

THE USE OF SIMULATIONS FOR ENHANCING OF CRITICAL THINKING OF STUDENTS IN ENGINEERING FIELDS

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ABSTRACT

Engineering fields are very complex and require a critical approach to their problems. In this context, it exists an increasing need for engineering students to develop critical thinking in the context of solving problems.

To achieve this should be used effective teaching methods that develop critical thinking and also facilitate and enhance the learning of students and their performance in general, making them able to cope with market demands of a globalized economy.

A simulation approach as in science and in engineering also increases communication, increases critical thinking and provides an analytical approach to various problems.

Therefore, this research is aimed to investigate the effect of simulations on the development of critical thinking, which will be expressed not only in the understanding degree of what is given in the lesson, but also with the ideas that simulation encourages the students to create solutions for different problems.

To accomplish this purpose are used qualitative and quantitative methods, where it was taken as a case study: Faculty of Electrical and Computer Engineering at the University of Prishtina.

It was made an experiment for the use of simulation and from this experimentation are extracted the results of the effect of using the simulation for the aspect of developing and increasing critical thinking.

The results of this research highlight the positive effect that the use of simulation in teaching and learning process has in developing the critical thinking of students and their overall performance. Simulation motivates students to learn, making them more cooperative and developing their skills for problem solving.

Key words: Engineering, Simulation, critical thinking, teaching, learning

INTRODUCTION

The rapid economic development and the global changes that are happening today, based on high technological development, pose a lot of requests for education system, especially for education system in fields of engineering. Preparing students in this field as engineer of 21 century, who are capable for solving complex problems and offering innovation in a global context is the focus of the study. This seems to be as a key for a successful economy and to secure welfare for the society in general. To fulfil this, the focus most orient to the quality of education in engineering fields. To find the ways, how to grow the performing of students as a new engineers in the context of these fields is essential. The development of technology did not influence just in the economic context, but also in the ways of teaching and learning. Technological components of information and communication have offered new ways as for teaching also for learning and one of them is the simulation way of teaching and learning. Simulation is essential in the engineering fields. The students of engineering disciplines learn for different engineering analyses. They do the design of the results which comes out from these analyses which usually are so complex and abstract. The use of simulation methods of teaching and learning offers possibility for: new ways to solve the problems, new ways of thinking for science and engineering, and to improve education and science practice and engineering (Mc Grath & Brown, 2005). Tools for simulation as a program Packet Tracer usually are used to grow the level of learning and to develop critical thinking and also they promoting some different styles of learning which supporting the attitude of students. Moreover in this paper will be presented the effects of use of simulation in teaching and learning process for enhancing of learning, and in developing the critical thinking in the field of subject for "Computer Networks" in the Faculty of Electrical and Computer Engineering at the University of Pristina. Also it helps in the encouraging of students for an analytic access for different science problems.

LITERATURE REVIEW

Critical thinking in engineering is viewed as being very important given that engineers need innovative approaches to tackle complex issues of real-world (Felder, 1997). Critical Thinking is the intellectually disciplined process of actively and skilfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Jessop, 2002). Critical thinking must be seen as a skill that is necessary for engineers to be able to engage in good problem solving where they are sensitive to the context of the problems they are solving (Siller, 2001). Also according to Siller, this means that for engineers there is greater uncertainty in their decision-making and a need for more critical and reflective judgement when they make decisions. Relationship between graphics and a type of information, increases learning and creates opportunities for application of what that is taught (Josef & al, 2010). Ultimately through the use of simulation students learn how to think critically in a complex situation (Brumfield,2005), thanks to the application of Theory in practice (Kanner,2007).

METODOLOGY OF RESERACH

To fulfil this research have been used mixed methods: quantitative and qualitative ones. Also it has been reviewed a relevant literature to conduct this study. These methods of study consist on qualitative and quantitative analysis of the effect of use of the simulation in the teaching process and learning in the engineering fields to develop critical thinking, and the encourage of teachers and students to use a simulation methods for teaching and learning. The data have been taken from narrative reports of interviewed students, even statistics reports and questionnaires themselves.

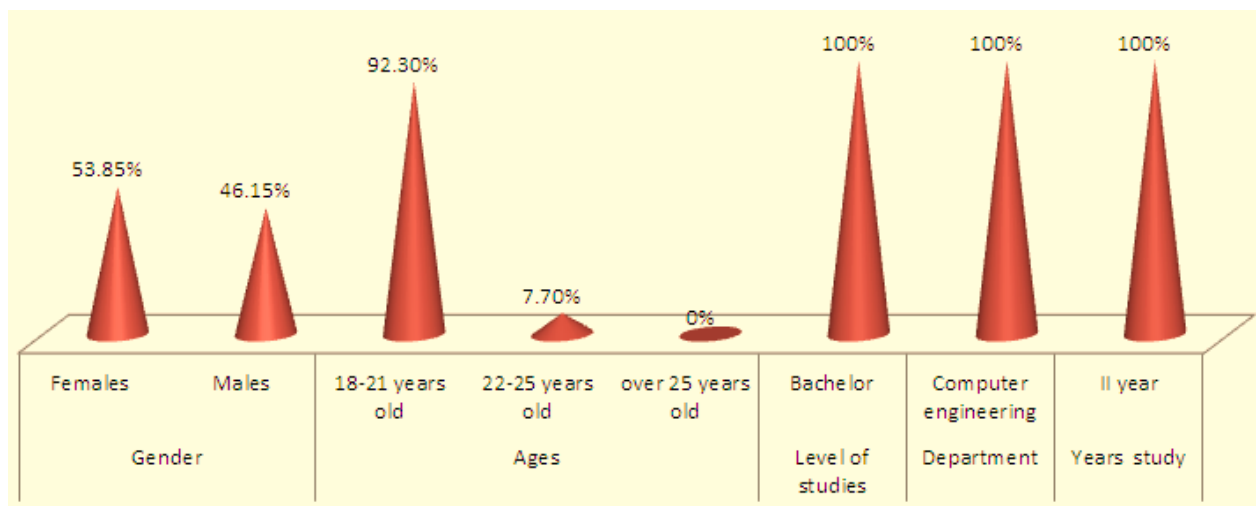
The survey was conducted with 65 students from the department of Computer engineering of the Faculty of Electrical and Computer Engineering at the University of Pristina, who took part in two lectures. First was developed without the use of simulation and the second with the

use of simulation. To accomplish the research there was designed a questionnaire, which is the main instrument through which had been collected data and opinions from students.

Questionary was created in three parts. First part contained demographic questions, in the second part students should answer in three questions, to write the answers, in that way to have their comments and opinions about the simulation method of teaching practically of learning. The third part of this questioner contained the questions about the effect of use of the simulation in to learning of students, concretely for developing of critical thinking in general. Students in this survey answered in these questions using an average from 5-points. Points in scale were the labelled "Fully agree ", "agree", "neutral", "disagree" and "strongly disagree". Finally, there were used ethical processes throughout the process of research and respected general rules in relation to the respondents.

RESULTS

After processing the data obtained completed by respondents, the results provided in the section set out in the structure of the questionnaire. **The basic demographic data-** respondent students' characteristics are shown in the graph below:



Graph 1. The demographic data

To get the opinion of students for the impact of the integration of simulation in teaching and learning, student answered to the questions. The table I. has presented the students' perceptions.

Table I. Results of questions about the effect of Integrating Simulation in teaching and learning perspective of students					
	Fully agree	Agree	Neutral	Disagree	Fully disagree
Improves teaching and learning	79%	21%	0%	0%	0%
Increase critical thinking skill among students	65%	30%	5%	0%	0%
Increase students participation and their interest to participate in discussion in classes	45%	50%	5%	0%	0%
Promote cooperation among students	30%	50%	17%	3%	0%
Increase students' communication and their interpersonal skills	40%	45%	14%	1%	0%
Motivates students to deal with teaching activities	35%	40%	20%	3%	1%
Increase student-teacher interaction	30%	35%	30%	4%	1%

To see the students perception about the use of interactive simulations as learning tools and his effect for helping students to deeply understand abstract and highly abstract engineering subjects in engineering courses, and development of their critical thinking, the interactive simulation form of teaching would be compared with the traditional way of teaching (by using white or black tables). The gained results from the questionnaire filled in by students are presented on the following table.

Table II. Results of questions: Which is the effect of using Simulations and Whiteboard on your learning performance and developing your critical thinking		
Effect	Simulations	Whiteboard
It makes the teaching contend and distribute material through teaching easier and more understandable	85%	15%
It enables discussion and testing theoretical	92%	8%

material encouraging discussion and raising critical thinking.		
Increase student's interest and classroom discussions	75%	25%
Increase the students 'possibility to judge in solving of problems which are discussed in the classroom	90%	10%
It offers the possibility to analyse and draw conclusions on the material examined	95%	5%
It makes the distributed material during teaching lessons easier and more understandable	90%	10%
It increases creativity	98%	2%

DISCUSSION

Students can study in many ways: by seeing and hearing, reflecting and acting, reasoning logically and intuitively, memorizing and visualizing, by doing things and by simulating, etc. In this context, the use of simulation in teaching and learning process plays an important role and it is un-substitutable. This conclusion has been reflected by the results of this research. Based on the results presented on the first table, it is noted that students believe that the integration of simulation in teaching and learning process has positive effects in raising the performance of the learning and for developing their critical thinking.

Also, the obtained results from the second table has highlighted the positive impact that comes from the use of interactive simulations as teaching and learning tools. As we can see the 92% of students agree that the use of simulation enables discussion and testing theoretical material encouraging discussion and raising critical thinking. In another side also the answers that have given students, in the first questions of the questionnaire, where we asked their written opinion it was found the same finding. A student with his answer noted, "That in a missing of real instruments, simulation has a lot of influence in our enhancement capacity as engineer,

especially in the cases when we need to analysis the abstract concepts "(Student 165431). Another students noted that simulation has made easier the way of finding the correct solution for complex problems of the real-world. Also, simulation has made more interesting the course, more simply and more practice “ (Student 184561).

CONCULSION

Based on the analysis of the survey results it is seen that reaction of respondents as far as the use of simulations is a good way for interpreting theoretical concepts and principles by giving many opportunities to the students to practical application of the theoretical knowledge and adding creativity in their thinking. From the results of this research and from the research done before, is highlighted that the integration of simulation in the process of teaching and learning have a positive influence in increasing of learning performance and developing the critical thinking of students in the engineering fields. However, it must be said that the use of simulations is one of the most important elements to increase the quality of teaching, students learning and thinking in critical way.

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