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Engineering Education Problems and Solution Suggestions

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Abstract: Engineering is to apply scientific and mathematical principles with technology for the benefit of mankind. The engineer must have certain theoretical and practical knowledge to be able to do his work, while the fundamental of theoretical knowledge is directly related to the knowledge of science and mathematics. Turkey's PISA score is far below the OECD average, ÖSYS results confirms this fact. For example, the net correct answered numbers of the questions the students who settled in the Department of Electronics and Communication Engineering of Namık Kemal University Corlu Engineering Faculty in 2016; For LYS1 Mathematics it is 16.9 for 50 questions, for LYS1 Geometry it is 7.7 for 30 questions and for LYS1 Physics is 5.5 for 30 questions. For evening education, the correct answers are as follows; 11.7, 4.3 and 4.1 respectively. ABET criteria and OSYS scores were examined and the reasons for the failure of students who settled in some engineering faculties were examined. In 2015, YÖK has initiated the practice of "restricting according to success" in engineering programs. In this study, it was concluded that the achievement rates of the students for the basic courses were compared with the OSYS success rank by taking the department as an example and it was inadequate to limit it according to success rank. In 2015, The Higher Education Council has started "The Application of The Restriction in Rank of Success in Programs for the Professional Execution". In this study, by taking NKU ÇMF, Department of Electronics and Telecommunication Engineering as an example, the success rate of the students for the basic courses are compared with the success rank of these students in the OSYS and it is concluded that the current method is not adequate for achieving the desired outcomes.

Keywords: Engineering education, Higher education

Introduction

Moving from the production centered society to information centered society makes essential for examining new production systems. The basic problem arising here is how to be considered of social parties opinions at taking changing decisions and solutions emerged from transformations. Education, a common known Notion by everybody is a future investment. This becomes real with modern university education (Akdeniz, 2001). Engineering education has a special role at creating the biggest value add in the development of a country.

Engineering is described as science application of turning natural resources for mankind use in the most appropriate way (EMO, 2012). In other words, it is application of technology for human help benefitting from scientific and mathematical principles. To make his job, an engineer needs some specific theoretical and practical information. The fundamental of theoretical knowledge is related to science and mathematics directly.
ABET (Accreditation Board for Engineering and Technology) in its revised report dated 20 October 2017 to accredited electric /electronics engineering programs declared its 2018-2019 criteria's as followings:

- Syllabus should supply graduates with demanded skills at electric/electronics systems designing, applying, installment, manufacturing, operating and /or care. Considered technical expertise related to varied electrical systems and unique aims of individual programs, some undergraduate programs can focus on deep but narrow masteries of others can choose training graduates in a various field expertise. For this reason, depth and width of expertise shown by graduates at undergraduate levels should be appropriate to support programs educational targets.

- Natural sciences, mathematics should be at algebra and trigonometry levels or higher than that and applied to electrics/electronics systems building, test, running and caring units.
- Control systems, instrumentation systems, communication systems, computer systems or power systems analysis the followings one or more, designing and application skills, applying ability of project management techniques for electric electronic systems; And to determine electrics/electronics systems performances, at least, abilities of differential and integral calculation skills should be obtained.

It is naturally expected for engineering education students adorned with science and mathematics to prefer this job. Whereas, in 2003 Science. Mathematics and Reading among OECD counties ranking were respectively 33, 35 and 35 and these rates regressed to 52, 49 and 50 in 2015. While Turkey's point 420, Mathematics reading average of OECD countries were 490 point. (MEB, 2015).

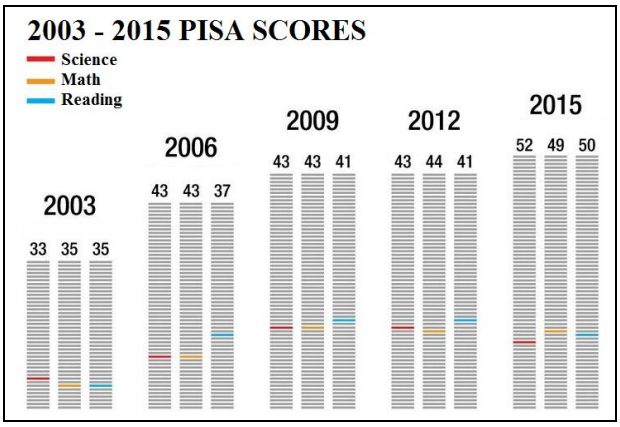

Figure 1. Mathematics, Reading and Science Turkey PISA Ranking in 2003-2015. (MEB, 2015).

It is obvious failure at higher education examinations when it was looked at PISA grades. In 2015, new YÖK (Higher Education Institution) made new arrangements receiving opinions of partners. In this context, limiting application according to success rates at the department's special to vocational performances was started. First, 40 thousand at medicine department 150 thousand success limit was determined and practiced in 2015 ÖSYS (student measuring and evaluating exam).With the same aim, meetings were made with the deans of engineering faculties. Same arrangements were done for engineering faculties as in medicine and law areas because of the ideas obtained from them. A success limit was regulated at engineering area as 240 thousand for this purpose.

2. An Example NKU Çorlu Engineering Faculty EHMB (Electronics and Telecommunication Engineering department).

At the EHMB department 2 professors, 2 associate professors, 1 assistant professor as teaching staff and 5 research assistant has been working. There are 335 undergraduates in formal programed and 310 in evening programmed. There are 41 master students. Students per teaching staff is 137. New branches cannot be opened because insufficient numbers of teaching staffs and running courses are becoming difficult more and more.
At Table 1 total net numbers at YGS/LYS of the students entered in 2016 formal and evening programs at Namık Kemal University Çorlu Engineering Faculty (ÇMF) Electronics and Communication Engineering Department (EHMB) are shown. (YÖK, 10.04.2017). It is inevitable that this table reflects negatively to all notional basic courses to be taken by students in his or her whole education career.

Table 1. Number of net questions answered by the EHM in 2016 YGS / LYS (YÖK, 2017).

Question Type	Number of correctly answered questions	
	Formal	Evening
YGS Turkish (40)	24,8	23,2
YGS social studies (40)	6,8	7,9
YGS Math (40)	22,5	19,5
YGS Science (40)	18,7	13,9
LYS-1 Math (50)	16,9	11,7
LYS-1 Geometry (30)	7,7	4,3
LYS-2 Physics (30)	5,5	4,1
LYS-2 Chemistry (30)	12,6	8
LYS-2 Biology (30)	8,2	5,4

2008-2016 LYS basic scores and placements were presented at Table 2. As seen from this Table 2 in 2008 EHBM took students from 27.000 and in 2016 took from 226.000. The success rate placed this department closed to 240.000 becoming upper limit for engineering in 2016.

Table 2. EHM base scores and rankings by years (YÖK, 2017)

		2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Base Score	**Formal**	268,28	273,833	288,827	304,45	319,613	359,064	409,009	426,971	315,5 (SAY 2)	317,417 (SAY 2)
	Evening	252,056	245,933	266,425	273,31	283,402	336,738	384,917	402,853	308,338 (SAY 2)	
Ranking	**Formal**		175.000	107.000	90.000	77.600	63.000	48.200	54.400	39.900	27.000
	Evening		226.000	143.000	126.000	93.700	80.200	64.700	64.600		

It is seen that EHBM basic scores and placements provided at Table 2 and success rates at basic notional courses according to the years of the students presented at Table 3 quite overlap.

For example, passing rates from the physics course at formal programed of the students entered 2008 is 68% and students entered 2015 is lowered to 11%.On the other hand, this rate decreased from 87% to 32% at the differential equation. This rate is available for basic vocational courses with the same periods. As it can be understood from Table 3 Fundamentals of Electric Circuits from 65% to 13%, digital design from 97% to 22%, Basic Electronics Circuits from 86% to 24%, automatic controls systems from 95% to 45%. Although it is perceived success rates are high at evening programed, some courses and years, it is understood from Table 3 that passing rates are lower than many courses in formal programed.

Decreasing passing rates, if students took courses beforehand, they do not have to attend class conditions increased student numbers in the classes. For instance, the department capacity is 60 students but at many courses numbers of students registered to those courses with evening programed beyond 350. Numbers of students in the class reality should be 25-30 is so unrealistic compared students' numbers receiving engineering education here. (YÖK, 10.04.2017).

Result

Though placing as to success application is evaluated positively, 240.000 limit is so low limit scale for engineering education. This limit should be arranged as 100.000 as soon as possible and make other arrangements for different engineering disciplines.

According to, EMO (The Chamber of Electrical Engineers) in 2016, engineering employment and vocational area research, unemployment rate escalated at Electrical, Electronics, Electrical-Electronics, Telecommunication and Biomedical Engineering and made public announcements for reasons of this situation and shared detections on this issue the followings:

Table 3. The success rates of the EHM in some courses over the years.

CODE	COURSES	2008-09	2009-10		2010-11		2011-12		2012-13		2013-14		2014-15		2015 - 16	
		Formal	Formal	İÖ	Formal	İÖ	Formal	İÖ	Formal	İÖ	Formal	İÖ	Formal	İÖ	Formal	İÖ
EHMB101	Introduction to Electronic Engineering	71%	88%	79%	82%	76%	70%	75%	63%	56%	64%	75%	84%	81%	71%	77%
FZK107	Physics I	68%	80%	79%	76%	85%	74%	31%	73%	61%	55%	38%	45%	15%	11%	8%
KMY004	General Chemistry	84%	87%	86%	87%	98%	95%	83%	72%	54%	47%	43%	48%	36%	53%	38%
LIC001	Linear Algebra	90%	93%	96%	82%	100%	75%	92%	68%	73%	67%	80%	65%	41%	61%	64%
MAT113	Mathematics I	65%	94%	96%	92%	95%	67%	75%	59%	89%	81%	80%	52%	58%	49%	33%
TBT001	Basic Information Technologies	90%	86%	89%	81%	79%	83%	52%	65%	59%	71%	66%	56%	79%	73%	81%
EHMB106	Computer Programming	48%	87%	86%	72%	34%	57%	32%	97%	94%	38%	21%	35%	47%	31%	31%
FZK108	Physics II	90%	88%	54%	85%	55%	86%	49%	81%	57%	51%	22%	3%	14%	13%	22%
MAT114	Mathematics II	74%	97%	93%	93%	90%	87%	68%	76%	70%	68%	77%	13%	3%	59%	47%
EHMB102	Fundamentals of Electrical Circuit	87%	65%	57%	70%	61%	94%	54%	56%	37%	29%	26%	24%	28%	13%	15%
EHMB207	Digital Design		97%		28%	60%	64%	52%	100%	57%	62%	48%	60%	50%	22%	39%
EHMB209	Circuit and System Analysis		90%		72%	71%	77%	75%	75%	68%	66%	41%	56%	52%	45%	45%
MAT202	Differential equations		87%		86%	33%	82%	70%	75%	54%	65%	74%	35%	13%	32%	33%
SYA002	Numerical Analysis		97%		89%	90%	50%	26%	72%	61%	93%	94%	39%	29%	24%	31%
EHMB202	Signals and Systems		39%		42%	19%	60%	35%	50%	37%	25%	28%	42%	41%	48%	64%
EHMB206	Electromagnetic Field Theory		97%		61%	53%	100%	85%	65%	78%	53%	57%	58%	53%	27%	30%
EHMB208	Basic Electronic Circuits		86%		77%	65%	93%	55%	51%	54%	43%	32%	36%	31%	24%	12%
EHMB301	Analog Communication				71%		76%	65%	100%	75%	48%	52%	41%	38%	42%	39%
EHMB303	Electronic Circuits				96%		63%	68%	38%	38%	31%	41%	55%	53%	59%	53%
EHMB305	Microwave				93%		75%	81%	67%	97%	50%	82%	74%	81%	76%	85%
EHMS 323	Electromagnetic Wave Theory				93%		91%	100%	90%	94%	83%	87%	48%	57%	84%	71%
EHMB302	Digital Communication				93%		100%	100%	90%	91%	60%	85%	55%	28%	52%	48%
EHMB 306	Digital Signal Processing				79%		67%	94%	84%	70%	30%	49%	56%	51%	56%	43%
EHMS312	Antenna and Propagation				90%		96%	100%	78%	97%	67%	92%	68%	67%	87%	85%
EHMS314	Communication Theory				72%		69%	74%	53%	68%	68%	76%	84%	81%	69%	70%
EHMB304	Automatic Control Systems								95%	90%	35%	98%	40%	50%	45%	48%
EHMB405	Mobile Communication Systems I								100%	100%	86%	83%	63%	92%	73%	65%

According to, EMO (The Chamber of Electrical Engineers) in 2016, engineering employment and vocational area research, unemployment rate escalated at Electrical, Electronics, Electrical-Electronics, Telecommunication and Biomedical Engineering and made public announcements for reasons of this situation and shared detections on this issue the followings:

- Our country remained fall behind so much of the technological development.
- Our country is not a producer but it is a market.
- Preferring economic growth model unable to create jobs for boosting young population.
- Rising numbers of engineering graduates.
- Effecting engineer's employment of privatization and marketing on electrical and telecommunication areas especially cause young engineers to be unemployed.
- Even foresights for employment run with planning contexts cannot be done any more with closed state planning organization.
- The young carry on registering to engineering faculties with great expectations and after graduation they meet unemployment dilemma.

EMO's suggested solutions for this issue (EMO, 2017) are the followings;

- Strategical planning and creating policies are needed to help technological improvements of our country with pioneered science and mind.
- Making urgent educational and employment planning are necessary at Electrical, Electronics, Telecommunication and Biomedical Engineering.

Above mentioned identified and suggested solutions are completely true. In addition to these, the followings should be added:

- On top of the problems financing of universities becomes first. Contribution margin to secondary education with general budget a higher education contribution margin foundation should be generated. (Akdeniz, 2003).
- Arranged rights to universities from general budget should be raised. Although numbers of universities, faculties, vocational colleges and students expand every year, reserved allowances for higher education decline year by year proportionately. For example, in 1993 0.90% of the GNP, 4.1% of the budget were reserved for higher education. In 1999, 0.84 % of the GNP, 2.8% of the budget were able to allotted for higher education. 2000 fiscal year budget law 0.80 % of the GNP, 2.2% of the budget designated for higher education. (YÖK, 2000). Even though with 15.9 % raise in 2016, 1.05 of the GNP, 4.6 % of the budget were allocated, this amount is not enough yet. (BUMKO,2017).
- Engineering departments should not be introduced without making essential infrastructure laboratories and teaching staffs.
- Privileges should be supported and infrastructures should be renovated at certain periods for updated technologies.
- At the state universities among total 6.137.014 students, there are 1.290.760 registered students in formal programme undergraduate studies and there are 420.705 registered students in evening programme at undergraduate studies. For the total 1.711.465 students, 21.834 professors, 14.481 associate professors and 31.130 doctor teaching staff total 68.445 teaching staff, 43.352 research assistants carrying on education and teaching too. (YÖK, 18.04.2017). Even if numbers of students to be 25 quantitatively with these numbers per teaching staff,there are unstable sharing situations among various disciplines against engineering faculties.Numbers of students per teaching staffs should be lessened to this ratio at engineering faculties as well.
- Although YÖK practised teaching staff education programme in different years, it will take long years to fill in missing numbers of teaching staffs. Because of the low income policy,teaching staff occupation lost its appeal and academic life should be made attractive for gifted and accomplished students.
- The critical circumstance to catch sustainable development at higher education is upsurging numbers of teaching staffs offering higher education. In spite of huge increase at numbers of teaching staffs and doctorate graduates, there are two significant problems. The first one: teaching staff focus on big cities. This occasion constitues imbalanced proportions among programmes, departments and faculties based teaching staffs. Besides,emerging instabilities influence both quality of the education and diminish capacity of teaching staffs with over load courses. Secondly, There are imbalances at delivering teaching staffs based on faculties, departments and programmes. (Öze, 2011).
- The top restriction should be 50.000 for Electrical, Electronics, Electrical-Electronics, Telecommunication and Biomedical Engineerings.

Unless afore mentioned expectations should be met, there will be enormous unemployed engineers crowd in the near future. Moreover, sources of the country will be used in vain and students wishing to be engineers with great enthusiasm for engineering will lack of notional science and mathematic information.

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