Evaluation of a Queuing Theory and Systems Modeling Course Based on UML

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Abstract

This paper presents how a new teaching method in the way that a queuing theory and systems modeling or simulation course can be done, was evaluated by the teachers and the students that attended the course and answered a questionnaire. This course is based on the use of Unified Modeling Language (UML) as the mean to teach modeling of discrete event systems such as queues and networks and not on Mathematics that sometimes is too difficult for students to understand.

1. Introduction

Our emphasis in this paper is to present how students confront our teaching method and the experience that was obtained by us. The teaching method is implemented on a queuing theory and queuing systems modeling and simulation course and is based on the use of UML [1], [2]. Our aim is to release students from the problems arisen by the use of mathematical model such as the demand of very good knowledge of mathematics like Probabilities Theory and Stochastic Processes or the high level of difficulty to model some types of queues. In addition, the transition from modeling to simulation adopting object oriented techniques is much easier using UML. The course was presented to second year's students of Department of Applied Informatics, who combine knowledge of informatics (object oriented techniques) and economics. Actually this paper presents the continuity of our efforts to change the teaching method in a queuing theory modeling and simulation course [3], [4]. After two years of implementation of our ideas we wanted to see the impact of these efforts on students from their point of view. Therefore, their opinion about the new method was asked through a questionnaire.

2. Course Schedule

In the beginning of the course the basic concepts of queuing theory are presented [5], [6], [7], [8]. Continuing, a short presentation of UML diagram types and their characteristics is necessary. [9], [10], [11]. Afterwards, class, activities, state and sequence diagrams are used to show how a system can be modeled using UML. Finally students are asked to model the M/M/1 queue (M stands for Markovian or memoryless (exponential)) and to develop an application that simulates it. They can use any object oriented programming language such as Java or C++. The aim of this laboratory assignment is to evaluate students' understanding of the course and see how they can pass from process modeling to simulation

3. Evaluation of the Teaching Method

From our side we believe that using UML to model not only queues and networks but any system gives a good understanding about the system properties and the interaction between its parts. Therefore students obtain the appropriate knowledge easily and without facing problems with the high level of mathematics that is required. Beyond the teaching process we consider that is easier for students to develop all the classes, that the system consists of and create an integrated application.

Our opinion about the way that the course was implemented is definitely influenced by our perceptions and beliefs. In order to obtain a more integrated feedback, a questionnaire was given to 81 students. Therefore, we had the opportunity to work out their answers and see how they evaluate our innovative teaching method.

Before the questionnaire, the equations of the mathematical model for M/M/1 queue were presented to students. We did that because we want them to be

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able to compare the mathematical model and the way that a queuing theory course was implemented before, with our teaching method.

The first four questions aimed to see how students deal with the theoretical part of the course.

Disagree				Agree
1	2	3	4	5
5	29	23	22	2

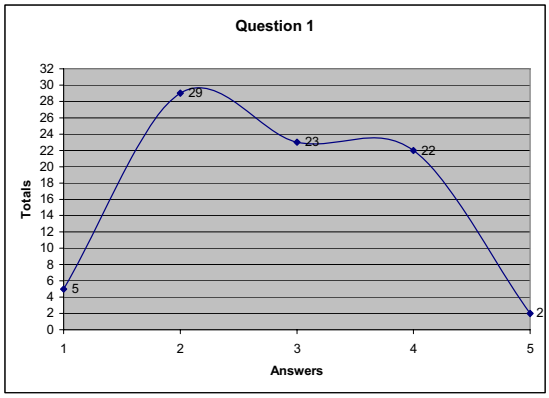

Figure 1. Question 1: It is not difficult to model systems using queuing theory mathematical model.

Disagree				Agree
1	2	3	4	5
		2	39	40

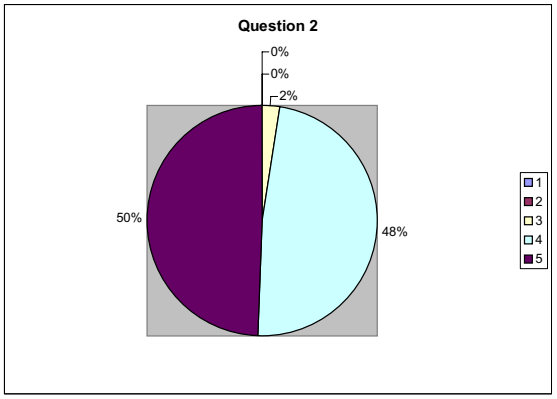

Figure 2. Question 2: UML helps in understanding queuing theory.

It is obvious that students recognize that using UML compare to mathematics, is a better and easier way to model and understand queuing systems

In addition diagram in Figure 3 shows that students consider that there is not any loss of information when a system is modeled using UML and that there is not any problem understanding queuing theory concepts. They also strongly believe (Figure 4) that the connection and the interaction between a system's parts, is better presented by UML. Actually this question is very important for us, because a critical part of the teaching method relies in this concept.

Disagree				Agree
1	2	3	4	5
20	46	9	6	

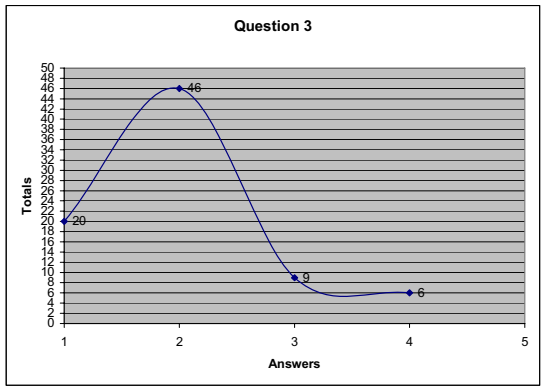

Figure 3. Question 3: There is a loss of information and there is a problem to understand queuing theory concepts when a system is modeled by UML.

Mathematics				UML
1	2	3	4	5
1	4	7	27	42

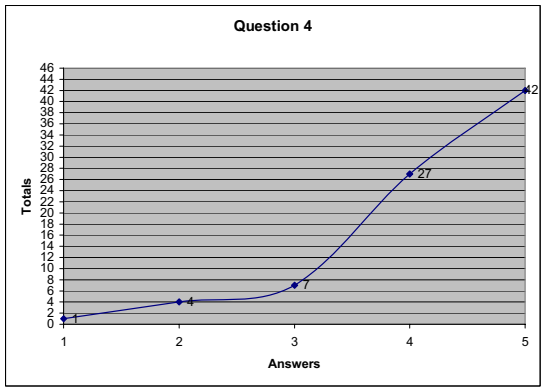

Figure 4. Question 4: Connection and interaction between the parts or objects of a system is presented better by mathematics or by UML

Mathematics				UML
1	2	3	4	5
1		3	31	46

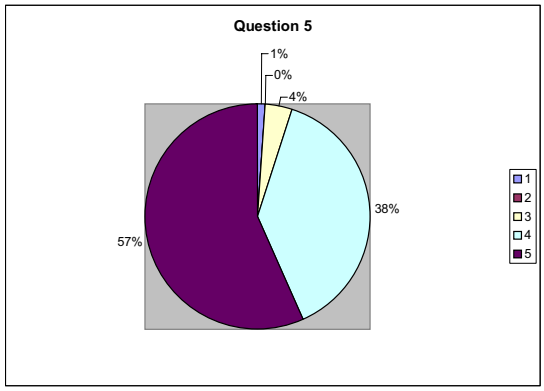

Figure 5. Question 5: Would you prefer to use UML or Mathematics, as basis in order to create simulation software

The above question (Figure 5) shows that students strongly believe that UML is better tool to design and develop software simulation for queuing systems. Students developed simulation software in the lab using the mathematical model in the beginning and using UML afterwards. Thus, they were able to see the differences and understand what method is more suitable for developing software.

Since our department of Applied Informatics has a lot of economic courses we wanted to see what students' opinion is about modeling an economic system.

Mathematics				UML
1	2	3	4	5
2	8	15	34	22

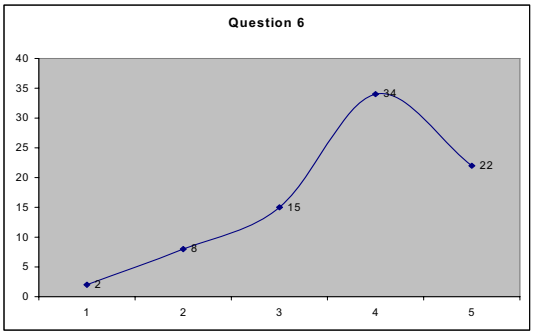

Figure 6. Question 6: An economic model can be modeled and simulated better by the equations of the mathematical model or by UML diagrams.

It is obvious from the above diagram that students believe that UML and queuing theory can easily combined to model economic systems.

The last question that is presented in this paper was about students' opinion about the course schedule.

Mathematics				UML
1	2	3	4	5
3	4	16	38	20

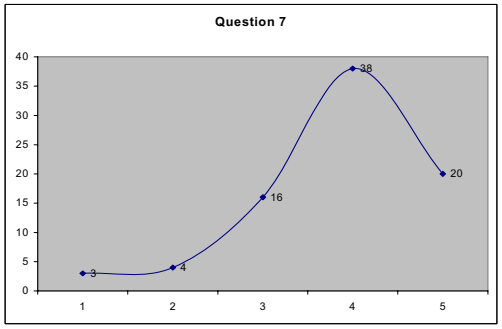

Figure 7. Question 7: Do you prefer a course about queuing theory based in mathematics or in UML.

From the above diagram we came in conclusion that students would like to see some mathematical equations from queuing theory. On the other hand it seems that they believe it is better to hide the high level mathematical equations and focus on UML diagrams.

4. Conclusion and Future Work

The outcomes from the questionnaire were really encouraging to continue this transition from the mathematical model to UML, as a mean to teach queuing theory or systems. But we have to take under consideration that these outcomes are definitely influenced by the fact that students find diagrams always easier to understand or the fact that some of them did not understand all the details of the teaching process. These issues hopefully will be clarified in the following years.

Beyond the teaching process that has to be improved since we have much more experience, our aim is to develop a software tool that will be able to combine UML and object – oriented programming languages. This software will give the user the opportunity to design and model any queuing system such as networks, computer processors, and economic systems using UML. The tool then will produce simulation software in order to give results back to the user.

5. References

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