A New Approach to System Simulation & Modelling Laboratory

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Abstract— **Introducing System simulation and modelling course as well as laboratory in the curriculum of computer science and information science program is of great challenge. The course focuses more on discrete event system. In laboratory, experiments are conducted using simulation software tools like Flexsim® or Arena®, where discrete system are realized by modelling and simulating job manufacturing process. These tools fail to narrate computer science and engineering related environment.**

The feedback collected by student during academic year 2010-11 clearly shows that the course is not connected with the program, and they find tools used focuses more on mechanical manufacturing process. The students have strongly recommended eliminating this course from curriculum.

An attempt is made to address these issues in academic year 2011-12, by redesigning the laboratory content so as to bridge these gaps. The laboratory content is divided into two parts; A and B. The term works of Part A is simulation of system using Flexsim® tool, while Part B is designed with the objective that the student should be able to design and develop simulation tool for computer network or operating system domain by integrating emerging technology such as C# with .NET and OpenGL or Windows Presentation Form.

These new initiatives have resulted in better learn-ability among students, as well as it has enhanced the skill to model and simulate a given system. The feedback collected during academic year 2011-12 reveals diminishing results. The students find this course more related to the program

Keywords— **System Simulation and Modelling, Discrete event system, Simulation tools, Integrating Technology**

I. INTRODUCTION

The recently designed curriculum of information science and engineering programme (ISE) at our college provides greater emphasis on design and project work. It emphasizes the need for independent thinking and encourages students to get involved in interesting and novel projects. During the process of curriculum design in the academic year 2007-08, Board of studies recommended introduction of System Simulation & Modelling (SSM) course at final year level. This course was new and first time introduced in the curriculum. Many of the staff members had reservation and were not convinced with the significance of this course. Even the reported literatures present the challenges in introducing this course [1-3]. The first batch under autonomy had chance to learn this course in the academic year 2010-11. The course was core subject as well as had laboratory component with it in 4-0-1 (L-T-P) pattern. The laboratory term works were designed in such a way that the technology required to solve them is by simulation software Flexsim® tool. The term works were more focused on discrete event system which shall be simulated through tools. The aspects like proper collection and analysis of data, the use of analytic techniques, verification and validation of models, and designing simulation experiments were not addressed.

On completion of course during academic year 2010-11, feed back from student was collected pertaining to teaching learning process. The results were in line with the views of some of the staff members who had reservations. Around 72% of students expressed in-adequacy of course for information science and engineering programme. Around 65% students felt that the used simulation software tool doesn't provide the simulation environment to narrate computer science related experiments. Basically the students were trying to visualize operating system, computer network, distributed system etc. To summarize; the students expressed to eliminate the system simulation and modelling course from the information science and engineering programme.

In order to address the issues a strategic plan is designed by referring reported literatures [4-7], newly designed plan is implemented. The laboratory course learning objectives were re-defined. The assessment criteria as well as plan of work were re- defined. However some challenges were faced while

implementing the new plan. But those were addressed by combining different technology innovatively. The feedback collected after completion of course depicts considerable appreciation towards the course. The course learning objective, strategic plan and assessment criteria are presented in the next section.

II. STRATEGIC PLAN

The thought process to address the issues started one month before the commencement of semester. The faculty focussed to address the issue of bringing relevancy of system simulation and modelling course to the information science & engineering programme as well as designing the term works so that simulation provides feel of concepts of computer science[11] related scenarios. First the abstract level lab plan was designed, where the proposed lab plan composed of two parts A and B. The Part A , having term works based on discrete even system and shall be worked by using simulation software Flexsim®. Where as the Part B was designed keeping in mind the objective that the student should be able design and develop simulation tool which simulates process of Computer network or Operating system concepts. The Table I presents comparison of abstract level lab plan for the academic year 2010-11 and 2011-12.

TABLE I

COMPARISON OF ABSTRACT LEVEL LAB PLAN FOR THE LAST ACADEMIC YEARS

Academic year 2010-11	**Academic year 2011-12**
Introduction	**Part A**
Simulation of single server	Simulation of single server
Simulation of Multiple server	Simulation of Multiple server
Simulation of Dump Truck Problem	Simulation of Dump Truck Problem
Simulation of DES-1	**Part B**
Simulation of DES-2	Problem Statement and Requirement Collection
Simulation of DES-3	Design & Plan of action
:	Activity 1
:	Activity 2
Simulation of DES-6	Activity 3
Open End Experiment	Demonstration of Simulation tool developed

Once the abstract level lab plan was ready the next task was to freeze detail (micro level) lab plan conveying the expectations very clearly. The students were encouraged to form a group of 4, and identify the scenario related to computer network or operating system which shall be better analysed by simulating the process and quote the same thing as problem statement in the first slot of Part B.

Once the problem statement was approved by the committee the students were asked to collect the detailed requirements of the system and propose the future work plan. Here it was observed that different teams had different work plan. And at the end of 6th slot students were expected to deploy the tool developed and demonstrate the working, features and capability of simulation software developed. The students were assessed continuously based on deliverables as mentioned in Table 2. The strategic plan can be summarized as shown in Figure 1 which clearly shows the processes involved.

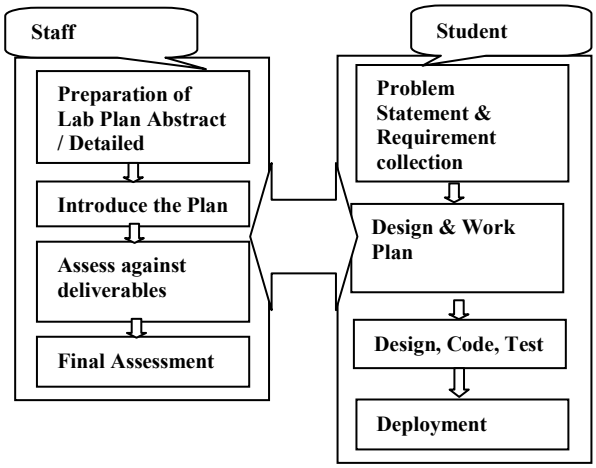

Fig. 1 Strategic Plan for new approach

The major challenge which was faced was to decide platform for the development of simulation tool. The simulation software tool Flexsim® what used in laboratory was the most powerful tool for modelling, analysing, visualizing, and optimizing any imaginable process - from manufacturing to supply chains, abstract examples to real world systems, and anything in between. Now it was asked for students to develop their own simulation tool. But expecting the tool such as the well established one like Flexsim® or Arena® is too ambitious. Hence the next task was to decide on technology. The technology which shall be explored were unlimited.

It starts with Microsoft Visual C++. This is most favoured development tool as Microsoft Windows is currently the most widely used operating system. C++ allows the developer to apply objected oriented programming. It also produces very fast and portable (re-usable) code. Among other alternative possibilities one is Java applications which is the Java language & is closely related to C++, but runs on a "virtual machine" that is available for different operating systems. So, a single version of the software can run under all popular operating systems. Other single source to multiple platform development tools are emerging, and will be popular with developers and second alternative is Internet applications which can be run on the user's machine (client side) and on the computer hosting the web site (server side) . But after lots of deliberation we found out C# with .NET technology along with OpenGL or Windows Presentation forms would be more appropriate.

Slot No.	Phases	Activity	Evaluation parameters	Deliverable by student
1	Problem Statement & Requirement Presentation	Identify and define a problem Requirement specification and Platform (Developing environment)	Features identified , List of entities/ blocks, GUI design, Level of understanding the requirements, Animation giving feel of simulation	PPT should include: • Problem definition. • System model with appropriate animation giving feel of simulation. • Features of Simulation tool. • List of entities / blocks. • Diagram of expected GUI.
2	Design of modules	Identifying modules within system and designing the module	Identifying various functions, classes, algorithms.	Class definitions of each module Explanation about the interaction between the classes identified Parameters passed. Snippet of Coding done for GUI
3	Coding -1	Coding of individual modules	Coding of respective modules	Working of individual modules
4	Coding -2	Integrating the modules and fixing the errors.	Level of working of integrated modules Analysing the results obtained to check for correctness. Performance analysis	Working of integrated system. Performance analysis
5	Demonstration of tool	Execute and Demonstrate the complete working Project.	Design of finally obtained GUI.	.exe file Mapping of developed GUI with proposed GUI Smooth Working of tool

III. Result & Discussions

In order to assess whether the course has met stated outcome, various reports are reviewed [8-10] & finally the feedback was collected so as to measure the relevance of SSM subject and lab for ISE Course by the innovativeness brought in lab by introducing the Part B. The process of taking feedback was scheduled in the last lab slot of every batch (A1,A2,B1,B2). The questionnaires were framed concentrating on core problems of relevance of subject learnability. The Table II below shows the feedback questionnaire.

TABLE II
FEEDBACK FORM

Q1How do you rate the relevance of subject to curriculum a) Very Relevant b) Relevant c) OK d) Not relevant
Q2 To what extent did the term works of part A has helped to develop DES in part B a. Great Extent b. Good c. Average d. Not Helped
Q3has the lab helped you to imbibe self learning? a. Great Extent b. Good c. Average d. Not Helped
Q4 How do you rate learnability 1 to 10 1-poor learnability 10-max learnability
Q5 How do you rate your ability for any given system, visualizing its model and applying simulation concepts in the scale of 1 to 10. 1-poor learnability 10-max learnability

The feedback results of every batch were satisfactory. The graph of every question answered by each batch gives a clear picture.

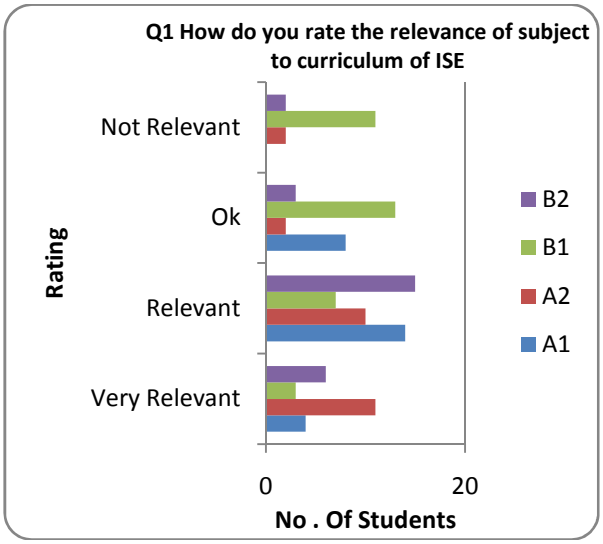

Fig.2 Bar graph of each batch with respect to relevance of subject

The graph was plotted against the number of students response of each batch for relevance of subject to curriculum of ISE .Its observed from the graph that batches A1 and A2 find it relevant but however one batch finds its irrelevant ,since the majority of students inclined their response towards relevant and very relevant, the success rate can be taken above 50 percent. In similar manner the response of each batch with respect to questions is plotted.

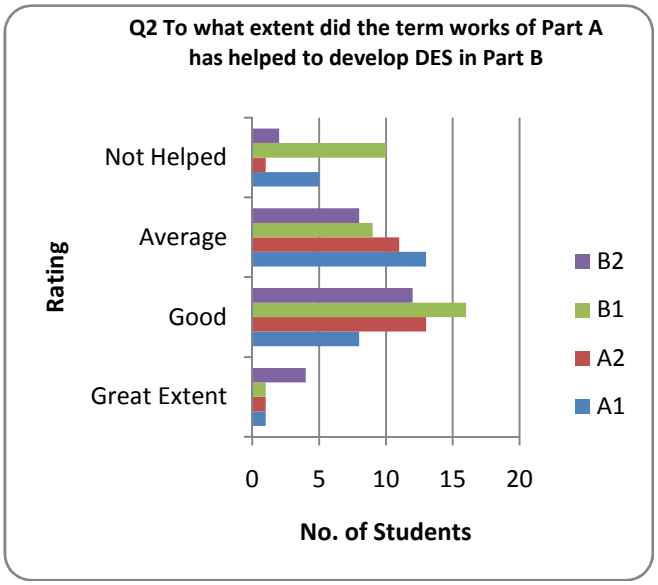

Fig 3. Bar graph showing distribution of term work of Part A helped in developing DES in Part B.

The Fig 3 depicts that rating is much concentrated on good an average ,which exhibits the fact that term work carried in Part A has helped students to contribute in developing simulation tool in Part B.

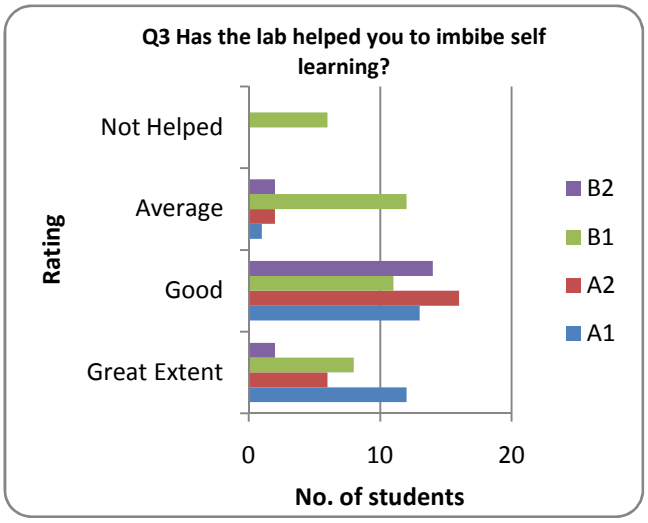

Fig 4.Bar graph depicting the self learning

The Fig 4 clearly shows the lab is successful as far as self leaning is concerned.

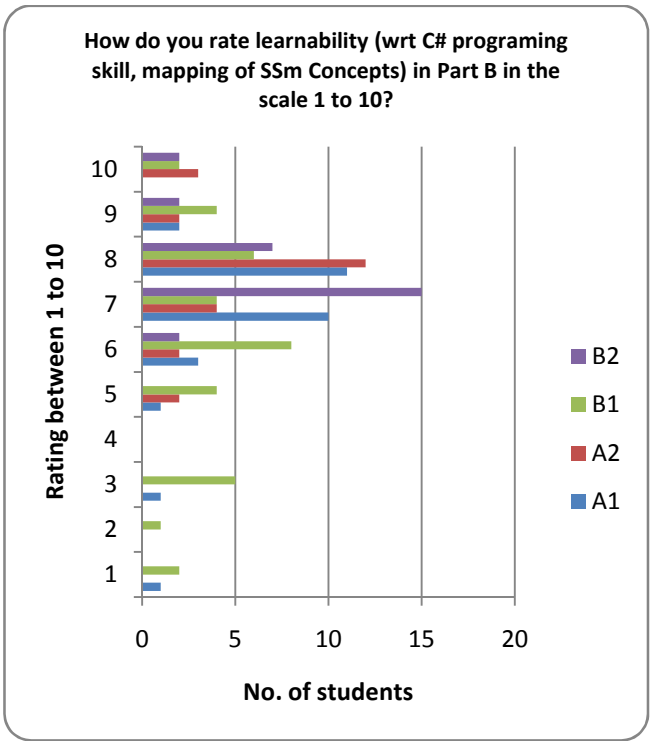

Fig 5 Bar graph depicting the learnability happened in lab

The Fig 5. refers to the learnability happened with respect to the language used for implementing tool in accordance with mapping of SSM concepts .It can be observed from graph that a rating between 7 to 10 is highly concentrated for learnability

From the Fig 6, its observed that an ability of any student with respect to visualizing any model and mapping SSM Concepts is between a rating of 7 to 10 is deeply concentrated, nothing but on an average an 8 of 10 rating can be considered which itself is great success for any lab which imbibes and cultivates the art of thinking of student to the level where he has the ability to visualize a system.

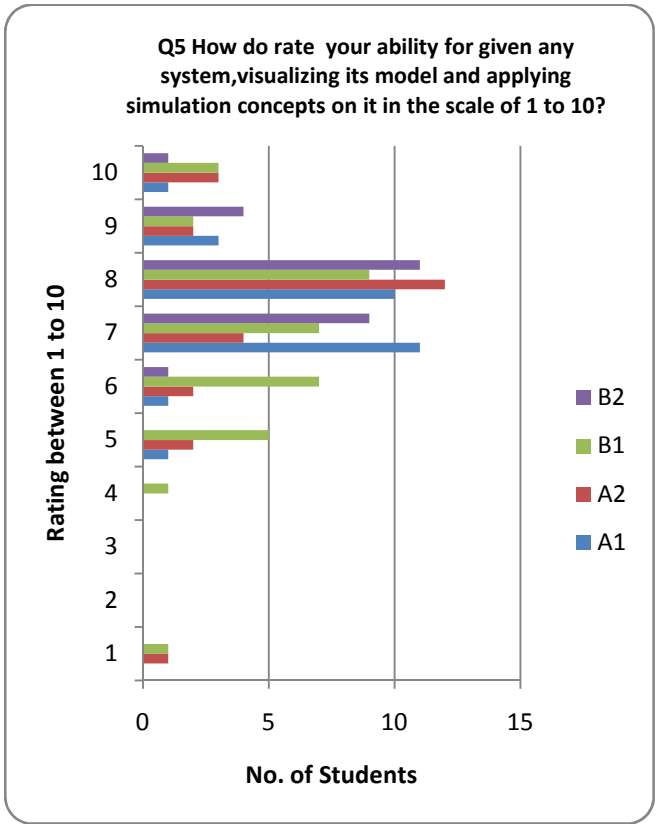

Fig 6. Bar graph showing the distribution of rating for visualising any simulation model by applying simulation concepts.

IV. Conclusions

The course System Simulation and Modeling which was observed with lots of reservations and students with mindset of non relevancy of this subject to the curriculum of information science & engineering till academic year 2010-11 was overcome to considerable extent in the academic year 2011-12 by the new approaches followed by integrating C# with .NET technology with Windows Presentation Form. The results of student feedback as well as performance in continuous internal evaluation reveal that course is appealing to student community and finding its relevance to the information science and engineering curriculum.

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