



## **Student feedback and reflection for teaching effectiveness: A case study of teaching a course on statistical process control**

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### **ABSTRACT**

This paper presents a case study of an intervention carried out in a BE Mechanical Engineering class. It focuses on student feedback on their understanding & retention levels of a recently taught topic and the level of motivation for revising the topic at home. Low level of understanding, retention and motivation for self-study made the teacher reflect and modify his teaching method from deductive teaching to inductive teaching. Feedback taken after the intervention resulted in significant improvement. This experience of reflection, modification in teaching style and the resultant improvement brought a positive and extensive change in the teacher's understanding of the way today's students want to learn. The intervention included making a detailed lesson plan involving learning objectives, sequence of subtopics, teacher activities, student activities and recapitulation sessions. The class was engaged using the lesson plan. Feedback was then taken using a specially designed questionnaire that had multiple-choice questions. The students desired that the plotting of the control chart was taken up before a detailed coverage of the concepts and fundamentals. The teacher then reflected on the feedback and his own teaching style. Using Gibbs cycle for reflection, the teacher evolved an action plan after studying extensive literature on Inductive and Deductive teaching. The teacher made another lesson plan for the next lecture by incorporating the feedback, changing teaching method to predominantly Inductive teaching and conducted of the lecture. Feedback on the teaching of the new lecture was taken again using a specially designed questionnaire and analyzed. The response was compared with the response of the earlier lecture. A significant improvement in understanding, retention and motivation for self-study was observed.

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### **INTRODUCTION**

Teaching is to motivate, stimulate and guide students and make them life-long learners. A teacher's role is to effectively impart domain knowledge, skills and human values and make students independent and confident. A problem faced by a teacher about learning on the part of students, is a symptom for which a root cause always exists. Many a times, the solution lies with the teacher. Over the years, because of technological developments and IT revolution, learning behaviors of students have changed. A teacher has to bring about a corresponding change in his teaching and embrace technology.

Reflecting on the formal and informal feedback of students and making necessary corrections in teaching and student interface should be integral parts of a teachers approach. Today, the pace of technological change is such that anyone not bringing a commensurate change in teaching-learning methodologies will

cease to be an effective teacher. In the changed scenario, students have access to instructional materials online and their learning styles have considerably changed. They will be attracted to attend classes only if the teachers gives them something more than what they have access to and make learning in the classes more interesting and effective Exposure to new ways of teaching-learning and reflective cycles make teachers more inward looking and reflect more systematically and honestly. This paper presents a case study in which, with the pursuit to make continuous improvement, a teacher carried out a recapitulation session, three days after a lecture class and found many students with low understanding and retention of the topic. On systematic reflection using Gibbs Reflective cycle (Gibbs, 1988), the teacher realized that the reason of low retention was the lack of student involvement in teaching learning process (Souise, 2001). He felt that, for such a topic, he needed to start with generalization and applications and then move to specifics using an inductive approach (Shaffer, 1989; Haight, *et al* 2007; Joseph, 2014) and focus on student centered learning (Carlile & Jordon 2005; O'Neill, 2005). The teacher then brought about the necessary change in his teaching style that resulted in improvement in understanding and retention levels of the students.

## **THE STUDY RATIONALE**

A teacher delivered the first lecture on 'Control Charts for Variables', under the broad topic of 'Statistical Quality Control' on to a large class of more than 100 students in a normal classroom. In the beginning of the succeeding lecture after three days, the teacher conducted a brief recapitulation session. This exercise revealed that the students had a mixed level of comprehension and retention of the subject matter. Some students comprehended and retained completely while others did not. This revelation motivated the teacher to conduct this study, focused on preparing systematic lesson plans, taking formal feedback, reflection on the feedback and corrections in teaching of the next lecture class. Exposure on aspects of 'Reflection, 'Teaching large classes, 'Retention times', 'Outcome based education' and 'Learning by doing' from the New Directions Program at Thapar Institute of Engineering and Technology (TIET) also provided necessary motivation and framework to carry out this study.

## **METHODOLOGY**

The intervention included the following:

- Preparation of a detailed lesson plan for teaching a large class (Hess, 2001) that included learning objectives, sequence of subtopics, teacher activities, student activities and recapitulations.
- Conduct of class as per the above lesson plan.
- Preparation of a questionnaire with multiple-choice questions. Each question, as listed below, had four choices A, B, C and D with score of 4 to 1, respectively.
  - Did the students understand the lecture in the class?
  - Could they retain the subject matter until the time of the next lecture?
  - Did they revise the topic after the lecture or read the material to be covered in the next lecture?
  - Was the sequence of the sub-topics taught appropriate or needed a change?
- Administration of the questionnaire in the tutorial classes and collection of feedback. Forty-two students of the two tutorial groups gave feedback in a structured manner.
- Compilation of the feedback and analysis
- Drawing conclusions from the study. The students desired that the plotting of the chart be taken up before a detailed coverage of the concepts and fundamentals.

- Reflection on the teaching by the teacher as per Gibbs cycle (Gibbs, 1988) and evolving an action plan after studying extensive literature on Inductive and Deductive teaching.
- Preparing the lesson plan for the next lecture on 'p-charts' by incorporating feedback, changing teaching method to predominantly Inductive teaching and conduct of the lecture.
- Preparation of Questionnaire 2, taking feedback, analysis and its comparison with the earlier response.

## RESULTS and DISCUSSION

### Results of analysis of feedback of questionnaire 1

Table 1 presents the response of the students to various questions contained in questionnaire 1.

**Table 1: Response of the students**

Choice	Number of responses to questions			
	Question 1 Understanding of the topic	Question 2 Retention	Question 3 Revision after the class	Question 4 Sequence of topics
A	4	1	1	9
B	28	15	13	18
C	10	22	14	13
D	0	4	14	2

The results contained in table 1 depicts the following:

- Only four students out of 42 understood the topic completely. 28 understood 'up to a large extent' while 10 had a partial understanding. No student reported that he did not understand at all.
- About retention of the topic after three days, only one student reported complete retention. 15 students retained largely, 22 had partial retention while four students forgot almost everything.
- For retention of already understood topic and comprehending the next topic, it is necessary that the students revise the topic at home. Only one student reported that he/she revised the topic thoroughly, 13 students revised it partially, 14 had a cursory look and 14 students did not revise at all.
- Regarding the sequence of sub topics covered by the teacher in the class, 9 students out of 42 felt that the sequence of starting with concepts and theory and then moving on to plotting the charts was fine. Many students, (18) felt that concepts and theory should be taught after the students are acquainted with the charts and their applications by drawing the charts themselves. 13 students felt that both theory and drawing the charts should be taken up side by side in the class. Two students had no suggestion in this case.

### Conclusions and actions based on the analysis of response of questionnaire 1

Feedback of students regarding understanding of the topic, although reasonably good, still required some thinking and actions to improve it further. Retention after three days however, was low and a matter of concern. It also became known that the students, in general, do not revise the topic at home or read the material to be taken up in the next lecture class. Many students also suggested a change in the order in which sub-topics were covered in the lecture. They wanted the teacher to start with a generalization and

examples and then come to specific topic and its depth. In case of control charts, they suggested that the drawing of the charts with involvement of students should be taken up first. Once the students know about the charts and their usefulness, fundamentals, statistical basis and concepts can be explained.

### **Reflection**

The feedback served as an input for reflection. The fact that some students could not fully understand or retain was disturbing. The initial reaction of the teacher was that the students did not apply themselves but later made him think, as per the Gibbs' reflective cycle, that perhaps there was something, which he needed to do for effective learning and retention. He went through various stages of 'description', 'feelings', 'evaluation', 'conclusions' and 'action' of the Gibbs' Cycle and realized that the reason of low retention was the lack of student involvement in teaching learning process (Souise,2001). He felt that for such a topic, he needed to start with generalization and applications and then move to specifics using an inductive approach (Shaffer, 1989; Haight, et al 2007; Joseph, 2014) and focus on student centered learning (Carlile & Jordon 2005; O'Neill, 2005). The modified approach involved students in the construction of control charts followed by discussion on theoretical concepts.

The teacher thus, prepared the lesson plan of the next topic by incorporating the feedback. In this lesson plan, the order of sub-topics was changed as per students' feedback and a substantial component of 'learning by doing' was added in the form of self-effort of students in drawing the chart with guidance from the teacher. Questionnaire 2 was then prepared to take feedback on the lecture delivered with the modified lesson plan.

### **Analysis of feedback of questionnaire 2**

Table 2 shows the response of the students to various questions contained in the second questionnaire.

**Table 2: Response of the students to questionnaire 2**

Choice	Number of responses to questions			
	Question 1 Understanding of the topic	Question 2 Retention	Question 3 Revision after the class	Question 4 Effectiveness of feedback and action taken
A	18	11	10	19
B	16	19	12	15
C	8	10	16	7
D	0	1	4	1

Results contained in table 2 show the following:

As many as 18 students understood the topic completely, 16 understood largely and 8 had a fair understanding. No student reported a complete lack of understanding. The response indicates that the teaching and learning were, in fact, quite effective.

Response of questionnaire 2 shows a very good level of retention. 11 students out of 41 retained the comprehended content completely, 19 students retained most of what was taught in the previous class, 10 students retained to a fair extent and only one student reported a complete lack of retention

Response of students to a question on revision of the studied topic and reading of material for the next lecture was quite heartening. 10 students did a through revision of the topic, 12 revised it largely and 16 had a cursory look. Only four students did not revise the topic or read the material related to the next class at all.

Regarding the fourth question on the action taken by the teacher in terms of changing his approach after the feedback of students on the lecture on Control Charts for Variables, the response of the students was quite encouraging. It did support the action taken by the teacher. 19 students (45%) strongly agreed that the process of feedback and action was very effective, 15 students (36%) were also in agreement with the outcomes, seven students mildly agreed with the effectiveness of the approach while one student did not agree.

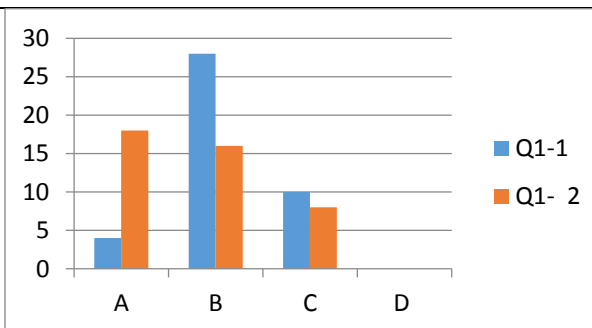
### Results and conclusions of analysis of questionnaire 2

Analysis of feedback of questionnaire 2 clearly indicates substantial improvement in the effectiveness of teaching-learning process. It also demonstrates the success of the rationale of taking up the study and making necessary modifications in the teaching methodology/approach of the teacher. Table 3 shows a comparison of before and after situation derived from the feedback of questionnaire 1 and 2.

**Table 3: Comparison of scores of question 1 and question 2**

NO.	Question 1 Understanding		Question 2 Retention		Question 3 Revision after the class	
	Before	After	Before	After	Before	After
A	4	18	1	11	1	10
B	28	16	15	19	13	12
C	10	8	22	10	14	16
D	0	0	4	1	14	4

As shown in the table and figure 11, number of students who understood the topic completely in the class increased from 4 to 18 and as a result, the number of students at the next level of understanding decreased to 16 from 28. In all, students who fall in category A and B increased from 32 to 34 with most of them understanding it completely. Number of students with partial understanding decreased marginally from 10 to 8. No student had 'No understanding' both before and after the change in approach of the teacher.



**Figure 11: Before and after score question 1**

The study shows a substantial improvement in 'Retention'. While only one student could retain the learning completely after the first lecture, 11 students had complete retention after the second lecture delivered by the teacher with a changed approach. Number of students who had a good level of retention increased to 19 from 15. In all student who had retention ranging from good to complete increased from 16 to 30. Number of students who had a fair or no retention decreased from 22 to 10 and 4 to 1, respectively.

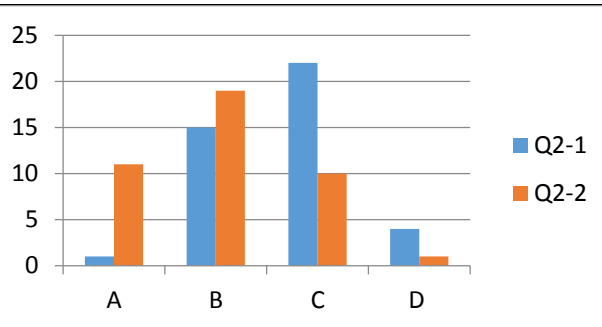


Figure 12: Before and after score question 2

The study also indicates that the interventions and the modified approach of the teacher helped in motivating the students to study on their own and revise the topic at home. Number of students who revised the topic at home completely, increased from 1 to 10 while those who revised largely decreased from 13 to 12. In all, the students who revised largely to complete revision increased from 14 to 22. Students who did not revise at all decreased substantially from 14 to 4.

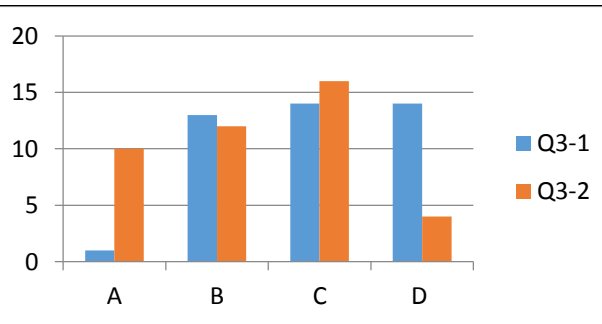


Figure 13: Before and after score question 3

In response to question 4 of questionnaire 2, the students reported directly that the changed approach in which they learned to draw the charts themselves before detailed coverage of statistical concepts and fundamentals, made the class more interesting and effective.

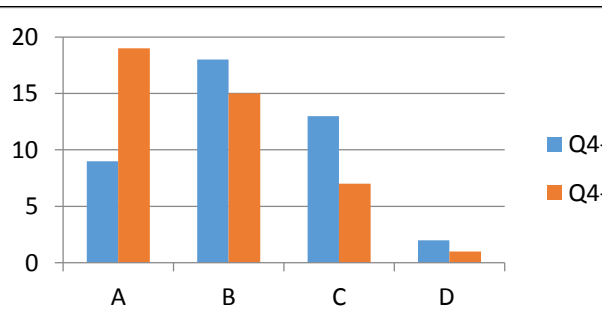


Figure 14: Before and after score question 4

## CONCLUSIONS

1. For better understanding and retention, the students should first be taught generalization with many examples and applications. They should be involved in the process of teaching learning by making them do work in the class.
2. Reflection is a very useful tool for introspection and improvement. Reflection, using a formal approach as per a standard model makes the teacher realize the situation, lets him shed ego, and brings flexibility in his approach to understand the students' perspective and shortcomings in his own approach.
3. Feedback from students can serve a very useful purpose of understanding the preferences of the students. It also demonstrates that the teacher is open and flexible and really cares for the students. The initiative was very specific to a course and a topic. The results may not hold good

for every topic. However, it is expected that the approach of getting feedback and aligning teaching with students' requirements will make teaching more interesting and effective.

### **Reflection and implications**

The initiative reflects a proactive approach of taking formal feedback from students on the effectiveness of learning. In today's times, the students can be attracted to attend classes only if the teaching-learning process in the classroom is interesting and effective. Every lecture should put the contents covered in a perspective and flow seamlessly ensuring student attention and involvement. The initiative of taking feedback to ensure the above, particularly when there was no problem reported by the students, reflects a good practice to change with the changing times and make continuous improvement.

The initiative, its results and subsequent improvement in student learning will always serve as a motivator to be open to new ideas for improvement and be flexible to manage change. Reflection is a great tool for a silent brainstorming and overcoming problems and egos. The study showed a substantial improvement in understanding and retention. The study also indicated that the intervention and the modified approach of the teacher helped in motivating the students to study on their own and revise the topic at home. The students reported that the changed approach in which they learned to draw the charts themselves before detailed coverage of statistical concepts and fundamentals, made the class more interesting and effective.

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