

## Effective Teaching and Evaluation Process for Control Systems

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### ABSTRACT

Teaching an under graduate/graduate course with effective teaching skill is becoming necessary to cope up the competitive environment for institutions and students both at the same time. Statistical analysis up to 2<sup>nd</sup> order characteristics can show certain facts to the instructor, which are hidden usually for understanding the culture and behaviour of students. The course of Control Systems is selected as an example to elaborate the importance of teaching quality assurance and effective teaching skills. The data collected and presented is based on real environment from different instructors teaching the same course over six years. The difference between two teaching methods is highlighted and concluded with the effective teaching and evaluation skill. The effective teaching and evaluation process is finally generalized for all the courses at any level.

**KEYWORDS:** Effective teaching, Evaluation process, Statistical analysis, Quality assurance.

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### INTRODUCTION

Teaching is always been a challenging profession but changes both within and outside the classroom have made it more complex. Teachers are being asked to teach by the problem solving skills because the students they teach come from different and challenging backgrounds.

Effective teaching involves the ability to apply research finding to classroom practice. Effective teaching also combines human relations skills, intuition, and judgment, knowledge of subject matter and understanding of learning into one unified act, resulting in improved learning for students. Effective teaching is also known as an academic process by which students are motivated to learn in a way that make a positive influence on how they think, act and feel [1].

A teacher also plays an important role in effective teaching process because teacher practices correlate to student performance. For an effective teaching process an effective teacher is required. An effective teacher is one who can active student energy and who can inspires students to act in a good and positive way and creates a positive learning environment [2]. The effective teacher will organize the classroom in a good way to maximize academic learning time. An effective teacher is one who is expert in his subjects and who can understand the individual abilities of the students [3].

Effective teaching demands broad knowledge of discipline and classroom management techniques and curriculum that's why an effective teacher should have all these qualities. Here are some more characteristics of an effective teacher which are much more important in an effective teaching process:

- 1) Effective teachers expect that all students can achieve their goals.
- 2) Effective teachers make lesson plans that give students a clear idea of what they will be learn and what are their assignments and what the grading policy is.
- 3) The effective teacher is one who is consistent in grading and return work in a timely manner.
- 4) Effective teachers ask questions to encourage the students and predict what will happen next.
- 5) Effective teachers present lessons in a structured and clear way.
- 6) Effective teachers are warm, accessible and caring.
- 7) Effective teachers are those who can make their students to learn more on their own [4].

There are many methods used by the teachers for effective teaching to improve the learning ability of the students. These methods make the teaching material easy to understand in many ways and these methods are equally helpful for the students and teachers. To achieve the goal of teaching, the teacher should adopt the effective teaching methods in education. The teacher has many options to choose from different teaching methods and techniques designed for teaching and learning. Writing lesson plans are very important for the teachers before implementing any teaching strategy in the classroom. The teaching method should be selected on the basis of the knowledge of the students, the environment and the learning goals selected in the academic syllabus or curriculum [5].

Every student have his or her unique way of absorbing knowledge so every student respond differently to different methods of teaching [6]. A teacher should adopt a teaching according to the mental abilities of the students and to increase their learning ability some common teaching methods for effective teaching are as follows:

- Lecture is a most common method used in effective teaching because it creates new ideas and it is good for large class and students can ask questions if they need any explanation or clarification.
- Group discussion is also a method used for effective teaching. By this method students listen to other's opinion and express their opinion and actively participate in the class and individual presentation is a method which is used for effective teaching as well. Students thoroughly understand the topic before giving presentation. This method increases confidence among students.
- Assignments increase the ability of research and it is also a method used for effective teaching.
- Seminars are also useful in learning process and seminars give chance to meet other people of same profession. It is an interesting method used for effective teaching.
- Workshops give chance to meet other people of same profession and it is another interesting teaching method.
- Conferences give chance to networking with other institutions and professionals that's why conferences are used as a method in effective teaching.
- Brainstorming is another method of teaching and by the help of this method students think beyond their knowledge.
- Role play is also a method used for effective teaching.

Educational psychology is also another useful tool which is used for the effective teaching and to understand the individual differences among the students and an effective teacher must be aware of educational psychology and its rules. By using the methodologies of educational psychology teachers can overcome the problems which they faced in their teaching career. Educational psychology offers alternatives to the teachers who faced problems in their teaching and the knowledge of research generated by educational psychologists is essential for those preparing to be teachers that's why educational psychology play a very important role in effective teaching process [7].

Effective teaching evaluation is also very important in the using the matching process. A teacher should develop new courses and redesign the old ones and innovate teaching strategies for use in both traditional classroom instructions and distance education. In short effective teaching evaluation is to collect data from multiple sources. Usually students give valuable information to teachers who want to improve their teaching. Mostly student evaluations collected at the end of a course. It allows teacher to select and adjust teaching practices [8].

Evaluation is a process by which the amount of achieving goals and aims are easy to understand by the teachers and the students as well. We can say that it is evaluation of the teacher which evaluates his or her complete activities of educational process [9]. There is a very strong link between effective teaching and students' academic achievement. There are many methods for evaluating teachers. These includes principal evaluations, ratings of teacher assignments and student work, teacher self report of practice including surveys, teaching logs, interviews and student rating of teacher performance. In educational system exams are having some difficulties and cannot meet the demands of present educational system by going through the experiences of the world have shown that the most significant inhibiting factors is the rapid change of educational system and process, using unscientific and old systems of exams [10]. Classroom observations are the most common form of teacher evaluation and by this method teaching evaluation can also possible.

Teacher evaluation based on professional teaching standards can improve the learning process. Well trained and knowledgeable evaluators are also important in the effective evaluation system. For assistance and review process expert teachers can be hired. Different teams of teachers can oversee the evaluation process to maintain the quality of education [11]. The effective teaching evaluation system value and encourage teacher collaboration. All these methods of effective teaching and evaluation can improve the learning process. In the light of all the above discussions a course is selected for experimentation then modern methodologies to apply and finally statistical analysis shows the improved results. Rest of the paper is divided in sections as organized below.

## DIVISION OF COURSE CONTENTS

The selection of the course of control systems was because of the core course of engineering degree in almost all curriculums of telecom engineering, computer engineering and electronic engineering. The other reasoning for selection of this course is because of availability of lot of data of student performance over six years. The course is divided into nine different topics that encamps all the subjects/topics of the course. The distribution of the course is decided on the bases of importance of the topic. This distribution of the course is selected on the basis of teaching experience of the subject after consultation of three different teachers who have experience of teaching this course. The weight of the topic is showing the importance of the topic relative to the other topics of the course. The weights distribution of the course corresponding to the course topic is shown in Figure 1. Table 1 shows the color scheme assigned to each course topic.

**Table 1.** Colour coding for each course area

Topic Name	State Space	Signal flow	Control Math	Root Locus	Stability	2 <sup>nd</sup> Oder system	Transfer function	Laplace and Inv Laplace	Lead Network (advance)
Color Assigned									

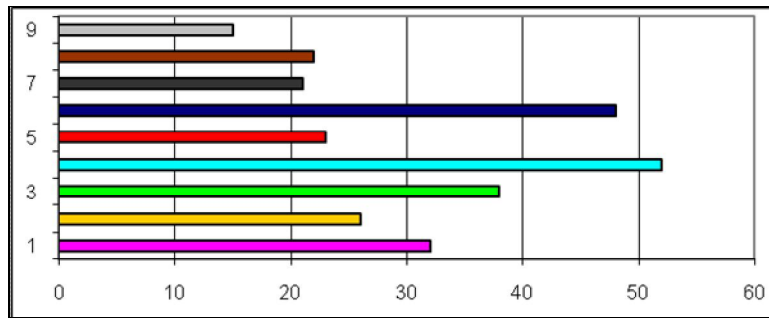


Fig.1. Weight distribution of topics corresponding to each subject of course

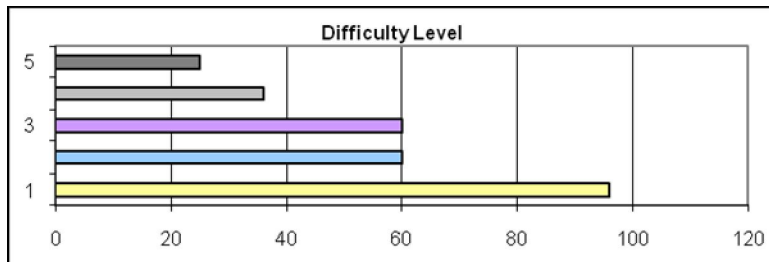


Fig.2. Weight distribution of importance of level of difficulty for all topics from very easy to very hard level

It is clear from Figure 1 that the most important topic of the course is root locus and 2<sup>nd</sup> important topic is analysis of second orders system. The least important topic for this course is lead networks at undergraduate level. Each course topics are further divided into five different levels of difficulty. The levels are very easy, easy, moderate, hard and very hard. But it is considered that the very easy level questions must be included in the course in high percentage as shown in Figure 2. Similarly the course is also divided into the time line which is taken as optional parameter to judge the learning speed. The over all course is recommended to teach with all of these parameters into consideration. Obviously all of the topics must be covered in order to satisfy the course curriculum. The timing analysis could be judged from the optional parameter of timing analysis.

### EVALUATION OF COURSE

Evaluation process is eventually the most important part of effective teaching. The more accurate teaching will lead to good percentage of not only the individual but the raised average percentage also. Proposed Evaluation method is divided into two parts. First is the evaluation for students and other is for the analysis of teacher/course.

### EVALUATION OF STUDENTS

The purpose of evaluation of the students is multi-fold. One main purpose is to create the understanding of self awareness of a student for particular subject and especially for the particular area of the subject. Second purpose is to create sense of competition among the students. The sense of competition among the students create a motivation for a student. Third and last purpose of the evaluation process is sense of achievement for a particular student. All of these purposes serves in harmony to create overall understanding of the evaluation process.

The result of first part of evaluation is recommended to handover to the students at earliest. The early submission of results back to the students would encourage them to have timely submission of assignments and quiz and regularity in studies. Regularity of the evaluation process is also necessary to keep the competition as alive process. It also creates the life time motivation in the students that is one of the essential component of creating continuous efforts to achieve some goal and future planning. Surprise assessment in form of quiz or assignment also creates better understanding of planning tactics. Figure 3 shows the final assessment of a student (F11) for each topic. It can be observed that this student has excellent skills in the 2<sup>nd</sup> order system and very good skills for the root locus analysis. This fact shows that this student has acquired almost very good understanding of the subject in total. As the emphasis of this course is to understand these two topics and as these two topics are correlated with the other topics of the course hence it could be assumed that the other skills are also good. For detailed analysis of this student, Figure 4 should be consulted and each of the topic could be analyzed. This exercise must be done many times during the assessment process and the student should be well informed about all of his progress in each topic. The feedback in this regard is highlighted in later sections.

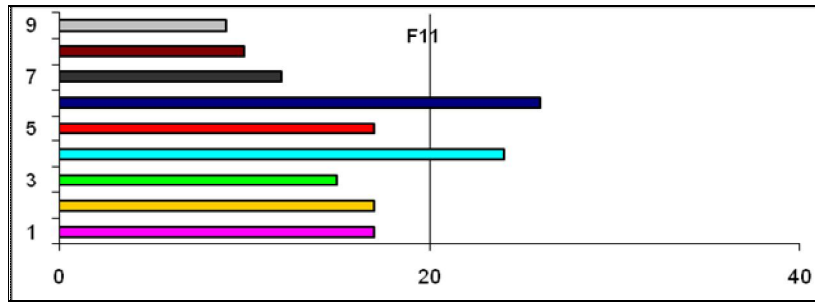


Fig.3. Final marks of the student in each category of the division.

**MONITORING THE PROGRESS OF THE COURSE**

Monitoring of the course is also one of the major objectives in the effective teaching and evaluation process. The regularity of the course can be check by looking at the data handling and statistical analysis as presented in the figure 4. It can be observed that during course, evaluation process is spread all over the semester with almost uniform distribution. Continuous evaluation process creates more sense of responsibility among the instructors and also among the students. Moreover evaluating the students more than one time for specific topic, sets the trend of covering that topic from all of its dimensions. The process of repeating evaluation for one topic has averaging effect on the total evaluation which creates more authentic results for assessment of not only particular student but also assessment of whole class. 1<sup>st</sup> an 2<sup>nd</sup> order statistics are applied to the available data and it is observed that the mean which is 1<sup>st</sup> order statistics is not enough to show the complete assessment of the topic as the mean could be high for one topic at the same time, having the high variance. High variance is 2<sup>nd</sup> order statistical indicator that shows the scatter among the students. The overall understanding of students for a topic is really good if the mean value of marks is high while variance is as low as possible. e.g. Q4 has more value of mean in the Figure 4 as compared to Q6 which indicates that the students have good knowledge of Q4 as compared to Q6. The previous statement could only be true if the variance value is small but it could be seen that Q6 has less variance value as compared to Q4. This means that teaching method for the topic of Q6 was has more effective rather than Q4 as it was understood to equal level by all the students. The instructor need to rethink about the teaching method applied to those topics which has less mean value and more variance value. He should also think about the previous knowledge required to grasp that particular topic.

**MANGAMENT OF EVALUATION OF COURSE**

Management of evaluation of the course for instructors is very important for looking into their own problems during the teaching process. It can also indicate the problems of the students and thought process of the students within the group or as an individual. There were various numbers of students under observation for period of six years that were going through the effective teaching and evaluation process. Some of the areas of the subject marks are shown in the Figure 5, 6. It can be easily observed that marks are distributed randomly and some of the students have high marks in particular area but it might also be observed that in the other area of the same course the particular student might not get high marks. This analysis can provide insight for the instructor to help particular student by advising him to improve particular area of the subject.

Second most important task for instructor is, to observe the area of the subject where every student has got less marks in it. This indicates that the teaching method applied to teach that area of the subject might not be appropriate for the students. Over all bad results in particular area of the subject might have various different reasons. One reason could be wrong selection of teaching method as discussed earlier. The second reason might be lack of interest of students in that area. Lack of interest of a student in some area of the subject is usually because of insufficient background knowledge. Instructor can apply various techniques to improve the particular area where the results are not satisfactory for single student or group of students.

Program : BET-6/BCE-6																																			
Course No : EEE261																																			
Course Title:Control System																																			
Teacher:Khurram Saleem Alimg eer																																			
Registered Students:49																																			
Sr #.																																			
Registration No																																			
		Sessional1 3-Oct																Sessional2 16-Nov																	
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	A1	A2	A3	A4	A5	A6	A7	AT	QA	QAP	Qdif	q1	q2	q3	qt	sp1	s1dif	q1	q2	q3	qt	sp2	s2dif	Tdif	pre
1 FA07-BCE-122		9	9	7	10	8	8	9	8	13	10	10	10	10	10	10	10	10	23	23	-0	10	8	4	7.3	8	-0.7	10	11	10	12	12	-0.4	-1.3	43
2 FA07-BCE-155		7	8	7	10	7	8	8	8	12	10	10	10	10	10	10	10	10	22	22	-0	9	9	4	7.3	8	-0.7	7	11	5	9	9	-0.4	-1.2	39
Mean		6.4	6	5.4	7.5	6.3	7.1	7	7.2	9.9	9.1	9.8	9.8	8.9	9.3	9	9.2	9.3	19	19.8	-1	8.1	7.7	3.6	6.5	6.8	-0.3	9	9	7	10	10	-0.4	-1.3	36.5
Variance		4	3.3	2.3	4.2	1.9	1.7	2.5	2.9	2.5	2.2	0.8	1.4	2.5	2.6	2.8	2.8	1.1	3	3.17	0.3	2	2.8	2.1	2.1	2.1	0.27	4	3	3	2.8	0.24	0.46	6.84	

Fig. 4. Sample of results with regularity and testing all topics and statistical analysis Fall 2010.

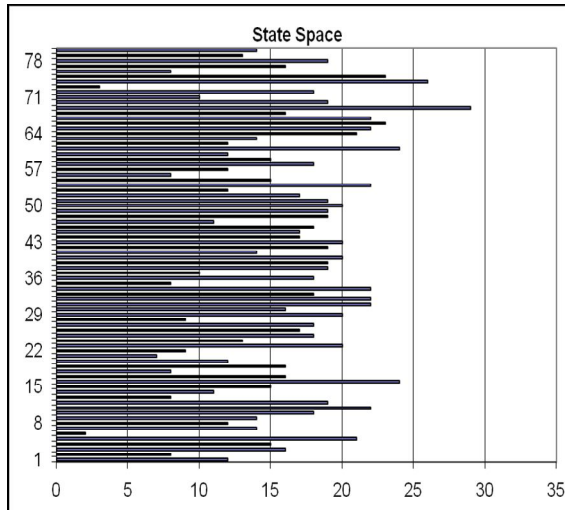


Fig. 5. Results of students in state space topic in 2010.

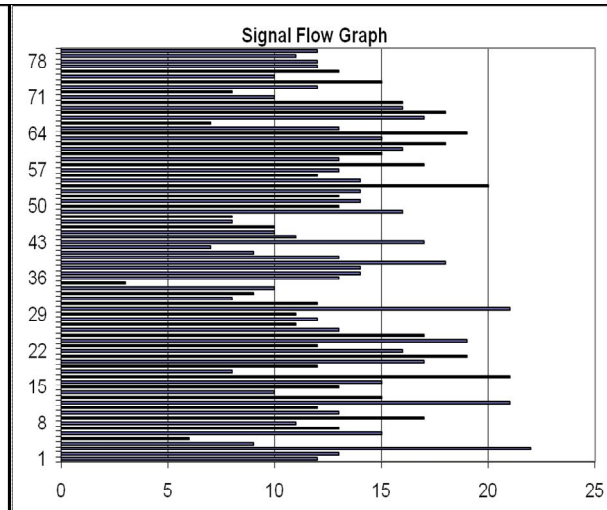


Fig. 6. Results of students in signal flow graph topic 2010.

The method of teaching was applied in 2009-2011 as shown in shaded color of Table 2. While from 2006-2008 the conventional method was applied. It can be observed that there is significant improvement in the results from 2009 onwards. The mean value of marks is also increased by applying the proposed methods and the variance of marks is also decreased. Not only ‘F’ grades are reduced but more ‘A’ grade students are produced. The gradual improvement from 2006 to 2011 is also analyzed as it is obvious from the Table 2. This gradual improvement is because of the development of teaching skill for the same instructors that are teaching the course. The overall effective teaching method is recommended to adopt to have better evaluation process.

Table 2. Results Analysis of the students before and after applying the proposed Method

	2006	2007	2008	2009	2010	2011
Mean of Marks	68.3	68.7	69.1	75	75.2	75.1
Variance of Marks	14.1	14.5	14.3	9.2	9.1	8.8
%age of F Grade	10	9.43	6.122	3.50	4.25	3.70
%age of A Grade	4	5.66	8.16	8.77	8.51	9.25

## CONCLUSION

Division of the course content into its logical distribution is the most important key feature to have effective teaching and evaluation process. Each topic must be evaluated during the assessment process multiple times and with multiple difficulty level to analyze the correct capability student. Regularity of assessment process with the immediate feedback to the students would create sense of responsibility at both ends. Statistical analysis of the marks record up to 1<sup>st</sup> order is not enough and there is need of 2<sup>nd</sup> order analysis to understand the student learning process for student having more than two type of classes/groups. Experimentation and application of statistical analysis over the data collection spanning over six years show the significance of the proposed effective teaching and evaluation method.

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## REFERENCES

- [1]. Patricia Smittle (2003): “Principals for effective teaching”, *Journal of developmental education*. Vol.26(3), pp:1-9.
- [2]. Vighnaranjah, Wong Su Luan, Kamariah Abu Bakar (2008). The shift in the role of teachers in the learning process: *European journal of social sciences*. Vol: 7(2), pp: 33-41.
- [3]. Philip Gurney(2007). “Five factors for effective teaching”, *Newzealand journal of teachers’ work*, Vol 4(2), pp: 89-98.

- [4]. Rehaneh Motalebi, Sadraddin Sattari, Ali Mohammad Naemi (2012). "Determine the type of personality (Behavioral patterns) in educational managers of Islamic Azad University of Tabriz", *journal of basic and applied scientific research*. Vol 2(9). pp: 8990-8994.
- [5]. Jason M. Carpenter (2006). "Effective teaching methods for large classes". *Journal of family and consumer sciences education, University of Carolina*. Vol 24(2), pp: 13-23.
- [6]. Kenneth Henson, Ben Eller (2012). "Educational psychology for effective teaching": pp: 5-10, 2<sup>nd</sup> edition, *Kendall Hunt publishing co.*
- [7]. Melita Puklek Levpuscek, Cirila Peklej (2007). "Motivation of student teachers in educational psychology course: Its relation to quality of seminar work and final achievement", *University of Ljubljana, Department of psychology, Ljubljana, Slovenia*. Vol 16(3), pp: 5-25.
- [8]. Laura Goe, Courtney Bell, Olivia Little. (2008). "Approaches to evaluating teacher effectiveness: A research synthesis", *national comprehensive center for teacher quality*.
- [9]. Mohammadi, Hassan (2006). "Descriptive evaluation a response to the deficiencies of the existing evaluation". *Tehran: Academic evaluation office of education department*.
- [10]. Haqi, Vali (2008). "Effective learning". *Nour publication of education ministry*.
- [11]. Laurie Stevahn, Jean. A King, Gail Ghere, Jane Minnema (2005). "Establishing essential competencies for program evaluators": *American journal of evaluation*, Vol 26(1). pp: 43-59.

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