simulation enables us to assess every student on network practical. We also want to believe that simulation enhanced learning to take place though we did not measure it.

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