Innovative teaching practice on “software engineering laboratory course”

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Abstract. Teaching software engineering is very difficult because it includes theory and practical approach. Applying the theoretical knowledge is very complex. At the same time theory can’t be understood without applying. In this paper, we present an innovative teaching practice on the course “Software Engineering Practical” by which students will have a practical knowledge. We use different teaching steps and software tools to build an interactive lab atmosphere for the students to learn, recognize and understand the concepts of software engineering.

Keywords: Document Review, Presentation, learning management system (LMS), Mentoring, Evaluating [10] Case Study

1. Introduction
Software Engineering Practical course is a very important main core course for computer science and Engineering. According to course objectives and outcomes and industry requirements, this course mainly encourages student skill set in software project development and maintenance of traditional approaches and methods and new development and maintenance approaches and methods[2],[15,16] Student required learning these skills and becoming a software engineer need to apply in the job role daily activities as a part of the project development. Student can be able to understand analyze different methods, to collect requirements, analyze the requirements, apply suitable process model, design principles need to follow for effective design, generate a minimum number of essential test cases to test the system functionality, preparation of different kinds of documents like training, help, requirement, design, coding, testing, maintenance documents, etc.[19,20].

Incorporating these skills in students is a very tedious process, we need perfect planning and implementation based on the student ability skill and availability of time and resources. Improved innovation teaching practical course methods to solve problems exist in the traditional teaching software engineering practical course [1].

2. Existing approaches
[13]Teaching Research and Innovative Practice on the Course "Software Engineering" Yehong Han suggested task-driven method for Software Engineering laboratory course. He recommended some of
the assessment methods to assess the students. At the end of the course student needs to submit the software engineering project. Instructor will perform the acceptance test to evaluate the student submitted project. This process will improve the subject understanding step by step and analysis capability and project implementation capability.

[14] Topic: Innovative Teaching of Software Engineering: Practical Approach with Labs by Prof Suthikshn Kumar creative way to deal with training the Software Engineering which gives a pragmatic hands on experience for the understudies. We utilize a few financially accessible and open sources programming to make an intuitive lab condition for the understudies to learn, comprehend and value the ideas of programming designing. The members will be needed to do hands on with these lab modules, with the coordinators giving the lab offices. Part more arrangement is required from the educator in setting up the lab meetings, pretends, tests and riddles and so forth. The additional exertion repays with huge improvement in understudy learning.

2.1 Summary of existing methods:

[13,14]The process of software engineering practical course involves the following series of steps.

   i. Forming a group
   ii. Assigning a task to each group
   iii. Reviewing group work
   iv. Mentoring or facilitator for the group
   v. Evaluating the group task

In the traditional approach, there are no particular rules for the above-said series of steps. There is no reasonable constraint for forming a batch who should be members of a group. There are no rubrics for evaluating the group task and effective review process. Time management is very important in this course. How to avoid plagiarism in solving the given task and preparation of documents is also very important[3]. Student has to actively participate, analyze and apply all the required software engineering principles.

3. Proposed method

[10]The software engineering practical course is a vital course for computer science and engineering students.[8,11] It is very important that incorporating the required knowledge and analysis skills in students. The proposed method describes the innovative teaching methodology for the software engineering practical course. Using the proposed method student will gain teamwork, communication, creative, problem-solving, analysis, and presentation skills. The proposed method is used 36 hours per semester, a continuation of 3 hours per week. The proposed method is a more interactive and brainstorming session, with this approach students will learn software engineering principles and able to build effective software engineering development and maintenance[12].

3.1 Steps for proposed method

The proposed method Innovative teaching Practice on software Engineering laboratory course has the following sequence of steps.

   i. Forming a group
   ii. Assigning a task to each group
   iii. Reviewing group work
   iv. Mentoring group
   v. Intergroup review process
   vi. Updating Intergroup remarks and preparing documents
vii. Class Review/Online quiz
viii. Updating class review remarks
ix. Evaluating the group task

At the end of this course, students need to submit a given case study documentation and PowerPoint presentation soft copy and hard copy to the department.

3.2 Course material planning
[19] In before the course start, the course plan is prepared. The course plan contained, course objectives and outcomes, each topic learning outcome, constraints for forming batch, list of case studies, rubrics for evaluation, and time allotment for each activity within the given semester schedule. It also includes teaching material, sample case studies, additional resources, and web links[4].

Before to start the practical course the prepared course plan (schedule of the course), course material and prerequisites like Software tools, learning management tools for the course and assignment and quiz topics, its schedule and rubrics, and continue evaluation process and its rubrics are also given to the students before the start of course[6,7].

3.3. Teaching practice implementation
This section will describe the implementation of the innovative teaching practice on software engineering practices[20].

3.3.1 Forming a group
The group formation will play an important role. I used a pre-assessment test for forming a group.[5] Before the start of the course conducted a pre-assessment test with 30 multiple questions of analysis, problem-solving, ethical, intrapersonal and interpersonal skill related. [17] Evaluated and prepared the result analysis report of 3 categories based on their scores shown in table 1 categories of pre-assessment for forming batch[21,22,23].

| S.No | Category score constraint | List of Students H.TNo |
|------|--------------------------|------------------------|
| 1    | 1-10                     | 1,2, 9, 11,14, 17,18, 19,20, 23, 30,31, 34, 39,40,41,50 |
| 2    | 11-20                    | 3,4,7,8, 12,13, 21,22,26,28,29, 32,33 44,45,46,47 |
| 3    | 21-30                    | 5,6, 10, 15,16, 24,25, 27, 35,36,37,38, 42,43, 48,49 |

Distribute equally to the above category people in each group. Each group size is 3 members. For example, group1 three members are from 1-10, 10-20, 21-30 categories respectively. Each group is having equal knowledge level members.

3.3.2 Assigning a case study to group
Assigning a topic to a group should be unique and it should be favorable to the group. The group would be willing to work on the given case study. To avoid copying each group wouldn’t have duplicate case studies and wouldn’t available in the internet resource.

A list of unique case study topics is prepared and given to the student group for selection. An option is given to the student to select from this list or group may also choose their case study.

3.3.3 Reviewing group case study progress:
The practical course has the contents requirement preparation, designing UML models, implementation, designing frontend, test cases, and Documentation. Every day during the lab session, one activity from the lab schedule is given as an assignment.

The 3 hours (180 minutes) lab time is distributed as in the table 2 schedule of software engineering practical course 3 hours.

| S.No | Activity                                                                 | Time in minutes |
|------|--------------------------------------------------------------------------|-----------------|
| 1    | demonstration and presenting example case studies                        | 30              |
| 2    | prepare solution for the given assignment                                | 30              |
| 3    | Intergroup review process                                                | 30              |
| 4    | Updating Intergroup review remarks and preparing documentation and presentation | 40              |
| 5    | Class Review/Online quiz                                                | 40              |
| 6    | Updating class review remarks                                            | 10              |
|      | **Total Minutes**                                                        | **180**         |

3.3.4 Mentoring group
The teacher should be playing the roles of facilitator and monitor the group members how they are participating in intergroup and intragroup, resolve the conflicts, and guide and path maker. Observe the participation of members in the group. In practical lab sessions, student strength is 25 for batch1 and 25 for batch2. So each lab session has 8 groups. Each faculty monitors 3 groups. 3 faculty are allotted for practical course. Table 3 is representing the faculty mentoring for batches in one session.

| S. No | Faculty | Batches |
|-------|---------|---------|
### 3.3.5 Intergroup review process

Preparing solution with the help of intergroup members and faculty mentor. Review is an important step in the software engineering process. Review is the process of presenting the solution to the peer group and note down the remarks made by the peer group. The review process enhances interpersonal skills, presentation skills, analysis skills, problem-solving skills, etc... In this process, each group interacts at most with the other two groups. For example, group1 is interacting with group4, group1 member is presenting a respective case study to group4, similarly, at the same time group 4 will present their respective case study to group1. In one interaction both the groups are learning one more case study in addition to their case study.

One group interacts with another group for 15 minutes, a total of 30 minutes is allotted for the intergroup review process.

### 3.3.6 Updating intergroup remarks and preparing documents

Update the remarks made in the intergroup review process and also prepare the documentation and PowerPoint presentation.

Use the software tool star UML or any other design tool supports given activity to prepare the solution and prepare the documentation. Time allotted for updating of remarks and preparing documents is 40 minutes.

### 3.3.7 Class Review/Online quiz:

After updating the intergroup remarks, preparing solutions and documents, each group will present to all groups using an LCD projector, in this process, every group will learn all other groups’ case studies in addition to their case study. This is the second review process with this approach most of the faults or missing things are identified.

And online quiz with 6 questions will be conducted in every lab using a learning management system (LMS). The results will be announced immediately on the next day of the lab.

The total time allotted for this process is 40 minutes.

### 3.3.8 Updating class review remarks

Update the remarks made in the class review process during the Presentation of each group in the class using an LCD projector. Updates need to be done in solution, word document, and PowerPoint document[10].

### 3.3.9 Evaluating the group task and Results

Continue evaluation needs to be done in every lab session based on student participation, solution of given case study assignment, quiz, document preparation, and Presentation. For each evaluation parameter given a rating between 1-5 scale based on the performance. The final total score will be scaled to given Practical course total internal marks [11].
Evaluation is done based on the accepting test. If the designed system and documentation is fulfilling the functionalities of user requirement or given case study requirements.

The following table 4 represented the result of the proposed innovative teaching practice on software engineering practical course. The total no. of students is 50.

**Table 4. Result of the proposed innovative teaching practice**

| S.NO | Final practical marks in % | No. of Students |
|------|---------------------------|-----------------|
| 1    | Greater than 90%          | 45              |
| 2    | Between 70% and 89%       | 4               |
| 3    | Between 69% and 59%       | 1               |

This approach is given 98% of accuracy, the majority of the students scored more than 90% of marks. With this approach, students could be able to solve any real-time problem; he is geared on the majority of the software engineering principles.

4. Results and discussions

The author proposed method compared with the task-driven method proposed by Yehong Han. The author implemented the two methods and made a comparison by evaluating student performance in terms of Assessments evaluation and course outcome. For evaluation considered 60 students from 3rd-year computer science and engineering students. The comparison results is specified in table 5 and Figure 1.

**Table 5. Comparison of proposed method and task-driven method proposed by yehong han**

| Metric                | Proposed method | task-driven method proposed by Yehong Han |
|-----------------------|-----------------|------------------------------------------|
| Assessments evaluation| 95.5%           | 83.4%                                    |
| course outcome        | 91%             | 80%                                      |
Figure 1. Comparison of proposed method and task-driven method proposed by Yehong Han

5. Conclusion

The software engineering practical course is very important for the computer science engineering student. Every computer science student needs to learn this subject. The theory can't able to illustrate practical exposure. So that more responsibility on the practical course to make awareness of analyzing and applying the software engineering principles for the development and maintenance of software projects.

The traditional software engineering practical training approach is not having much impact on student analysis skills. The proposed method is used to inculcate the knowledge of software engineering principles and applying in real-time problems. With this approach students able to solve any real-time problem. Student is getting more exposure to learn creativity, problem-solving, leadership, and communication and presentation skills. The author’s proposed method is given 95% performance in comparison with the existing task-driven method.
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