The effects of the changes that have taken place in the global pedagogical paradigms in Turkish engineering education

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ABSTRACT: The aim of this research is to evaluate engineering education in Turkey in the direction of student ideas. For this purpose, 842 students were administered a survey. The findings show that the paradigm of engineering education in Turkey is a traditional curriculum that is not centred on industry. This paradigm places particular importance on the cognitive progress in education and neglects emotions. Also, it was found that instructors tend not have sufficient pedagogical backgrounds. The problem seems to be related mainly to the pedagogical paradigm. According to the students surveyed, reformation is inevitable.

INTRODUCTION

The changes that have taken place in the pedagogical paradigm in recent years has affected engineering education system deeply and had led to new demands on the schools [1][2]. Multidisciplinary engineering education has became obligatory, since monodisciplines are considered as being inefficient in solving complex problems concerning many disciplines today. Therefore, presentation strategies in classes have left their place to methods such as problem based on learning and free discussion [3].

Defined as critical thinking motors, engineering schools follow multidimensional instructional strategies that are focused on cognitive, physical and affective progress in order to educate global engineers who can use all their capacity [4-6].

Defined also as post-modern paradigm, today's paradigm leads to significant changes in the roles of students and instructors. The instructor is considered to be a guide for facilitating learning, while the student is a passive recipient who is considered as an individual responsible for learning (Köksoy cited in [7]).

These changes in the pedagogical paradigm are reflected in many countries – especially in the USA – as *student-centred teaching strategies* [1][8]. However, the engineering education in Turkey is still based upon Fordist production principles.

As a result, an uncreative, imitator engineer profile has emerged. This is why Turkey is not able to advance in science and technology, despite having a potential of 500,000 engineers [9][10]. It does not have to continue in this way; Turkish engineering education has to prove that it is indeed useful [11][12].

Aim of the Research

The aim of this research is, in light of the global pedagogical paradigm, to evaluate the engineering education available in Turkey in the direction of student ideas.

METHOD

Population and Sampling

The population of this study incorporated fourth grade students from the Engineering Faculties at the universities of Fırat, Dicle and Inönü in 2004-2005. The samples comprised 842 fourth grade students who were administered a specially devised and implemented survey.

The distribution of these students, according to gender, discipline and universities, is listed in Table 1.

Table 1: Demographic data of the surveyed students.

Variables	N	%
Gender		
Male	188	22,3
Female	654	77,7
Discipline		
Computer-Electric-Electronic	204	24,2
Construction-Architecture	202	24,0
Machine-Metallurgy	222	26,4
Geology-Mining-Chemistry	214	25,4
University		
Firat	293	34,8
Dicle	288	34,2
Inonu	261	31,0
Total	842	100

Data Collection Tool

Data was gathered using a survey prepared by the researcher. Before preparing the survey, related literature was searched on obtaining the views of students and instructors. A trial survey form was prepared.

This trial form was then administered to 168 students from different branches as a pilot application in Elazig city centre and subjected to factor analysis. Those items whose factor degrees were found to exceed 0.35 were considered as useful, while those items that fell under this rate were removed from the survey [13].

After these processes, the rates for the survey were found to be: KMO = 0.666 (sd=990), Barlett = 2917.726, Cronbach alpha = 0.831.

Data Analysis

Data in this study was analysed using percentage and frequency. Using the variables gender and discipline, it was tested by chi-square (X^2) as to whether or not there was a significant difference between the students' views. The significant difference between the students' views, according to these variables, have been interpreted and are shown in Tables 2 and 3. Insignificant differences have not been taken into consideration. The significance level is accepted as p=0.05.

Table 2: Distribution of the students' views according to gender.

Item	Gender	No		Partly		Yes		X^2	p
		f	%	f	%	f	%		
1	Female	68	36.2	74	39.4	46	24.5	11.388*	0.003
	Male	164	25.1	262	40.1	228	34.9		
13	Female	36	19.1	40	21.3	112	59.6	9.857*	0.007
	Male	28	4.3	62	9.5	564	86.2		
19	Female	8	4.3	8	4.3	172	91.5	7.497*	0.024
	Male	50	7.6	58	8.9	546	83.5		

FINDINGS

Findings on Choosing the Right Students for Engineering Education

As shown in Table 4, it can be seen that 32.5% of the students chose engineering education since they were interested in it, 39.9% answered were partly interested, while 27.6% of the students chose this department even they were not actually interested in the field.

A significant difference was found among the students' views about item 1 according to the variables of gender (X^2 = 11.388; p=0.003) and discipline (X^2 =103.887; p=0.000).

Table 4: Distribution of the students' views on their preference of engineering education.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
1	Did you prefer engineering education because you are interested in this area?	274	32.5	336	39.9	232	27.6

Findings on Whether Engineering Education is Pleasing to Students

Table 5 shows that 81.5% of the students surveyed found engineering education to be insufficient. Indeed, 69.4% of these students found the available education insufficient on the account of school-industry cooperation, 61.3% on the laboratories and 55.6% on the content.

Concerning the students' viewpoints about item 2, a significant difference was detected according to the discipline variable (X^2=36.801; p=0.000).

Table 3: Distribution of the students' views according to discipline.

Item	Discipline	No		Partly		Yes		X^2	p
		f	%	f	%	f	%		
1	Computer-electric-electronic departments	66	32.4	46	22.5	92	45.1	103.887*	0.000
	Construction-architecture departments	24	11.9	136	67.3	42	20.8		
	Machine-metallurgy departments	77	34.7	66	29.7	79	35.6		
	Geology-mine-chemistry departments	65	30.4	88	41.1	61	28.5		
2	Computer-electric-electronic departments	16	7.8	20	9.8	168	82.4	36.801*	0.000
	Construction-architecture departments	10	5.0	48	23.8	144	71.3		
	Machine-metallurgy departments	17	7.7	22	9.9	183	82.4		
	Geology-mine-chemistry departments	5	2.3	18	8.4	191	89.3		
	Geology-mine-chemistry departments	22	10.3	28	13.1	164	76.6		
	Geology-mine-chemistry departments	62	29.0	27	12.6	125	58.4		
13	Computer-electric-electronic departments	146	71.6	34	16.7	24	11.8	26.734*	0.000
	Construction-architecture departments	144	71.3	36	17.8	22	10.9		
	Machine-metallurgy departments	169	76.1	30	13.5	23	10.4		
	Geology-mine-chemistry departments	119	55.6	48	22.4	47	22.0		
17	Computer-electric-electronic departments	2	1.0	4	2.0	198	97.1	54.949	0.000
	Construction-architecture departments	10	5.0	38	18.8	154	76.2		
	Machine-metallurgy departments	15	6.8	15	6.8	192	86.5		
	Geology-mine-chemistry departments	9	4.2	11	5.1	194	90.7		
	Geology-mine-chemistry departments	101	47.2	63	29.4	50	23.4		

Table 5: Distribution of the students' views on how pleased they were with the engineering education provided to them.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
2	Is the education you get sufficient for being a qualified engineer?	48	5.7	108	12.8	686	81.5
3	Is the education you get sufficient on account of school-industry cooperation?	112	13.3	146	17.3	584	69.4
4	Are laboratories and equipment in the department sufficient and current?	178	21.1	148	17.6	516	61.3
5	Is the education you get current and sufficient on account of content?	170	20.2	204	24.2	468	55.6

Findings on the Pedagogical and Vocational Sufficiency of Instructors

Table 6 shows that 76% of the students surveyed considered the instructors to be pedagogically insufficient, with 55.6% finding them to be insufficient in vocational knowledge. Indeed, 56.6% of the students surveyed felt that the instructors were using their capacity for their own progress instead of teaching.

Table 6: Distribution of the students' views on the pedagogical and occupational qualifications of their instructors.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
6	Are the instructors sufficient pedagogically?	66	7.8	136	16.2	640	76.0
7	Are the instructors sufficient on account of vocational knowledge?	188	22.3	186	22.1	468	55.6
8	Instructors use their knowledge, intelligence and capacity for their own progress and edition studies.	476	56.5	134	15.9	232	27.6

Findings on Instruction and Teaching Strategies

According to the data in Table 7, 59.1% of the students considered that the engineering education made available to them did not take students' interests and needs into account.

According to 60.1% of the students surveyed, the lessons were being performed with presentation methods, but not with the problem solving method (50.8%). Notably, 58% of the students surveyed were not pleased with the success of the assessment and evaluation methods.

Table 7: Distribution of the students' views on teaching strategies.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
9	Are students' interests and needs being taken into consideration?	144	17.1	200	23.8	498	59.1
10	Are the lessons performed by presenting information and narration methods?	428	50.8	138	16.4	276	32.8
11	Are the lessons performed using a real problem solving method?	150	17.8	186	22.1	506	60.1
12	Are you pleased with the method by which your success in education is being evaluated?	212	25.2	142	16.9	488	58.0

Findings on the Affective Dimension of Students' Engineering Education

As can be seen in Table 8, 68.6% of the students surveyed thought that engineering education did not take their feelings into consideration. Indeed, 62.7% of these students find this education to be insufficient with regard to educing students' social skills, with 65.6% of them deeming it insufficient for understanding human psychology. It was found that 62.7% of the students surveyed considered that this education was not adequate in facilitating their understanding of their skills and controlling their feelings.

Table 8: Distribution of the students' views on the affective dimension of their engineering education.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
13	Is the education you get taking your feelings into consideration besides the mind?	116	13.8	148	17.6	578	68.6
14	Is the education you get sufficient in bringing social communication skills to you?	174	20.7	140	16.6	528	62.7
15	Is the education you get bringing in skills to understand human psychology?	66	7.8	224	26.6	552	65.6
16	Is the education you get bringing in the skills for understanding and controlling your feelings?	166	19.7	148	17.6	528	62.7

According to the variables of gender (X^2 =9.857; p=0.007) and discipline (X^2 = 26.734; p=0.000), a significant difference was found between the students' views about item 13 in Table 8.

Findings Concerning Reformation in Engineering Education

Table 9 shows that 87.6% of the students surveyed thought that engineering education should be reformed. Indeed, 87.2% of the students engaged in the survey considered that engineering education should be based on informatics technology, with 85.3% of the students thinking that greater emphasis should be placed on English teaching. According to 80.8% of the students surveyed, engineering education should focus on social problems. The percentage of those students who demanded multidisciplinary engineering education was 71.7%, while the percentage of the students who wanted economics, social and human sciences lessons to be added to the teaching programmes was 66%.

Table 9: Distribution of the students' views about the reformation of engineering education.

Item	Views	Yes		Partly		No	
		f	%	f	%	f	%
17	Do you think that the available engineering education should be reconstructed?	738	87.6	68	8.1	36	4.3
18	Within reformation, engineering education should be based more on informatics technology.	734	87.2	76	9.0	32	3.8
19	Within reformation, English teaching should be given more importance.	718	85.3	66	7.8	58	6.9
20	Within reformation, engineering education should focus on social problems.	680	80.8	108	12.8	54	6.4
21	Within reformation, engineering education should be multi-disciplined.	604	71.7	132	15.7	106	12.6
22	Economics, social and human sciences lessons should be also added to the programmes.	556	66.0	122	14.5	164	19.5

A significant difference was found between the students' views about item 24 in Table 9 according to the gender variable (X^2 =7.497; p=0.024). Additionally, a significant difference was also detected between the students' views about item 17 according to the discipline variable (X^2 =59.949; p=0.000).

ARGUMENTS AND RESULTS

Arguments and Results on Choosing the Right Students for Engineering Education

For a successful engineering education, firstly students who are interested in this profession should be chosen [10][14].

The findings listed in Table 4 show that two thirds of the students chose this field of study despite them having partly or no interest in the discipline. This situation is a serious problem that affects quality, because some effective characteristics, such as interest and attitude, have a direct impact on efficiency and creativity [4][10]. This problem has probably resulted from not taking students' interests, attitudes and skills into consideration in university entrance examinations. Also, families and the press are partly responsible for this situation because they, without taking students' interests and skills into consideration, direct students to 5-10 jobs, considering that these jobs bring high economic standards with them [15]. The solution is to prepare an examination system that selects those students who are skilful and have interest in the field of engineering from the 1,750 students demanding entrance to universities every year.

It was determined in this research that males have much higher levels of interest in engineering education (see Tables 2 and 3). This may have resulted from technical jobs being thought to be male-oriented jobs in Turkey, while females have a secondary condition in working areas. According to the research findings presented in this article, the students from computer-electric-electronic departments have the highest levels of interest, while those students from construction and architecture departments have the lowest levels of interest (see Tables 2 and 3).

Arguments and Results on Pleasing Students in Engineering Education

Today, all definitions of quality focus on the customer. Thus, today's paradigm handles quality in engineering education as student satisfaction [9]. Related to this, the findings listed in Table 5 show that 81.5% of the students surveyed found the available education to be insufficient. It was revealed that 69.4% of the students considered school-industry cooperation to be insufficient, with 61.3% of them also deeming the laboratories to be insufficient. It was also found that 55.6% of the students thought that the available education was not current.

These findings can be interpreted that students are not satisfied with the engineering education provided. This problem is also the same in big universities in the Marmara district, where 60% of Turkish industry takes place [16]. For instance, research by the Chamber of Architects and Engineers in Turkey found that graduates from engineering departments were dissatisfied. Other research carried out in Marmara and Istanbul Technical University revealed that only 23% of the students found school-industry cooperation to be sufficient [17]. These findings show that the engineering education in Turkey is far from pleasing to students with its dimensions of school-industry cooperation, equipment and programme content.

In the research, it was determined that the students from computer-electric-electronic departments considered the available education to be mostly sufficient, while those students from geology-mining-chemistry departments deemed it most insufficient. This finding can be interpreted as a sign of the level of quality of education in these departments.

Arguments and Results on the Pedagogical and Vocational Capacity of Instructors

Today's pedagogical paradigm stresses the pedagogical capacity of instructors [18][19]. Therefore, for a qualified education, instructors should be aware of new pedagogical concepts and learning methods, and reflect these in their teaching [14].

However, according to Table 6, 55.6% of the students found their instructors to be insufficient vocationally, while 76% of

the students surveyed considered them insufficient pedagogically. This situation adversely affects the quality of engineering education. Since learning the character of engineering depends on pedagogical qualifications of instructors [7][10][20].

Notably, 56.5% of the students surveyed were of the opinion that their instructors were using their intellect and capacity for their own academic progress, rather than for teaching. This problem arises from a system that only accepts the number of editions admitted to the Science Citation Index (SCI), in order to gain academic progress [21]. This means that students are being neglected. The solution is to take the educational qualities of instructors into consideration when considering academic progress, or to classify instructors as researchers and teachers.

Arguments and Results on Instruction and Instructional Strategy

The data gathered over the last few years has deeply influenced instructional strategies [15]. In the recent paradigms, teaching is now more based on solving problem and aims to realise multi-directional and maximum teaching [7][11].

In Table 7, it was revealed that 59.1% of the students felt that their interests and needs were not being given proper importance. It was found that 60% of the students surveyed thought that teaching was not based on problem solving, with 50.8% of the students considering the teaching to be based on the presentation strategy. However, as Lazarowitz noted, the presentation strategy is an inefficient approach and does not contribute to academic and social progress (cited in [7]).

In the research, it was identified that 58% of the students were not pleased with the method of evaluating success. This finding shows that the available evaluation system, which depends upon examinations, is not satisfying to students. This finding also proves that engineering education in Turkey lies opposite with the student-centred global pedagogical paradigm.

Arguments and Results on the Affective Dimension of Engineering Education

Contrary to traditional paradigm stressing external stimulus; today's emphasis is upon emotions, the inner world and self-determination of individual. According to this, engineering education should focus on inner motivation and developing the intellectual and affective capacities of the individual [22].

In the findings shown in Table 8, 68.6% of the students thought that engineering education did not take emotions into consideration. This finding shows that Turkish engineering education focuses only on intellectual development and is not in accordance with the holistic instructional paradigm that places importance also on emotions [4][22-24]. It was found that 62.7% of the students surveyed considered engineering education to be insufficient with regard to facilitating social communication skills, while 65.5% of the students thought their education to be insufficient concerning human psychology. This points at a crucial problem because engineering is also involves the art of cultural communication skills, empathy, understanding human psychology and producing appropriate solutions. Therefore, an engineer should be aware of the deep relationship that exists between technology and the social context [10][14].

It was also found that 62.7% of the students considered this education to be lacking with regard to encouraging skills in controlling emotions; this is also a crucial problem. Since controlling emotions is related closely to effective communication and identifying solutions to problems. All of these show that Turkish engineering education neglects affective progress and focuses instead on intellectual progress. This situation is an important problem, because the cost of neglecting emotions in education is a reduced capacity of intellect [4].

In the research, it was found that the females considered there to be greater insufficiencies when compared to males (Tables 2 and 3). This can be interpreted that the female students are being more sensitive than their male counterparts.

Those students from geology-mining-chemistry departments found engineering education to be the most sufficient when taking emotions into consideration, while the students from machine-metallurgy departments deemed it the most insufficient (Tables 2 and 3). This finding can be interpreted as geology-mining-chemistry departments giving greater emphasis on emotions when compared to other departments.

Arguments and Results on Restructuring Engineering Education

Almost everybody in Turkey accepts that reformation is necessary in the area of engineering education. The problem lies in how to accomplish this. Although everybody declares their ideas on this subject, students' being silent is a paradox.

The findings listed in Table 9 show that 87.6% of the students demand reforms in engineering education. According to 87.2% of the students, engineering education should be based on informatics. This view is in accordance with today's paradigm [16]. It is very sensible for the students to demand English-centred education (85.3%). The position of the USA in world of science and technology makes English necessary for engineers. The fact that some engineering faculties in Turkey consider that being English-centred is very popular confirms this [25][26].

The students demand a multidisciplinary education policy (71.7%), an education policy that is sensitive to social problems (80.8%) and the lessons of economics and the social and human sciences (66%). These are appropriate with today's multi-disciplined engineering education paradigm. It is apparent that this mentality is gaining popularity at educational institutions of developed countries [3][12][27][28]. The views of engineering students should be evaluated as crucial demands that should be seriously considered when reforming engineering education in Turkey.

In the survey, it was found that the females place much more importance on English in engineering education (Tables 2 and 3). This may be interpreted as females being more open to globalisation.

In the research, it was found that the students from computer-electric-electronic departments demanded reformation in engineering education the most (97.1%), while the students from construction-architecture departments demanded it the least (76.2%). This situation may be related to the expectation levels of those students from computer-electric-electronic departments in that the preferences of the best students are higher than for those students from other departments.

Results in General

The results obtained in this research study are intended to aid the evaluation of engineering education through student views by showing that engineering education in Turkey is far from satisfying student expectations with regard to the following dimensions:

- The student selection system;
- The qualifications of instructors;
- The curriculum content and presentation;
- Evaluation;
- Education strategy.

Indeed, these problems seem to be related to not identifying a suitable educational paradigm. Especially over the last 15-20 years, Turkey has not kept up with the various changes to the pedagogical paradigm that have occurred in engineering education. The result is that, with a few exceptions, an out of date engineering education model is training staff to state offices, which are already full of staff, by demanding great funds for this, instead of training enterprising engineers who have global qualifications and capacity to turn science into technology. This situation is among the main reasons why Turkey has experienced no improvement concerning science and technology, despite the potential it has.

The problem in Turkish engineering education is mostly related to pedagogical paradigm, because the instructional strategy has a critical importance in determining engineers' qualifications. In order to train renascence engineers, who have global qualifications, Turkish engineering education has to accept an education policy that is sensitive and relevant to industry and global paradigms [14].

That is why an immediate change is inevitable. Although there are various obstacles, such as the available form of Turkish industry and the level of bureaucratic resistance at universities, this change can still be accomplished by the potential of the younger population, with a great demand for education, a perspective in line with the European Union (EU), a culture full of the desire for development and change, and by forcing available economic conditions.

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