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Analysis the prediction of control engineering for the impact of power engineering

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Abstract-This paper helps in analyzing the written exam result at courses related to control engineering, held for students of Ljubljana University. After the exam, the students were asked about their performance and how well did the exam go. Then, the students were told the right answers along with the answer key to evaluate their own test results. The outcome of the marks were then correlated to the actual outcome given by the teacher and a verbal test was further taken.The further conclusion showed that the expected results of the students for their exam before the exam was 3.6% more that their obtained result. The same prediction after the exam was 3.2% more than the obtained the results. The individual's self-evaluation was 1.68% lower than the actual results. Result of students studying in a professional course were more astonishing as their expectation of marks before the exam is higher than the actual marks by 25.81% and the same after the result increased by 8.88%. Their self-evaluation was lower by 2.8% points.
Keywords-PID controller, control system, stability, dc motor

Introduction

Contemporary programs of study were introduced under the Bologna reform; according to the legislative requirements of the academic councils, prior to which students at Ljubljana university - Faculty of Electrical Engineering (LU FEE) were allowed admissions for the courses of electrical engineering under two different levels of professional or academic. Under the program of Academic study – the students had to go through 9 semesters of exercises and theoretical lectures in accordance, after which they had to give an entire semester's time into their diploma thesis, hence making this course last a total of 10 semesters that is 5 years to be precise [1-7].The students under this academic study program had to go through the same syllabus for the first two years. It was from the third year onwards when they were allowed to select any one of the four compulsory subjects according to their interests in the respective fields to be studied by them till the end of their fifth semester [8-12]. These four subjects were as follows:

- Automatics
- Electronics
- Power Engineering
- Telecommunications

When it came to the matter of electrical machines, not all students were privileged enough to get a hold of the knowledge this subject had to offer. Even though all of the students had some basic knowledge of the subject, which was due to a similar syllabi course in the second year, the main

courses related to electrical machines and drives, power generation, power electronics and delivery etc. could be availed to study only by the students who had selected to study the subject of Power Engineering, along with some other subject covering the vast topic of Control Engineering. The Control Theory course elaborated the students of third year on some relative theories and fundamentals of non- linear and linear control systems, the theoretical knowledge isn't enough to give one the idea of any entirety on the subject, hence, practical experiences on general trivia and applications of power electronics, motion control and power systems was also given to the students under the program of academic study who had elected for this subject.As mentioned, the second and more derivative of the two programs of study into which the students of The Ljubljana Universi– Electrical Engineering Faculty (LU EEF) were admitted is that of the professional level programs of study. This program unlike the academic one, allows its students to go through semesters of theoretical lectures and exercises in accordance to six more months of practice at the subjects, which doesn't include the 3 extra months of their diploma thesis. Before the introduction of the Bologna reform, this program of study had a duration of a total of 4 years. Among a few other similarities, the professional level program had a common course syllabi for the entirety of 2 semesters, after which the students as per their interests and ideas for furthering their knowledge in different fields, were allowed to select any one of the following compulsory subjects,

- Quality Assurance
- Telecommunication
- Electronic
- Power Engineering and Plant Automation
- Automatics

As brought into consideration earlier, the topics under electrical machines like electric motors, power electronics and drives and power systems were covered only in the syllabus of students who had opted for the subject of power engineering in the academic program of study, but here in the program of professional level, these subjects are covered under the electives of Power Engineering and Plant Automation in accordance to the syllabus. Being a bit more derivative than the academic level of study, the professional level of study sees through the topics of Control engineering in the third year of its syllabi. The students of professional level are briefed on basic terminologies and theories of control engineering. These concepts of control engineering are useful to the students in future references and studies as they give them a clear basis upon which certain moderate courses are elaborated and studied by the students in their upcoming semesters. These courses then help them enhance and get a more descriptive - in – depth knowledge of the subject of control engineering, which is very vast indeed.

As mentioned earlier, the Bologna reform had brought about several changes in both the syllabus and the methodology of both of these study programs made available to students in The Ljubljana University – Electrical engineering Faculty (LU EEF). Before the introduction of the Bologna reform, the study programs in the University were getting old and battered by their use over the decades there, their fruitfulness was fading over as the students required and contemporary modulation in their programs of study for a more efficient as well as quantity assured result. Even though the levels of the programs of study available to the students on the University are of the same number and under the same category of academic level and profession level of study, the duration of the latter has been changed to 3 years and 3 months, which has a more efficient purpose as compared to the 4 year program of professional level of study prior to the Bologna reform changes. The academic level of study in the University of Ljubljana has now been subdivided into two successive cycles; the first one being of 3 years and the second one consisting of the remaining 2 years, being staged as different categorical syllabi. In similarity to the previous academic level of study the new academic level also allows the students to select subjects from the third year onwards in accordance with their interests and ideologies of their future work. These subjects have been somewhat changed in the sense that now they give the students a wider range of options to select for their first cycle of the course. Following are the four subjects,

- Automatics
- Electronics
- Energetic and Mechatronics
- Telecommunications

This new extensive level of academic study, having subdivisions has more numbers of selective subjects as well. As the students can have different opinions and interests developed after the first cycle of their course, they are allowed to select from a wider range of subjects for the second cycle of their course. These subjects provide them with a chance to either continue their study of the subject they selected during the first cycle of their course or select a new subject from the given options. These subjects provide the students in the academic level of study a chance to expand their horizon of knowledge in a more descriptive and elucidative manner.The new subjects that the students of the academic level of study are given as options to select from are as following,

- Biomedical engineering
- Automatics and Informatics
- Telecommunication
- Robotics

- Mechatronics
- Electronics
- Power Engineering

The new kind of professional level of study has a duration of 3 years and 3 months in addition to the introduction of a credit system of 10 credits (ECTS) for the purpose of their diploma thesis. As this level of study was already descriptive and tough enough for the students to keep up with its syllabus, the subjects that were given to the students as options to select from in accordance with their interests and future ideologies of their referral work were not changed. Even though the duration of this course was shortened by a period of 6 months, the students were still allowed to choose from the elective subjects and theoretical modules to study from as per their own freewill.These study programs were wearing out in terms of their efficiency to provide the students with the wholesome purpose of preparing them and giving them tools to work for their future. As a matter of fact, the gradual decline in the results of the written examinations of the students admitted under these courses, their lacking interest and readiness for the oral examinations and their lowered enthusiasm in attending the lectures and descriptive classes so as to get a grasp of the subjects they had in their syllabus was almost worrisome. The students, even after selecting the subjects of their interest showed very less dedication towards getting a better hold of their subjects and getting a deeper – more elucidative knowledge of the topics being covered in their syllabus. This problem faced by the University had no proven solutions. The absence of any ideology or solution to the given problem lead to the development of an original instrument, that would at the least bring about some positive changes and progress towards getting a better solution for the discussed difficulties. The new study programs in the University as discussed above, were introduced in accordance with the legislative requirements under the Bologna reform. However, it was the professors of the University who had most of the power and authority when it came to the various methodologies of teaching for a particular subjective course as well as the content of the subjects being tutored to the students of the University. Forecasting The Results of Written Examinations. The gradual degradation in these programs of study required a stern but effective enough solution. As proposed, the students were the ones predicting their results, analyzing them, and comparing their results as to what they thought was right. In this way, not only did the students get a better idea of what they were doing wrong and how it affected their results, they also understood the perception of how they have to prepare a subject in accordance to get a better result along with a more effective understanding of the subject. As these subjects were selected by the students according to their own freewill, they were forced to work on their up gradation even on an ethical basis of rules and regulations. Initializing this measure, the students, before knowing anything about the questions and tasks given to them in their examinations, were asked to bring their level of preparedness and hard work in retrospect to the situation and give an approximate prediction as to what their result might be as per their own expectations. The students were allowed to predict and give an approximation of their result up to a round off of 5 percentages of marks.When the students were done with their exams, they were again asked to give an approximation to a round off of about 5 percentage of marks, of their results. This was done so that the students could give a prediction of their own marks after putting in the thought of how they performed in their examinations and to what extent they think

they were right about their answers. This also gave the students and idea as to what their level of preparedness was for the examinations of the subjects they had selected themselves to get tutored in. This prediction was to be done by the students keeping in mind what their experience of the examination was. Once the examination papers were evaluated and checked by the respective professors of the University, the students were once again called upon to self - evaluate their sheets as they were given the correct answers and descriptive keys to the question papers. This was so that the students could mark themselves on how they performed in their examinations, this got them thinking on how they answered the questions as the correct answers that were expected from them were right in front of their eyes to be analysed and compared with what kind of answers they had written in their sheets. By this comparison made by the students, they got to know the extent of their perception in concern with the respective subjects they had given the exams for.These predictions, evaluations and comparisons of their results were not just done to give them the right answers, this could've been done by the tutors and professors as well. However, the students after going through this whole process were expected to get a better idea of how they have to answer and what points they have to keep in mind in essence of the subjects they were tutored in. These evaluations were also to hint the students on how much they think they knew when it came to thinking of the right and more suitable answers to the questions in the examinations.

Result and Analysis

Some students were taken for the purpose of this research. The number was however quite low. 26 to 37 per option per year under Power Engineering course in an academic level program who were studying the subject of Control Theory were taken. In addition to that similar survey analysis and research was conducted on a different set of students differing on grounds of academic level. Approximately 42 to 3 per year per option was the number for the same Power Engineering and Plan Automation course but as professional level study program. In an abstract, two sets of student groups were considered for this research; one on an academic level and the other on a professional level.Due to issue of statutory rights in Slovenia, quite a few exceptions took place each year among the students who were considered for the research and henceforth some facts from the time of research were distorted in the retelling so it was best to consider only one generation of students for the purpose of avoiding this chaos and confusion. The data taken therefore for the purpose of consistency is from exams and tutorials on the course of Control Theory for both Academic and Professional level in an interval of 4 years. Under this course; Control Theory, some tests were conducted to evaluate students on certain parameters for the purpose of this research. For students on the Academic level, a total of148 tests were conducted, processed and evaluated. It was indeed a smooth process and not as cumbersome as it was predicted to be since all the students were very cooperative for the task. They readily agreed for the tests without any hesitation or doubt and also evaluated themselves for their own answer sheets. Out of the students who did the self-evaluation, 3 students discovered smaller errors in the assessment done by the respective faculty. The result reflected on the answer sheets were then rectified accordingly. Such unnoticeable amendments are naturally integrated in the analysis. While self-evaluation was one of the parameter, the other parameters were forecast before the exam, forecast post exam, difference of the forecast before the exam with respect to

the achieved result, difference of the forecast post exam with respect to achieved result and the difference of self-evaluation with respect to the achieved result. The results obtained are depicted in the table below, with total number of students being 148 in the Academic level of study alongside an average % of students and a standard deviation percentage.

Table.1

		Student Count	Mean (%)	SD
Result Obtained	Ar	140	70.11	17.15
Forecast before the exam	F_b	140	72.81	7.60
Forecast post exam	F_p	140	72.30	13.36
Self-evaluated Result	Sr	140	68.33	16.42
Difference of forecast before	F_b– Ar	140	1.70	16.02
Difference of forecast after	F_{ap} - Ar	140	1.19	12.52
Difference of self-evaluated result	Sr – Ar	140	-3.78	6.40

The table one depicts Forecasts and Results at the academic level of the exams for the course of Control Theory . For a better understanding of these results, Forecast of the results keeping achievements as its function are given below. On the X-axis we have percentage of forecast and three lines indicating the three parameters; forecast post exam, forecast prior exam and self-evaluation. On the Y-axis we have percentage of achieved result with category 1 meaning 20%, category 2 meaning 40%, category 3 meaning 60% and category 4 meaning 80%. From graphs we can observe the pattern of these parameters as a function of achieved result and draw a better analysis for our research. Note that the precision and accuracy of the graphs is not in accordance with the data collected as most points that deviated from the linear portion have been removed for easier interpretation.

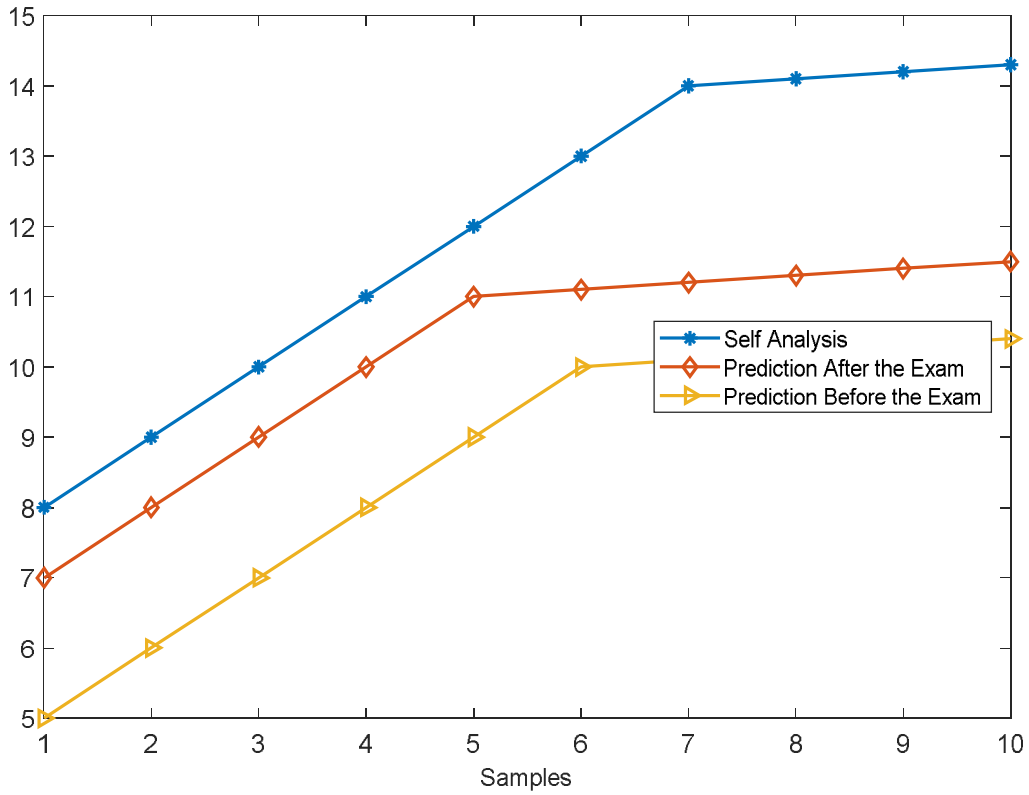

Fig.1

When the other set of students were evaluated for the results who were studying the same course Control Theory at a professional level, some 86 theory papers were scrutinized. The response of all the students was positive to this research but out of those 86 only 76 appeared for self-evaluation. For the 10 students who were missing, that is, who didn't appear for self-evaluation had their average achieved result to be around 11.70%. Just like previously, small errors occurred in the original assessment. Two students after being thorough with the process of self-evaluation identified small error in the assessment pertaining to minor calculation mistake etc which was immediately rectified by the respective authorities. These corrections were considered within further analysis. Again the same parameters were taken for analysis. 86 students were taken into accounts however for the parameter of self-evaluation only 76 were considered alongside an average percentage and a standard deviation. The table two given below depicts the analysis.

Table.2

		Student Count	Mean (%)	SD

Result Achieved	Ar	82	39.20	25.17
Forecast before the exam	F_b	82	65.01	11.15
Forecast post exam	F_p	82	48.19	20.07
Self-evaluated	S	72	40.15	22.17
Difference of forecast before	F_{pb}- A	82	24.81	24.15
Difference of forecast post	F_p - A	82	7.99	17.24
Difference of self-evaluated	S - Ar	72	-1.80	9.71

Again for a better understanding of these results, Forecast results are plotted keeping it as a function of achievements. On the X-axis we have percentage of forecast and three lines indicating the three parameters; forecast after the exam, forecast before the exam and self-evaluation. On the Y-axis we have percentage of achieved result however this time with category 1 meaning 0%, category 2 meaning 20%, category 3 meaning 40% and category 4 meaning 80%. From graphs we can observe the pattern of these parameters as a function of achieved result and draw a better analysis for our research. Note that the precision and accuracy of the graphs is not in accordance with the data collected as most points that deviated from the linear portion have been removed. The analysis results are plotted in fig.1 and fig.2 accordingly.

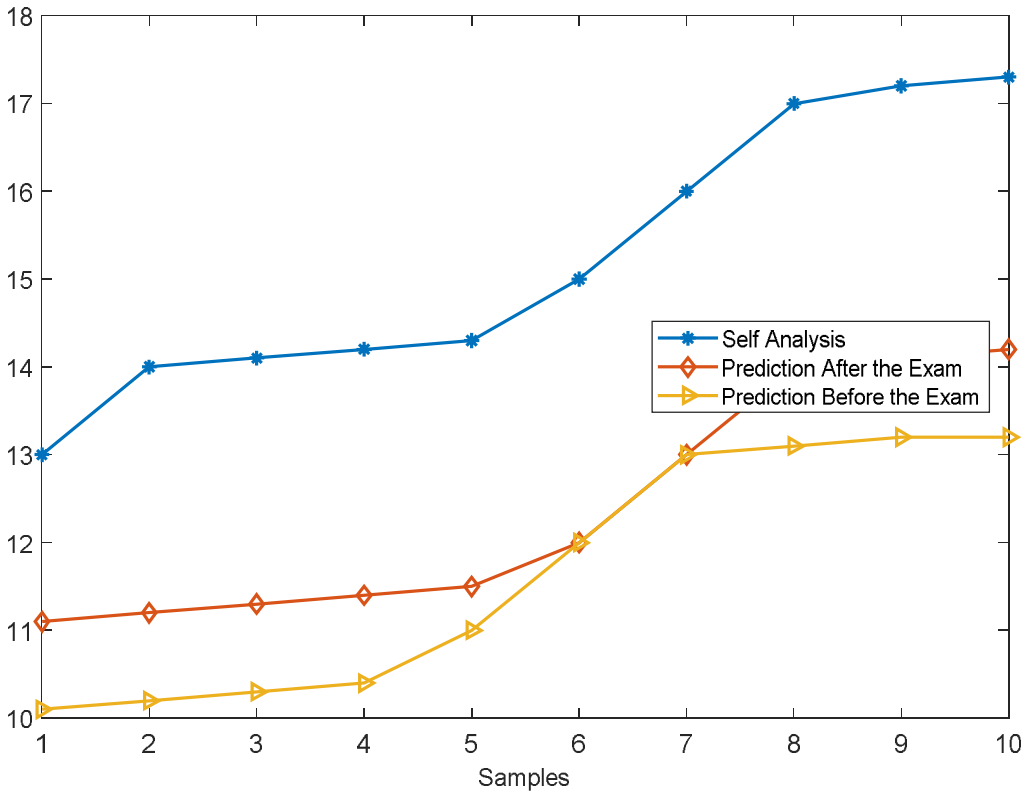

Fig.2

Conclusion

The prime agenda of the paper isn't to be puzzled with the sufficiency and efficiency of mentioned methods of self-evaluation and forecasting for students studying for exams. However, these effects are vital for evaluating the effectiveness of the learning process that takes place among students studying a course. It was also found that student lacked communication skills as if they were under some stress when interviews were conducted after self-evaluation process in the form of oral examination. This methodology proved quite fruitful in terms of eliminating minor errors that occurred in the student's evaluations. It was also noted that it's possible to come up with more suitable questions in the exams and a more comfortable yet stringent scoring system. Otherwise, a tremendous difference is observed between the two sets of student groups that were considered for the research, the academic and the professional level study program. Students in academic level achieved an average result of 72.11% whereas those in professional level achieved an average result of 40.20%. Other differences were also quite prominent such as in forecast prior, academic level students achieved 3.70% whereas professional level achieved 25.81% and in forecast after, academic students achieved 3.19% and professional level students achieved 8.99%. Logically, students studying at professional level study program are expected to have a better grasp of concepts involved along with and a more intensive learning curve and

capability. This is verified through the increasing standard deviation for these students. It was also found that students were more pumped to increase their results in the theory exam. Students who achieved lower results aspired for higher results in self-evaluations and those who already scored high were more cautious and careful about evaluating their own answer scripts.

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