TÜRKİYE'DE MEKATRONİK ÖNLİSANS EĞİTİMİN GELİŞİMİ VE BUGÜNKÜ DURUMU

DEVELOPMENT AND PRESENT SITUATION OF MECHATRONICS ASSOCIATE'S EDUCATION IN TURKEY

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ABSTRACT

The education of mechatronics in Turkey continues on master, graduate, associate and Anatolian high school degrees nowadays. There is Mechatronics engineering master education in four universities, Mechatronics Teacher's Education in two universities. Mechatronics associate's education has started in Kocaeli University Gebze Vocational School and Sakarya University Sakarya Vocational School in 2001 and reached to the number of 21 schools in 17 universites in 2008. Only Sakarya University Adapazarı Vocational School has the internet based education. In this study, the present situation of mechatronics education in Turkey was investigated in Vocational Schools. Increasing of the number of Mechatronic programs and their quotas, regional distribution of the Mechatronics programs in accordance with provincial centers and townships were reviewed. The existence of Electrical and Electronics, Mechanics and Computer programs in the vocational schools that has Mechatronics program was investigated. Because these programs are the sub-components of the mechatronics education. In addition to this, the current situation of the mechatronic programs were evaluated in general view.

Keywords: Turkey, Mechatronics, Associate's Education, Development.

ÖZET

Günümüzde Türkiye'de mekatronik eğitimi, lisansüstü, lisans, önlisans ve Anadolu Meslek Lisesi düzeyinde verilmektedir. Dört üniversitede Mühendislik Lisans, iki üniversitede Mekatronik Öğretmenliği Lisans eğitimi bulunmaktadır. Türkiye'de mekatronik önlisans eğitimi 2001 yılında Kocaeli Üniversitesi Gebze Meslek Yüksekokulu'nda ve Sakarya Üniversitesi Sakarya Meslek Yüksekokulu'nda başlamış ve 2008 yılı itibariyle 17 üniversitede 21 programa ulaşılmıştır. Bu programlardan sadece Sakarya Üniversitesi Adapazarı Meslek Yüksekokulu mekatronik programı internet tabanlı uzaktan eğitim vermektedir. Bu çalışmada Türkiye'de mekatronik önlisans eğitiminin başlangıcı, gelişimi ve bu günkü durumu araştırılmıştır. Yıllara göre mekatronik programlarında ve kontenjanlarında meydana gelen artışlar, programlarının bölgesel dağılımları, il ve ilçelere göre dağılımları incelenmiştir. Mekatronik programı olan Meslek Yüksekokulları'nda mekatroniğin alt bileşenlerini oluşturan Elektrik-Elektronik, Makine

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ve Bilgisayar bölümlerinin olup olmadığı araştırılmış ve genel olarak bu günkü tablo içerisinde mekatronik programlarının durumu değerlendirilmiştir.

Anahtar Kelimeler: Türkiye, Mekatronik, Önlisans Eğitimi, Gelişim.

1. INTRODUCTION

The term "mechatronics" was first introduced by a Yaskawa Electric Engineer in 1969 (Kyura and Oho, 1996). Although many definitions about this term were expressed in the following years (Auslander,1996), the most widely known one is: "The synergistic integration of mechanical engineering with electronics and intelligent computer control in the designed manufacturing of industrial products and processes" (Harashima,1996). In recent years, this synergistic integration that have already existed in the nature of mechatronics has been compatible with market demands together with the rapid developments in computer, microprocessor, power electronics and software technologies, and as a result it has become more and more popular rapidly.

The increasing demand for the products of mechatronics found in every field of daily life stimulated the need for well-educated human resources in this field. Since 1983, Toyohaski University has run a regular Mechatronics Education course in mechatronics engineering in Japan, and in Europe; on the other hand, the beginning of mechatronics education has dated back mid 1980's (Acar and Parkin,1996). The courses of mechatronics engineering at undergraduate and graduate levels as well as vocational training courses are increasing rapidly all over the world (Acar,1997). Today, education of mechatronics engineering is given in many countries throughout the world.

Although mechatronics was introduced to Turkey in 1993, the development in this subject were performed in a quite slow course. In the early 2000, it became possible for mechatronics to be widely known in academic and industrial fields. Today, mechatronics, even with a limited capacity, has become a kind of discipline in every level of education from high school level to master degree (Akpınar, 2004). The education of mechatronics has started in Turkey late after Japan, America and Europe. Though there was a specific development during 16 years from 1993 to 2009, there appeared no rapid and widespread of mechatronics. The educational experiences obtained on graduate and master degree have been reflected slowly into associate and high school degrees.

Gürbüz (2004) has carried out probably the most detailed study ond Mechatronic Education in VSs in Turkey made significant suggestions about the system; howewer has not performed the latest developments after 2004. The present study discusses changes on student quotas, situation of VSs in geographical regions, the latest developments and general problems and solution suggestions.

2. A GENERAL VIEW OF MECHATRONICS EDUCATION

Mechatronics was introduced into Turkey's agenda in 1993 (Akpınar, 2006). Since then, Middle East Technical University (METU) has been holding international meetings of "International Mechatronics Designing and Modeling Study". Besides since September 1994, METU has been publishing an international journal about mechatronics named as "International Journal of Intelligent Mechatronics: Design and Production" (Dülger, 2002).

Since 2008, mechatronics education in Turkey has been continued on master, graduate, associate and High School degrees (Table 1).

Table 1. Mechatronics Education as graduate, master, associate and high school level

Engineering Education	**Technical Education Faculties**
Sabancı University [a,b]	Marmara University [a]
Kocaeli University [a,b]	Suleyman Demirel University [a]
Bahçeşehir University [a,b]	
Ortadoğu Technical University[c]	
Atılım University [a]	
Bogazici University [b]	
Istanbul Technical University[b]	
Dokuz Eylul University [b]	
Vocational Schools	
Bahçesehir University VS	Kastamonu University VS
Balıkesir University Edremit VS	Kocaeli University Gebze VS
Celal Bayar University Soma VS	Kocaeli University Karamursel VS
Çanakkale Onsekiz Mart University Çan VS	Mustafa Kemal University Iskenderun VS
Dokuz Eylul University Izmir VS	Namık Kemal University VS
Gaziantep University Gaziantep VS	Sakarya University Sakarya VS
Gaziosmanpasa University Turhal VS	Sakarya University Adapazarı VS [DE]
Gaziosmanpasa University Zile VS	Selçuk University Kadınhanı Faik Içil VS
Giresun University Şebinkarahisar VS	Selçuk University Eregli VS
Kadir Has University VS	Uludağ University Technical Sciences VS
Karadeniz Technical University A. Kanca VS	
High School Education (Anatolian VHSs)	
Balgat (Ankara)	Hurriyet (Bursa)
Çayırova (Kocaeli)	

[a] GRADUATE EDUCATION [b] MASTER EDUCATION [c] BRANCH EDUCATION

Engineering graduate and master degree education in Sabancı, Kocaeli and Bahçeşehir Universities, engineering graduate education in Atılım University, mechanical engineering as a lateral branch in METU, master degree in Science Institute of Bogazici University, Istanbul Technical University (ITU) and Dokuz Eylul University, Erciyes University, graduate degree of mechatronics teaching in Technical Education Faculties of Marmara and Suleyman Demirel Universities have been continued. While there is a program of mechatronics on an associate degree in 21 VS, one of which has a distance learning education, there is an education of mechatronics in Balgat (Ankara), Çayırova (Kocaeli), and Hürriyet (Bursa) Anatolian VHS since 2003-2004 education periods.

3. VOCATIONAL SCHOOLS AND MECHATRONICS EDUCATION

In Turkey, mechatronics education started in Kocaeli University Gebze VS and Sakarya University Sakarya VS in 2001 on a VS level. Before the undergraduate education of mechatronics started in Turkey, VSs had programs of electrics, electronics, computer and machine independent from each other. The first experiences aiming at mechatronics undergraduate education were observed in the programs of 'Control Systems Technology' (CST) where the basic courses were Electric, Electronics, Control and Computer.

Before 2001 when the mechatronics undergraduate education started in Turkey, the education of CST program considered as the closest program to mechatronics was given in only three of the present 21 schools (Table 2).

Table 2. Programs and Student Quatos of Vocational Schools in Turkey

	Vocational Schools Mechatronic Programs	FE	EE	DE	Geographic Region	City -Town
1	Bahçesehir University VS	60	60	-	Marmara	City
2	Balıkesir University Edremit VS	30	30	-	Marmara	Town
3	Celal Bayar University Soma VS	40	-	-	Aegean	Town
4	Çanakkale Onsekiz Mart University Çan VS	40	40	-	Marmara	Town
5	Dokuz Eylul University Izmir VS	45	45	-	Aegean	City
6	Gaziantep University Gaziantep VS	30	-	-	Southeast Anatolia	City
7	Gaziosmanpasa University Turhal VS	35	-	-	Blacksea	Town
8	Gaziosmanpasa University Zile VS	40	40	-	Blacksea	Town
9	Giresun University Şebinkarahisar VS	40	-	-	Blacksea	Town
10	Kadir Has University VS	50	50	-	Marmara	City
11	Karadeniz Technical University A. Kanca VS	40	-	-	Blacksea	Town
12	Kastamonu University VS	50	50	-	Blacksea	City
13	Kocaeli University Gebze VS	50	50	-	Marmara	Town
14	Kocaeli University Karamursel VS	40	-	-	Marmara	Town
15	Mustafa Kemal University Iskenderun VS	30	30	-	Mediterranean	Town
16	Namık Kemal University VS	40	-	-	Marmara	City
17	Sakarya University Sakarya VS	30	-	-	Marmara	City
18	Sakarya University Adapazarı VS (DE)	-	-	700	Marmara	-
19	Selçuk University Kadınhanı Faik Içil VS	40	-	-	Central Anatolia	Town
20	Selçuk University Eregli VS	40	-	-	Central Anatolia	Town
21	Uludağ University Technical Sciences VS	30	30	-	Marmara	City
	Total	**800**	**425**	**700**		

FE: FORMAL EDUCATION, EE: EVENING EDUCATION , DE: DISTANCE EDUCATION

Today, it is seen that these three schools have the highest degree of the experience on the way to mechatronics education. Of these schools, VS of Gaziantep University transformed their CST program into mechatronics program in 2002. The other one, was CST program of Izmir VS of Dokuz Eylul University. This program underwent a much more different change. In 2002, "The CST Program" as a part of VS program development project decided to change the name of the program as "Industrial Automation" and finally the curriculum was prepared according to it without making branch division (Balcı et.al., 2003). Industrial Automation Program of Izmir VS of Dokuz Eylul University was turned into mechatronics program in 2007 by considering the demands of Chamber of Industry of Aegean Region (EBSO) for well – educated human resources in this field.

Since 2008, these two schools of 21 VS giving mechatronics associate's education in Turkey have been the oldest schools having the experience of education in the field of Control and Automation. While 17 of 21 VS giving associate's education of mechatronics since 2008 were continuing their education with different programs according to the curriculum in 2000, the rest three schools (A.Kanca VS, Gebze VS, Adapazarı VS) were established after 2000. Mechatronics education in VSs has been improved throughout the Turkey since 2002 and the student quotas and newly-opened departments per year are as follows Table 2.

- 2001: Totally 55 students, 30 of whom were in Kocaeli University Gebze VS and 25 of whom were in Sakarya University Sakarya VS having formal education.

- 2002: 30 students having formal education in Gaziantep VS of Gaziantep University, Tekirdag VS of Trakya University (today connected to the Namık Kemal University) and Turhal VS of Gaziosmanpaşa University.
- 2003: The first internet-based distance learning program of Turkey started in Adapazarı VS of Sakarya University with 300 students.
- 2004: 30 students having formal education in Şebinkarahisar VS of Sivas Cumhuriyet University (today connected to the Giresun University) and 50 students with formal education in Karamürsel VS of Kocaeli University.
- 2005: 90 students having formal and evening education in technical science VS of Uludağ University and 40 students in Eregli and Kadınhanı VS of Konya Selçuk University.
- 2006: No program was set up in addition to present quotas. Besides, student quotas having evening education in technical science VS of Uludağ University was reduced from 90 to 60 as opposed to previous year.
- 2007: 40 students having formal and evening education in VS of Izmir Dokuz Eylul University and 30 with formal education in Çan VS of Çanakkale 18 Mart University, Edremit VS of Balıkesir University and İskenderun VS of Mustafa Kemal University. Besides, student quotas having formal education in technical science VS of Kocaeli University was reduced from 50 to 40 as opposed to previous year.
- 2008: 120 students having formal and evening education in VS of Bahceşehir University, 40 in Soma VS of Celal Bayar University and 100 with formal and evening education in VS of Kastamonu University, 50 with formal education in VS of Kadir Has University, 40 with formal education in Karadeniz Teknik University A. Kanca VS.

While the number of mechatronics program in 2001 was two and student quotas were 55, this number increased to 21 including distance learning programs and student quotas increased to 1925 in 2008. It can be estimated that, in view of the intensive interest and demand for mechatronics and the need of the sector, these numbers will increase more and more.

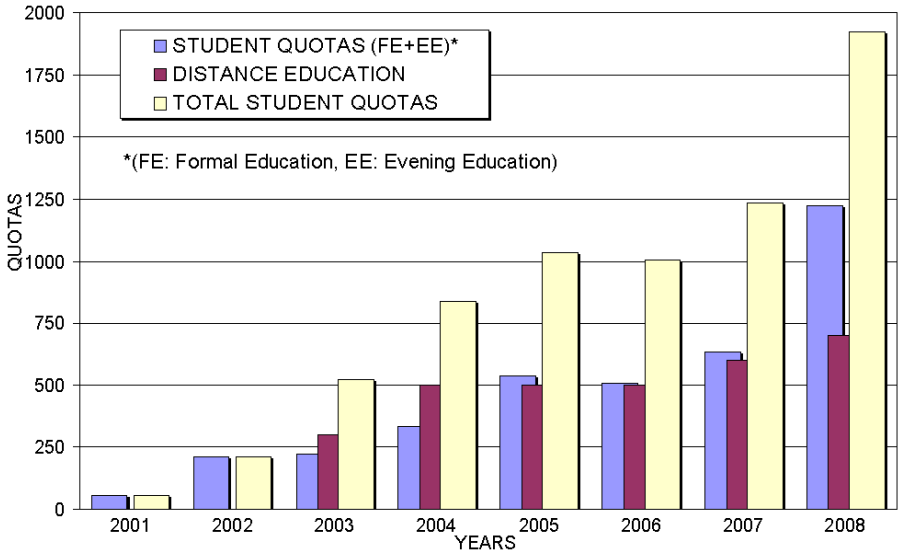

Figure 1. Student Quotas versus years.

3.1. Distribution according to regions and residential units

The distribution of Mechatronics programs according to seven Geographical Regions of Turkey varies. While there is not any mechatronics program in Eastern Anatolia, Marmara Region has the highest number of programs in ten schools. This is quite normal, because Marmara Region is the most advanced region in terms of its industrialization. Though the second region following Marmara is the Aegean Region with an advanced industry, it is quite behind Marmara in terms of mechatronics programs. In Aegean Region, the first mechatronics associate's program was set up in VS of Dokuz Eylul University in 2007. Since 2008, there has still been a Mechatronics undergraduate education in only two universities of Aegean Region. In Blacksea Region, whose industrial development is far behind compared to Aegean and Marmara, this education of mechatronics is given in five VSs. Central Anatolia has two VSs while Mediterranean and South East Anatolia have one VS giving Mechatronics associate's education. Furthermore, in the universities of some big industrialized cities such as Kayseri, Eskişehir, Denizli, there is also mechatronics associate's education (ÖSYM, 2000-2008). Considering the distribution of mechatronics programs of the year 2008 in accordance with provincial centers and townships, nine programs are in provincial centers (except for distance learning) and 11 programs are in townships.

3.2. Distance education

Although Mechatronics undergraduate education started in 2001, there is internet-based distance learning in only one of the 21 schools which have still been maintaining their education. While Adapazarı VS of Sakarya University, which started its distance learning program in 2003, admitted 300 students during the early years, in 2008 this number has reached to 700. In this program the services such as textbooks, CDs, internet access packages are provided by a standard education fee. The courses are given on internet by computer animations and simulations. In a 50 student imaginary classes, students can ask questions by means of e-mails, forms, and chat programs, receive special help and take assignments. At the end of the first semester, students get condensed campus training for fifteen training days and consolidate their knowledge. Moreover, the students get a training of thirty days at the end of the third semester and consolidate their practical knowledge. There is a summer school for students who fail some of the classes. The students of this program who have the same rights like those of organized education are entitled with the degree of "mechatronics technician" (Akpınar, 2006).

There is a crowded and young ambitious group of students in Turkey who demand for having a university education of profession. This demand cannot be met due to lack of resources and staff available. In this situation, virtual and remote laboratories will contribute to the development of technical VS of higher education in Turkey by filling the absence of adequate staff and instrument (Uzun and Kara, 2007). Thus, it can be stated that to spread the education of Mechatronics by means of the present facilities and sources will take certain time period. So, it is necessary to advance and support the internet-based education.

3.3. The other programs related to mechatronics in VSs giving mechatronics associate's education

In Table 3, it was observed whether there are any other programs comprising sub-components of mechatronics in VSs giving mechatronics undergraduate education
Considering the employment of teaching staff and common use of the laboratory, the programs in relation to mechatronics such as Computer, Electric, Industrial Electronics, Industrial Automation, Machinery and Automotive Programs were evaluated. The schools whose curriculum includes Computer, Electric, Electronics and Machinery Programs have important advantages in giving mechatronics education covering these three scientific branches. Of the so-called programs, the teaching staff and common use of laboratories increase the quality of the given education and enable the extremely limited technical facilities in many schools to be used in a most efficient way. The collaboration to be made between the programs will highly advance the integration found in the basis and nature of mechatronics and expected to be in scientific branches. The natural process in beginning mechatronics education is to apply this, after having a certain experience during the given education in conventional branches such as; Electronics, Computer and Machinery. It is clear that this situation will have many advantages in application. However, in some schools, programs were set up without any consideration (Table 3). When the schools that have no such programs comprising the sub-components of mechatronics, they have to built separate laboratories for Electric-Electronics, Computer, and Machinery classes and employ teaching staff for each of them. This is not an efficient situation for the schools having real limited sources.

Table 3. Related Programs to Mechatronic Programs

	Vocational Schools Mechatronic Programs	Mechatronics	Computer	Electrics and (or) Electronics	Mechanics and (or) Automotive	Industrial Automation
1	Bahçesehir University VS	*	*	*	*	-
2	Balıkesir University Edremit VS	*	*	-	*	-
3	Celal Bayar University VS	*	-	*	-	-
4	Çanakkale 18 Mart University VS	*	-	-	-	-
5	Dokuz Eylul University VS	*	*	*	*	-
6	Gaziantep University Gaziantep VS	*	*	*	*	-
7	Gaziosmanpasa University Turhal VS	*	*	*	-	-
8	Gaziosmanpasa University Zile VS	*	*	-	*	-
9	Giresun University Şebinkarahisar VS	*	*	*	*	-
10	Kadir Has University VS	*	*	*	-	-
11	Karadeniz Technical University A. Kanca VS	*	-	*	*	-
12	Kastamonu University VS	*	*	*	*	-
13	Kocaeli University Gebze VS	*	-	*	*	-
14	Kocaeli University Karamursel VS	*	-	*	-	-
15	Mustafa Kemal University Iskenderun VS	*	*	*	*	*
16	Namık Kemal University VS	*	*	*	*	*
17	Sakarya University Sakarya VS	*	*	*	*	-
18	Sakarya University Adapazarı VS (DE)	*	*	*	-	-
19	Selçuk University Kadınhanı Faik Içil VS	*	*	-	-	-
20	Selçuk University Eregli VS	*	*	*	*	-
21	Uludağ University Technical Sciences VS	*	*	*	*	-

(*) PRESENT, (-) NOT PRESENT VS: VOCATIONAL SCHOOL DE: DISTANCE EDUCATION

4. RESULTS

Mechatronics associate's education has started in Turkey in 2001. Although the significant increase of the school count and student quotas between the year 2001 and 2008, these developments are still insufficient for the Turkey as a developing country. The aim is to have one million employees in mechatronics field in 2023. The count of mechatronic programs of VSs and their student quotas must be increased to achieve this aim. Also, there is only one school gives internet-based education and this is not sufficient. This type of education must be supported and student quotas must be increased.

The most important problem is the lack of plans and strategies in the development process of mechatronics associate's education in Turkey. Also, the VSs show some dissimilarity according to their placements. The existent 11 VSs out of 21 VSs (one is internet based school) is in the towns, others are in cities. Considering the distribution of VSs on the basis of geographical regions, most of the VSs built on the most industrialized Marmara region. However, the second industrialized Aegaen region has only two schools and less industrialized BlackSea region has five schools. There is no mechatronics education in the major developed cities like Kayseri, Eskişehir and Denizli today. Unbalanced distribution of school counts and student quotas of VSs (excluding Marmara Region) is present if the needs of well trained work force and their employments are considered in the industrialized regions.

Suggestions to overcome all of these problems are stated as;

- There must be a National Mechatronics Platform about Mechatronics education and this platform must have a specific mission and strategy for extending this education from high school level to master degree.

- The role of VSs must be made strengthened and their aims must be well defined in the national strategy of mechatronics education.

- Because mechatronics education covers many main disciplines within itself, it will be beneficial in terms of teaching staff and common use of laboratory if there are at least two of Computer, Electrics, Electronics, Machinery; Automotive, Industrial Automation Programs in VSs thought to initiate new programs. This situation will be helpful for the arranging process of the program besides leading to a greater success and also make it possible for much more students to be trained by means of the sources at hand.

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