

Visual teaching and learning in the fields of engineering

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Abstract

Engineering education today is faced with numerous demands that are closely connected with a globalized economy. One of these requirements is to draw the engineers of the future, who are characterized with: strong analytical skills, creativity, ingenuity, professionalism, intercultural communication and leadership. To achieve this effective teaching methods should be used to facilitate and enhance the learning of students and their performance in general, making them able to cope with market demands of a globalized economy. One of these methods is the visualization as a very important method that increases the learning of students. A visual approach in science and in engineering also increases communication, critical thinking and provides analytical approach to various problems. Therefore, this research is aimed to investigate the effect of the use of visualization in the process of teaching and learning in engineering fields and encourage teachers and students to use visual methods for teaching and learning. The results of this research highlight the positive effect that the use of visualization has in the learning process of students and their overall performance. In addition, innovative teaching methods have a good effect in the improvement of the situation. Visualization motivates students to learn, making them more cooperative and developing their communication skills.

Keywords: visualization, simulations, teaching, learning, student performance.

Introduction

The level of economic and social development of a country depends from the quality of education system and the level of education in that country. 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 the fields of engineering matters, or more concretely in the aspect of Information and Communication Technology. Preparing students in the field of engineering in a global context is the focus of the study. This seems to be the key for a successful economy and to secure welfare for the society in general. To fulfill this, the focus most orient to the quality of education in engineering fields. To find the ways how to grow the performing of teaching and learning in the context of these fields is essential. The developing of technology did not influence just the economic context, but also the ways of teaching and learning. Its integration in these two processes has contributed in the transformation of teaching and learning, from the traditional way. Technology components of information and communication have offered new ways not only for teaching, but also for learning and one of them is the offering of the visualized way of teaching and learning. Visual learning is essential in the engineering fields. The students of engineering disciplines learn for different

engineering analyses. The use of visualization methods in teaching and learning offers good possibilities for new ways to solve the problems, new ways of thinking and improvement of education and science practice and engineering (McGrath & Brown, 2005, 56-63). During the last decades the visualization was just in the formation 2D, static, without having possibility for any animation, today thanks different software's and with the use of computer system the work can present in a format 3D and with animations, which helps a lot in increasing of quality of teaching and learning. Tools for visualization usually are used to grow the motivation aspect of the courses. Such a tools offers animations, the view or visual part, sounds, and interactivity, to activate or promote some different styles of learning which supports the attitude of student. The visualization is an effective help of learning, and like it offers an external memory to study of doing duties and offering of help for students to understand the learning concepts in the lectures (Myller et al, 2007,43-49). Moreover in this paper will be presented the effects of use of visualization in the process of teaching and learning, in the field of subject 'computer skills' in the Faculty of Electric and Computer Engineering at the University of Pristina. Also it helps in the encouraging of students for an analytic access for different science problems.

Visual Teaching

As a global community we are moving from a time period where our way of seeing of the world was predominated from produce language and itself the produce. While now the idea aspect for information and communication forms our discourse. In another side it cannot be ignored the fact that today's students are generation that are visualized simulates to learn. And this is for the reason that they are grown in a world oriented visualized, with the use of computer, Internet and different software, which in the same time have educate and entertained. So, these students should offer knowledge throw the visual way, with strategy of active learning (Gangwer, 2015,4). Visual teaching is a style of teaching in which ideas, concepts, the data and other information are linked with the image and the use of different software for simulation and their illustrative presentation. All of this cannot be achieved using just a textbook and a traditional lecturing environment. It is important to integrate advanced educational technologies tools, such as interactive simulations and visualizations into the teaching process. As examples: through animations/visualizations, electrical engineering students can visually observe the performance of different types of modulators and demodulators; thus enabling them to deeply understand the characteristics of the communication components, also in computer science, interactive visualization has become a recognized branch of knowledge that studies how human-computer interaction create graphic illustrations of information efficiently (Nguyen & Khoo, 2009,1-7). The Integration of the educational technologies in the process of teaching and visual teaching have a positive influence in the motivation students to learn, grow the level of learning, and even help effectively manage large classes while supporting the teacher as facilitator (Kurtis, 2003, 295-299). When teachers incorporate visual simulations of real-life scenarios into their classroom activities, students participate more and have a more satisfying learning

experience (Duran, et al., 2007,55-73). However we must have more attention also the selected visual instruments, they should select on accordance with the course material, which have to use.

Visual learning

Visual learning is a learning style where the learner better understands and retains information when ideas, words and concepts are associated with: images, illustrative animations, simulations, or further explanations with visualizations. It is one of the three basic types of learning styles in the widely used Fleming (Fleming, 2001, 1-121) VAK/VARK model that also includes kinesthetic learning and auditory learning. According to Felder (Felder, 1988, 674-681), most engineering students are visual, sensory, inductive and active learners (while some of the most creative students are global learners).

Visual learning appears to be the preferred mode of learning for most people and was and it is the preferred mode for engineering students (Felder & Brent, 2005, 57-72). In this context visual learning can be incorporated into engineering education in a variety of ways and as a result to have these benefits for students: open up new ways of problem solving, provide new ways to think about science and engineering, and simulating and increase the critical thinking. An important benefit from a visual approach to science and engineering is better communication, which provides for scientists and engineers a communication more complex and more subtle concepts to each other and to students. Also, visual approaches to learning can engage the student more fully in the ideas. Visual thinking is needed in order to create the collaborative learning methodologies and enhance the distance learning environments that are crucial to the future of learning (McGrath & Brown, 2005, 56-63).

Materials and methods

To fulfill this research have been used mixed methods: quantitative and qualitative ones. Also it has been reviewed a relevant literature to conduct this study. These study methods consist in a quality analyses and quantitative of the effect of use of the visualization in the teaching process and learning in the engineer fields, and the encouragement of teachers and students to use a visual methods for teaching and learning. The data are taken from the narrative reports of teachers and the interviewed students, from the statistic report and from the questioners.

The research is realized with 15 teachers from the different departments of the FECE and 65 students from the department of telecommunication, who took part in two lectures. First was developed without the use of visualization and the second with the use of visualization/simulation. To realize the research have been created two questioners: one for teachers and one for students. As main instrument through which are taken details, and opinions from teachers and the students. Questioners have been created in three parts. First part of the questioner contained demographic questions, in the second part students and teachers have to answer in three questions, to write the answers, in that way to have their comments and opinions about the

visual method of teaching practically of learning. The third part of the questioners contained the questions about the effect of use of the visualization learning of students, concretely in the increase of performance of teaching in general. The people in this survey answered in these questions using an average from 5-points. Points in scale were labeled as: "Fully agree", "agree", "neutral", "disagree" and "strongly disagree". Finally, ethical processes throughout the process of research were used and respected general rules in relation to the respondents.

Data analyses and 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 and academic staff are presented in Tables I and II.

Table I . The demographic characteristics of academic staff

Table I . The demographic characteristics of academic staff				Table II. The demographic characteristics of Students			
		N	%			Nr	%
Gender	Males	12	80	Gender	Males	30	46.15
	Females	3	20		Females	35	53.85
Age	25-30 years old	0	0	Age	18-21 years old	60	92.30
	31-45 years old	9	60		22-25 years old	5	7.70
	Over 45 years old	6	40		over 25 years old	0	0
Nationality	Kosovar	15	100	Nationality	Kosovar	63	98
	Others	0	0		Others	2	2
The level on which holds lessons	Bachelor	5	33	Level of studies	Bachelor	65	100
	Master	9	60		Master	0	0
	PhD	1	7	Department	Computer engineering	0	0
Department	Computer engineering	6	40.00		Telecommunication	65	100
	Telecommunication	4	26.67		Electronics	0	0
	Electronics	1	6.67		Automatics	0	0
	Automatics	1	6.67		Industrial Electroenergetic	0	0
	Industrial Electroenergetic	2	13.33		Electroenergetic systems	0	0
	Electroenergetic systems	1	6.67		Years study	I year	0
Work experience	Less than 5 years	0	0	II year		65	100
	5-10 years	2	13.33	III year		0	0
	11-15 years	5	33.33				
	Over 15 years	8	53.34				

Table II. The demographic characteristics of Students

To get the opinion of students and the academic staff on the impact of the integration of new educational technologies in teaching and learning, both respondents answered to some questions. The table III has presented the students' perceptions, while table IV those of the academic staff.

Table III. Results of questions about the effect of Integrating Visualization 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%

Table III. Results of questions about the effect of Integrating Visualization in teaching and learning -perspective of students

Table IV. Results of questions about the effect of Integrating Visualization in teaching and learning -perspective of academic staff.

Based on the results presented on the two tables, it is noted that both students and academic staff believe that the integration of visualization has positive effects in raising the performance of the learning and teaching.

On the other side also the answers that were given to students and teachers, in the first questions of the questioner, resulted in the same manner. 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 understand the abstract concepts" (Student 125431). Moreover a teacher noted "visualization/simulation showed an easier way of transmitting the information to students and also have made the subject more interesting, simpler and practicable" (Teacher 134561).

	Fully agree	Agree	Neutral	Disagree	Fully disagree
Improves teaching and learning	73%	27%	0%	0%	0%
Increase critical thinking skill among students	33%	60%	7%	0%	0%
Increase students participation and their interest to participate in discussion in classes	47%	53%	0%	0%	0%
Promote cooperation among students	40%	53%	7%	0%	0%
Increase communication and interpersonal skills of students	27%	46%	20%	0%	7%
Motivate students to deal with learning activities	27%	66%	7%	0%	0%
Increase cooperation among teachers and students	40%	47%	13%	0%	0%
Facilitates and makes more attractive teaching	80%	20%	0%	0%	0%

To see the students perception about the use of interactive visualizations/simulations as learning tools and their effect for helping students to deeply understand abstract and highly abstract engineering subjects in engineering courses, and development of their communicative abilities, the interactive visualization 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.

Effect	Visualization/Simulations	Whiteboard
It makes the teaching content and distribute material through teaching easier and more understandable	85%	15%
It helps students in learning and remembering information easily	90%	10%
Increase student's interest	75%	25%
It reduces communication between the teacher and student	10%	90%
It increases possibility of cooperation amongst the intake and offers exchange of ideas	95%	5%
It makes the distributed material during teaching lessons easier and more understandable	90%	10%
It increases creativity	98%	2%

The obtained results from this research have highlighted the positive impact that comes from the use of interactive visualizations/simulations as teaching and learning tools. It is just for the sake of improving teaching and increasing students' learning.

Conclusion

From the results of this research, it become clear that the integration of visualization in the process of teaching and learning has a positive influence in increasing the teaching performance and growing of learning students in the engineering fields. The visualizations provide dynamic representations of knowledge and improve accessibility of instructional materials because the learning objects provide an alternative to text. The interactive approach enables students with different learning styles to comprehend theoretical constructs and apply them in a grounded practice. Also the visualization gives the ability to the students to improve the communication as an important component for the job market. From all of this it can be concluded that visual teaching and learning is very important for the engineering fields, based in the fact that the nature of the engineering courses is mostly abstract and asks forms for its concretization. In this sense, visual teaching and learning is the key to realize this concretization.

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