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Grooming IT Students for Industry Through Industrial Training and Graduation Project Work

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Abstract

It has been observed that, Information Technology (IT) Professionals educated with the conventional approach do not fully satisfy expectations of the industry since they lack the ability to develop solutions to real-life problems immediately after graduation. This is because most of the conventional education techniques view learning as remembering facts, terms and definitions in order to answer questions rather than concentrating on system design, project development and implementation concepts. With the choice of suitable problems, educational institutions should encourage Project Based Learning (PBL) through analyzing, designing and implementation rather than simply defining and explaining.

This paper introduces a PBL framework and curriculum for educating IT professionals who specialize in information system design and software development for small and medium size businesses. The proposed framework integrates industrial training and graduation project work in a PBL environment to groom IT students for industry before graduation. A new curriculum is also suggested for enhancement of university-industry cooperation.

Key Words: Industrial training, projectwork, Educational policy, curriculum.

1. Introduction

Ever since computers are widely spread in the business and industry, the need to skilled personnel has been an important issue. Managers are aware of the fact that digital transformation improves profit margins through efficiency and reliability. However, they are also aware of the fact that, hiring and orienting an engineer or an IT professional to get the required job done, is very time consuming (6-to-12 months), expensive (around $50000), difficult and risky, as stated in [1]. A fresh-out-of-school newly hired engineer or IT professional take 6 to 12 months to be professionally competent in the business context [1]. Businesses can not ignore this engineering time-to-market issue. An engineer, who is an increasingly valuable investment for the, say, European or American industry, needs at least 5 years and around 1.5 million dollars to mature enough and be at the peak of its performance [2]. Hence, the industrial adaptation and training is a very expensive and time consuming process and should be completed in the university during the education period through the university-industry cooperation. As a result, the graduates enter the industry in a fully nurtured form and ready to work.

The first country to realize the importance of bridging the gap between the university and the industry is the USA. Due to the free-market economy based industry and its non-centralized higher education system, the universities and industry in the USA started serious cooperation successfully three decades ago [3]. Zaky and El-Faham [3] stated in their article the reasons why the universities were confined in their ivory towers as the industry grew and little efforts have been paid to bridge the university-industry gap [3]. The article also explains the factors contributing to the university-industry gap and the reasons why the gap needs to be bridged.

The way in which partnership between industry and education can enhance the development of engineers through industrial placement is discussed in [4], where the special case of "sandwich programs" employed in British education system is considered as a case study.

Engineering technology programs graduate students who can readily contribute to the workforce in industry and society. The immediate contribution is achieved by imparting state-of-the-art knowledge and skills; continued success and lifelong learning are assured by knowledge of the fundamental concepts in engineering and the physical sciences acquired in their studies. Knowledge and course work; teaching engineering practice rather than engineering science; good teaching; integration of collaborative learning techniques; and continual course updating and development. Students must be nurtured, not just taught. They need to develop problem-solving skills. In their article, Nowlin and Sundararajan discuss the demands of the 21st century engineers and how these demands are met [5]. It is worth noting that, the demands of the 21st century engineers seem to match the demands of the 21st century IT professionals in many respects.

Problem solving skills are best developed by letting the students learn to solve real-life problems through capstone projects. This is discussed in the article by [6] where a framework that provides a promising and sound environment for a capstone experience by balancing creative research work with analytical design methodology and technical implementation skills.

The ABET EC2000 criteria also suggest that, students are trained to maintain teams, evaluate the effectiveness of the teams and assess the contribution of each individual through open-ended problems. The project work requires that students become actively involved in the cognition process while they search and acquire knowledge as suggested in the article [7].

Cooperative learning through group projects had shown to enhance performance of the students in terms of better grades; greater persistence toward graduation; better analytical, creative and critical-thinking skills; deeper understanding of material and higher motivation

than the students taught in a traditional style [8]. With cooperative learning students can establish better relationships, more positive attitudes towards the subject, lover level of stress and anxiety and higher self esteem [7].

Realizing the importance of university-industry integration for a competitive economy, the Department of Education and Science in the UK has introduced the Education Reform Act, 1988, which essentially required that Local Education Authorities must establish, for each of their education institutes, a new governing body comprising at least 50 per-cent industry-nominated governors [9]. The motivation behind the Education Reform Act was, apparently, to let the industry have a say about the educational activities going on within the universities so that the graduate's performance in the industry would be maximized.

The article by Mackenzie [10] investigates the requirements of the UK industry with reference to the imperatives which influence the development of the industry in the world today. These imperatives, he suggests, are the globalization of industry, technological development and the move to product customization. Advanced planning and development of the UK industry and education system towards a single market in the EU, has revealed that the proportion of engineering products in the UK industry had increased from 42% in 1989 to 60% in 1999.

In this paper, we describe an effective method for bridging the university-industry gap through the summer training and graduation project work. Students are trained and preconditioned before they go to 40 working days industrial training in groups of 3-4, for developing a graduation project proposal under the supervision of the industrial advisors as well as their instructors. The project students bring from the industry is the *problem* to solve in the Problem Based Learning environment.

2. Objectives of IT Education

In many developing and underdeveloped countries today, building the necessary IT infrastructure and the human resources for **digital transformation**[1] is slow due to issues, such as lack of funding, lack of adequate qualified IT professionals and academics, lack of government support in terms of policy guidelines and technology and finally lack of awareness of the end users. In such circumstances, information products and services are recognized as important economic resources. With the increased volume of information, different sectors of the economy should be coordinated in producing and disseminating information. Countries which are successful in doing so have succeeded in the race whereas

[1] Digital Transformation: The process of transforming all bookkeeping, paperwork, forms and tables, cards, financial transactions and communications and other services, to be carried-out continuously and effectively in electronic processing and communication environment.

most 3rd world countries are still striving to develop the necessary conditions for starting the digital transformation [11, 12].

Digital convergence[2] is increasingly tying computer technology to telecommunications, broadcasting, electronic media and business machines. The IT industry includes the development and application of computers and communications-based technologies for processing, storing and managing data and information; computer hardware and component manufacturing; computer software development and various computer related services; communications equipment and services. Current industry trends are for growing acceptance of online trading, an expansion of e-commerce, increased tendency towards small home offices and an increased demand for client support services. Information storage and retrieval and network administration are areas in which growth is most anticipated. According to the Bureau of Labor and Statistics forecast for the years 2000-2010, computer related occupations take up 8 of the top 10 positions [13]. These finding are in harmony with our interview results with IT specialist companies, to find out the skills and knowledge for IT graduates, these are system analyst, database designer and administrator, network/web-based application programmers, information portal design and implementation and end user support. The education and training system and the government authorities should be organized to provide the necessary human resources to carry-out these duties and they need to do it very fast. And the students must be aware of their important role in this movement. Then, they will understand the importance of the most important problems in education, which is "to make the students want to learn".

Students arrive at the university with different expectations regarding higher education. Some come with the thirst for computing knowledge while a majority of them come just for a degree with the correct title. However, the industry demands only one thing: The availability of human resources as the most important element in IT diffusion. Employers argue that university graduates possess general computing knowledge, but lack specific skills that industry requires [1] since educators place an emphasis on theory, problem solving and analytical skills. Educators argue that, in skill and competency based programs, graduates' scope for learning is narrowed, as the programs often lack fundamental and analytical knowledge and function at an abstract level [1]. This argument can be true only if the IT educators are not professionals from the IT industry or they don't have a strong connection with the IT industry while working in the academia.

[2] Digital Convergence: All digital equipment (such as DVDs, Telephones, Televisions, Computers, Newspapers, College courses, Textbooks on CD-ROM and Banking/Finance equipment) becomes digitally compatible with each other.

The discussions among university administrations and teaching-staff about the basic skills of the graduates of Information Technology education in four-year undergraduate degree programs, pointed out the technically trained graduates that can work effectively in a team environment to produce new products, processes, services and systems. A cooperative university/industry student project can be an effective way for the instructor to teach and nurture skills in interdisciplinary problem solving, teamwork and communication [14].

Organizational skills such as communication and understanding business have also become increasingly significant [3, 15, 16]. Hence, *educational institutes should tend to employ application professionals rather than scientists in order to emphasize a balanced approach for technical and organizational skills*. This requires continual updating of the curriculum and educational policies in accordance with the trends in the IT industry. Before an organization starts digital transformation, factors such as availability of the required technological infrastructure, organizational requirements, service needs and requirements must be satisfied. Educational institutions should be aware of these factors and their influence on the set of skills required of the IT graduates. These set of skills should be embedded into the curriculum so that the graduates meet the industry requirements.

2.1. Defining IT

Information Technology (IT) is defined by Further Education Unit in the UK as [9]:
the means for the acquisition, production, transformation, storage and transfer of data (information) by electronic means in the form of voice, picture, text and numbers, so as to facilitate interaction between people, and interaction between people and machines.

The Dearing report in the UK [17] and the Snyder report in the USA [18] suggest the graduates in all educational disciplines to be IT competent and the course curricula of these disciplines be reasonably well specified to achieve this goal.

To satisfy IT needs, organizations have to regard IT as a factor of production like capital and labor and bear an in-house IT department, or they have to attempt to minimize transaction costs internally and externally through outsourcing and call centers. In either case, to cater for the IT needs, customized state-of-the-art professionals with the following special talents are required for:

- transforming the issue at hand in the form of a structured industrial problem,
- analyzing the facilities surrounding the problem and the transactions between these facilities,
- asking the right questions that will lead to the solution of the problem at hand
- defining the system requirements for the solution

- describing the method and place for the processing and storage of the data required and yield,
- the means of taking the processed data and solution to the user.

This will lead to successfully complete business establishment or transformation, which are described in the following section.

2.2. Expectations from the Graduates

We conducted a study through interviews with IT companies in the North Cyprus, in order to determine the expected skills and knowledge required from IT professionals as they graduate from the university. The study revealed that these primary skills and knowledge, which we call the professional skills, are a) system analysis through observations, surveys and questionnaire, b) data collection, data processing and database design, c) web/network-based application programming, d) web based information system design and support and e) end user education and support.

Once the students gain the primary (professional) skills and knowledge, they also need to have the secondary (soft) skills such as reading, writing (using word-processors), communication, report writing and presentation skills, project management and team-work [19]. Our survey results matched almost exclusively with those presented by Noll and Wilkins, who list the critical skills factors under 5 categories [20], namely the:

a) Business Knowledge

- Knowledge of business functions
- Ability to interpret business problems and develop appropriate technical solutions
- Ability to understand business environment
- Knowledge of specific industry (retail, manufacturing, financial etc.)
- Ability to work collaboratively in team project environment
- Ability to develop and deliver effective, informative and persuasive presentations
- Ability to plan, organize and lead projects
- Ability to plan, organize and write technical manuals, documentation and reports

b) Advanced IT/IS Applications

- Electronic commerce
- Decision support systems and group decision support
- Expert systems/artificial intelligence/neural networks
- Knowledge management systems
- Executive support systems

c) End User Education and Support

- End-user computing support
- Help desk/information centre
- Training/education
- Telecommunications/networks
- Ability to work closely with users and maintain positive user or client relationship

d) *Programming*

- Software applications development and selection
- Database modeling and development
- Programming/CASE tools

e) System Planning

- Hardware acquisition (evaluation and selection)
- Systems analysis
- Information systems planning, management and evaluation
- Information access and security

It has been observed that, IT Professionals educated with the conventional approach does not fully satisfy the expectations of the industry listed above, since they lack the ability to develop solutions to the real-life problems. This is because conventional education techniques view learning as remembering facts, terms and definitions in order to answer end of the chapter questions. Hence, institutions which are responsible for IT education has to seek new approaches to teaching and learning in order to fill this gap. Instead of explaining the expectations of the industry to the students in the classes, they could be allowed to go on summer training for a significantly long time period in order to find out about the expectations of the industry [21].

2.3. Cultural approaches to IT Education

The aim of IT education can change from one culture to another. For example, in eastern cultures, a large number of students aim to study IT just to become an IT professional. However, in western cultures, IT education does not bear much credit unless it is used to support a modern profession such as banking, finance, journalism, engineering, law or medicine. Hence, IT Education can be regarded as aim, or as a tool depending on the cultural origin of the students.

3. Project Based Learning To Give It Education A Sound Meaning

With the choice of suitable problems, *Problem Based Learning* (PBL) can be adopted to encourage solution aided learning through analyzing, synthesizing and evaluating rather than

simply defining and explaining as in the conventional approach. When, however, a PBL framework for educating IT professionals (who specialize in information system design and software development for small and medium size businesses which are less structured and less institutionalized and therefore they can tolerate delays or partly failure of the IT projects) is established, the questions of "what is a good problem/project" and "where to find suitable problems for the technique to be successful" should be answered. In other words, the *problems*, which are the fundamental elements of the PBL method, can be easily found from the "industry", specifically the small and medium sized businesses sector for the reasons stated above in this paragraph.

3.1. Characteristics of Suitable Problems/Projects

The IT department has two units, namely the Graduation Project Committee[3] and the Summer Training Committee[4], that are responsible for organizing the search for *problems*. These problems should have such natures to provide unique opportunity to train IT professionals in the analysis, design and implementation of Information Systems, while keeping the students highly motivated. The nature of the suitable problems/projects can be listed as follows [22]:

- Effective problems should arose students' interest and stimulate them to explore further, the concepts being introduced. The students are expected to have a higher contribution in solving the problem if the subject is related to the real world.
- Good problems require students to make decisions or judgment based on facts, information, logic and/or rationalization based on the principles being learned, assumptions made, relevant information and/or steps or procedures required in order to solve the problems.
- In order to work effectively through a good problem, cooperation from all students in the group is strictly necessary.
- The questions asked towards the solution of the problem should be open-ended, connected to previously learned knowledge and have controversial nature to stimulate students' discussion for producing diverse opinions.
- The learning material throughout the solution of the problem should be related to the objectives of the current course taken and the other related courses in the department registered or elsewhere.

[3] The Committee within the Department of Information Technology in the Eastern Mediterranean University, which is responsible for finding, nurturing and rendering the industrial problems in the form of a Graduation Project.

[4] The Committee within the Department of Information Technology in the Eastern Mediterranean University, which is dealing with industrial placement of the internship students.

- A good problem should encourage students to work as a group in order to feed on each others knowledge and ideas rather than working individually on the rims of the problem.

The educational method proposed here is specially suited to developing or underdeveloped countries where the *digital transformation* will require a huge human resource for developing the required network infrastructure, software and information content. The required human resource will be the students studying in the IT departments of the universities in these countries. As their graduation project work, the students are expected to produce a complete IT solution to the company's digital transformation problem. The challenges of this education model are two-fold:

- on one hand, the students are exposed to actual hands-on experience in developing IT solutions;
- On the other hand, students will help bringing technology to academe with almost no cost to the education institute.

3.2. How/Where to Find Suitable Problems/Projects

Problem finding and compiling into a graduation project should be a curricular responsibility of the students under the supervision of the department Summer Training Committee. The rules and regulations of which, including the job scheduling diagrams, must be well defined by the department.

The proposed methods, that makes use of the students and staff in computer related departments of universities/high schools, to overcome the shortage of IT professionals and missing budgets is suitable for *digital transformation* of underdeveloped countries. This PBL proposal, not only will create a huge human resource specialized in IT, but also give IT education, in such institutions of underdeveloped countries, a sound meaning.

3.3. Importance of Team-Working and Cultural Effects

PBL relies upon responsible, self driven, self sufficient and confident students and instructors. Normally, PBL is difficult to apply to societies in underdeveloped countries. This may partly be due to the cultural background, where youngsters find it difficult to put forward their ideas (especially controversial ones) in front of their teachers or elders. However, when these students are integrated, in small numbers, into a multinational, multicultural education system that hosts students from developing and developed countries, they will be freed from the influence of their own culture and gradually tend to accept PBL.

4. Curriculum Design for a B.Sc. Degree in IT

The mission of the IT department and the possible opportunities available to achieve this mission; e.g. the students are graduated ready to work in the industry. They don't have to go through a year of adaptation and acquaintance program to the industry.

Educational philosophy of the Eastern Mediterranean University-School of Computing and Technology is designed to groom students to be active professionals and contributing members of their society in computing and technological issues. Our students should be knowledgeable and educated individuals with highly professional, personal, and ethical standards. It is our responsibility to guide our students in learning and produce graduates who are confident individuals; inquisitive, critical thinkers; competitive; willing to engage in collaborative enterprises; sensitive towards the natural environment; respectful of social and cultural diversity and who can demonstrate initiative, honesty and personal integrity; can consider the differing opinions of others; have a sense of responsibility towards society and have bilingual competency and multilingual potential. Beside the above skills, the IT graduates should be well educated in software, database design and internet applications. The graduates are ready to integrate to industry as soon as they graduate.

4.1. Course Categories

Within the above framework, IT Department believes, in principle, in the application of General Education (GE) concepts (also known as Liberal Arts Education) and that, its requirements are fulfilled in IT undergraduate program. Hence, the courses offered to IT undergraduate students are categorized in 5 groups

- University core courses
- IT core courses
- Area core courses
- GE elective courses
- Area elective courses

4.1.1. University core courses

University core courses are mainly GE required predefined courses and offered to all students. Table 1 shows the distribution of university core courses.

Table 1: Distribution of University Core Courses

Course name	Credits
SPIKE Program [23]	0
Communication in English I and II	6
Communication in Turkish I and II	4
History of Turkish Reforms	2
Critical Thinking I and II	6
Mathematics and Physical or Natural Sciences (3 courses)	9-12
Computer Literacy	3

According to the distribution shown in Table 1, the University core courses of IT department are shown in Table 2.

Table 2: University Core Courses of IT

Course name	Credits
EFL107- English I	3
EFL108- English II	3
Critical Thinking I	3
Critical Thinking II	3
MATH111- Basic Mathematics I	3
MATH161- Mathematical Logic of Computers	3
PHYXXX- Physics	3
TURKXXX- Turkish I	2
TURKXXX- Turkish II	2
HIST200- History of Turkish Reforms	2
IT101- Computer Literacy	4

4.1.2. IT and Area Core Courses

IT core courses are courses common to all students of IT department. They include some distributed GE courses, additional Mathematics and Physics courses, or courses believed to be necessary to develop a common background and culture for the students of different disciplines within the IT. Area core courses are fundamental discipline-specific courses required by a specific program but not including specialized tracks in the discipline. Not more than 12 area core courses are suggested for a program as shown in Table 3.

Table 3: IT and Area Core Courses

Course Code	Course Name	Credits
IT113	Algorithms and Programming Tech.	4
IT114	Structured Programming	4
IT225	Internet Programming	4
IT213[5]	Data Structures and Applications	4
IT255	Computer Organization and Architecture	3
IT202	Operating Systems	4
IT212	Database Management Systems	4
IT226	Internet Applications	4
IT234	Systems Analysis	4
IT242	Object Oriented Programming	4
IT309	Computer Networks	4
IT313	Database Programming	4
IT335	System Design	4
IT312	System Programming	4
IT346	Software Engineering	4
IT354	Programming Languages	4
IT341	Object Oriented Applications Dev.	4
IT300	Summer Training	0
IT401	Graduation Project Orientation	0
IT402	Graduation Project	3

4.1.3. GE Elective Courses

These are mainly humanities and social sciences courses such as defined within the GE curriculum. All students are required to take at least five courses described in the following categories as distributed electives:

- Arts and Humanities (including non-English languages)

(At least 2 or 3 courses, not more than 2 in any sub-category)

- Social and Behavioral Sciences

(At least 2 or 3 courses, not more than 2 in any sub-category)

According to the GE Requirements GE Elective Courses of IT are shown in Table 4.

[5] The first digit in the course code, e.g. IT213 correspond to the academic year, the second digit corresponds to the group of courses, i.e. General Education, area elective etc. and the last digit corresponds to the fall (odd numbers) or spring semester (even numbers). 2-1-3 means, 2nd year, GE course in the first semester.

Table 4: GE Elective Courses of IT

Course Code	Course Name	Credits
IT161	Introduction to Business	3
IT162	Basic Economics	3
MATH211	Introduction to Statistics	3
IT362	Organizational Behavior	3
IT421	Management Information System	3
NTEXXX	Non Technical Elective	3
NTEXXX	Non Technical Elective	3
EFL 207	English III	3
MATH112	Basic Mathematics II	3

4.1.4. Area Elective Courses

These are the elective courses offered by the department. Some of these courses can be taken from other departments upon the approval of the department board. At least 8 area elective courses are suggested for a program. Under special circumstances regarding the departmental resources, the number of area electives can be increased at the expense of the area core courses. Table 5 shows the area elective courses of IT department.

Table 5: Area Elective Courses of IT

Course Code	Course name	Credits
TEXXX	Technical Elective I	3
TEXXX	Technical Elective II	3
TEXXX	Technical Elective III	3
TEXXX	Technical Elective IV	3
TEXXX	Technical Elective V	3
TEXXX	Technical Elective VI	3
TEXXX	Technical Elective VII	3
TEXXX	Technical Elective VII	3

The final year courses are intentionally made Technical Electives, so that, students will be able to choose which technical track they will follow, and hence, which courses are more suitable in order to reinforce their knowledge towards solution of the Graduation Project.

4.1.5. The Ratio of Category Credits over Total IT Curriculum Credits

The ratio of each course categories over the entire curriculum is shown in Table 6.

Table 6: Ratio of Categories

Name of Category	(Category/Total) Credits (%)
University Core Courses	20.39 %
IT and Area Core Courses	46.06 %
GE Elective Courses	17.76 %
Area Elective Courses	15.79 %

From Table 6, it is seen that the ratio of University Core Courses over the entire IT curriculum is 20.39%, Department and area core courses is 46.06%, GE elective courses is 17.76% and area elective courses is 15.79%.

4.2. Objectives of the First Year

In the first year of the IT department, the students are expected to complete all the basic courses at introductory level as shown in Table 7. The departmental student advisory system is established for motivating the students, describing the mission and vision of the department, introducing the laboratory and class facilities, academic staff, library and the ways of how the students benefit from these facilities. An International Student Advisor is also employed in order to help the international students settle down in the department as well as in the country.

Student to Student Academic Support System (S2S) is another departmental service introduced in order to help academically poor students or those lagging behind for any reason, to ketch up with the department educational pace. S2S may also help students to know the campus, find new friends and a place to live, solve any cultural or adaptation problems with the aid of the university Psychological Counseling Service (PCS).

Table 7: The courses in the first year

FIRST YEAR		
FALL SEMESTER		
Course code	**Course name**	**Prerequisites**
EFL 107	English I	
IT 101	Computer Literacy	
IT 161	Introduction to Business	
IT 113	Algorithms and Programming Techniques	
MATH 111	Basic Mathematics I	
GE 101	SPIKE I	
TURK100	Introduction to Turkish	

SPRING SEMESTER		
EFL 108	English II	EFL 107
MATH112	Basic Mathematics II	MATH111
IT 114	Structured Programming	IT 113
MATH161	Mathematical Logic of Comp.	
CT 101	Critical Thinking I	
GE 102	SPIKE II	
TURK101	Communication in Turkish I	
IT 162	Basic Economics	IT 161

4.3. Objectives of the Second Year

In the second year, internet programming, database management and some programming courses (such as object oriented programming) are presented at an introductory level as shown in Table 8. The students are required to catch the basic programming philosophy. Critical Thinking I and Critical Thinking II courses are also introduced in this year.

Table 8: The Courses of the Second Year

SECOND YEAR		
FALL SEMESTER		
EFL 207	English III	EFL 108
IT 225	Internet Programming	
IT 213	Data Structures and Applications	IT 114
IT 255	Computer Organization and Architecture	MATH161
MATH211	Introduction to Statistics	
CT 102	Critical Thinking II	CT 101
TURK102	Communication in Turkish II	TURK101
SPRING		
SEMESTER		
IT 202	Operating Systems	IT 255
IT 212	Database Management Systems	
IT 226	Internet Applications	IT 225
IT 234	Systems Analysis	
IT 242	Object Oriented Programming	IT 213
ENG101	Communication in English I	

4.4. Objectives of the Summer Training and the Third Year

In the third year, students are registered to the Summer Training (IT300) course, which is very important for the nurturing of Graduation Project proposal while the students are in the industry doing summer training. The groups of 3-5 student's, are expected to bring a real-life

problem from the industry and transform this problem into a well structured, well defined project. Then, they will register, as a group, to the IT401 and IT402 courses.

Table 9 shows the course list for the third year. In the third year, most of the courses are programming courses. At the end of third year, students are ready for the industrial training and solving the IT related problems.

Table 9: The Courses of the Third Year

THIRD YEAR		
Fall Semester		
Course code	**Course name**	**Prerequisite**
IT309	Computer Networks	IT 202
IT313	Database Programming	IT 212
IT335	Systems Design	IT 234
IT341	Object Oriented Appl. Develop.	IT 242
TEXXX	Technical Elective	
Spring Semester		
IT312	System Programming	IT 202
IT346	Software Engineering	IT 335
IT354	Programming Languages	IT 341
IT362	Organizational Behavior	IT 161
TEXXX	Technical Elective	
IT300	Summer Training	

4.5. Objectives of the Graduation Project and the Fourth Year

After summer training, the students register to IT401 course, which is the orientation of the graduation project. The students are assigned a project advisor by the department and plan weekly meeting hours with the advisor. In the last year, almost all of the courses are area elective courses and are designed for supporting the graduation project. These are shown in Table 10.

Table 10: The Courses of the Fourth Year

FOURTH YEAR		
Fall Semester		
Course Code	**Course Name**	**Prerequisites**
IT421	Management Information Systems	
TEXXX	Technical Elective I	
TEXXX	Technical Elective II	
TEXXX	Technical Elective III	
NTEXXX	Non Technical Elective	

HIST200	History of Turkish Reforms	
IT401	Graduation Project Orientation	
Spring Semester		
TEXXX	Technical Elective IV	
TEXXX	Technical Elective V	
TEXXX	Technical Elective VI	
NTEXXX	Non technical Elective	
IT402	Graduation Project	IT 401

In the spring semester of the fourth year, the students make an oral presentation in front of a jury and defend their graduation projects. When the students graduate, they would have learned how to deal with and how to solve real life problems.

Summer training, graduation project work and group project work are aspects of cooperative learning exercises [24] which are the essence of Project Based Learning approach [7]. These enhance learning of all students because different rules reach the students with different preferred learning styles and all students are encouraged to learn [7, 25].

4.6. Curriculum Structure and Subject Balance

The subject balance calculation is based on the credits of individual courses shown in Table 11. The total credits are 152 with 51 courses including summer training, graduation project courses and history courses.

Table 11 Subject Balance of the Courses

Subject of Courses	Ratio (%)
Business and Economics	7.89
Hardware	1.97
Interpersonal Communication	10.53
Network, Web, Database	15.13
Physics, Math, Chemistry	5.92
Software	58.55

5. Assessment Methods

Summer training is the main prerequisite for the graduation project work in order to ensure that students go to the industry for assembling a suitable graduation project that will be the project described in the Project Based Learning model [26, 27]. This is described in detail in the following sections.

5.1. Assessment of Industrial Training

The students in the IT department must go for 40 working days summer training at the end of the third year, preferably in groups of 2 to 4. The summer training placement is done by the

Summer Training Placement Unit in the department in cooperation with the related department chair. They are expected to return back to the department with a graduation project in their briefcase. The success of the summer training is subject to the approval of the project by the departmental summer training and graduation project committees. The project should bear the characteristics described in the Project Based Learning model as given in [26, 27].

5.2. Assessment of Graduation Project

Assessment methods normally employed in other education disciplines then IT are of limited value in skill based disciplines such as IT where a complete solution to industry/service-business originated real-life problems are aimed up to the delivery of user manuals and online help wizards to the end-users. The assessment of the Graduation Project (GP) is done in three steps, 1) the GP report, 2) The GP presentation seminar and 3) the merits of the GP itself as a commercial asset. The weights of the parts are listed in Table 12.

The final Grade will be determined according to the evaluation result as listed in Table 13 [28]. Note however, that, according to the EMU Bylaw, all responsibilities of grading belong to the academic staff.

5.2.1. GP Report

The GP report is a fundamental component of the GP work that is designed to help the students develop their abilities for presenting the work done to the customer. The customer is the real customer they have worked with during their 40 working days summer training period.

5.2.2. GP presentation seminar

The GP presentation session is an opportunity for the final year students to gain communication, report writing and presentation skills as one of the most important soft skill required by the industry. In order to improve these soft skills, the students are given a preliminary training in the IT department by either joining in the seminars organized by the department or the GP presentation sessions of the senior students who will graduate before them. The extensive use of educational technologies such as computers, data projectors, multimedia terminals, and electronic whiteboards are encouraged by providing these facilities during their GP development work.

Table 12: Weighting of the Parts Making-Up the GP

		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Report 35 %	Organization									
	Literature survey									
	Contribution/ Originality									
	Simulation/ Experiment/ Theory									
	Conclusion									
Presentation 35 %	Organization									
	Command of English									
	Knowledge Of subject									
	Ability to express Ideas clearly									
	Timing									
Product Quality 30%	Finished on time									
	Properly working									
	Economic value									
	Cost/Benefit justification									

5.2.3. Merits of the GP

The merits of the graduation project are evaluated in accordance with its successful operation, usefulness, originality, acceptability and ease of use by the end-users, contribution to the hosting company's development and competitiveness and benefit to the education of the students.

Successful operation is a technical issue, so it is easy to assess. Usefulness and originality are also relatively easy to judge. However, contribution to the hosting company's development and competitiveness are trivial tasks. Therefore, the experts from the hosting company are also invited to take part in the jury during the GP presentation sessions and contribute to the grading of the GP.

The benefit of the GP to the education of the students is also a trivial task, which is evaluated through intelligently asked questions and required practical demos during the GP presentation.

Table 13: Grading System in the Department of IT

Mark	Grade	Weight (out of 4.00)
90 – 100	A	4.00
85 – 89	A-	3.70
80 - 84	B+	3.30
75 – 79	B	3.00
70 – 74	B-	2.70
65 - 69	C+	2.30
60 – 64	C	2.00
56 – 59	C-	1.70
53 – 55	D+	1.30
50 – 52	D	1.00
40 - 49	D-	0.70
00 - 39	F	0.00
00	NG	0.00 (Nil Grade)
	S	Satisfactory (for non-credit courses)
	U	Unsatisfactory (for non-credit courses)
	E	Exemption (for transfer students)
	I	Incomplete
	W	Withdrawal

6. Discussion and Conclusion

In the last 3 decades, the universities and the industry had been approaching each other due to the mutual need and benefit of corporate project development and experience exchange. However, in many institutions, the collaboration process had not been very successful since the expectation of the industry is not well known by the educational institutions and the industry had not been receptive of the scientific and theoretical knowledge of the academics in the universities.

Industrial training process could be the golden opportunity educational institutes had been looking for in order to bridge the university-industry gap. However, usually, students go to industry aimlessly and return back empty handed. With the method proposed in this article, students are sent to industry for a very good reason, the search for a real-life industrial problem, and they successfully return back with a real-life problem in their briefcase that can easily be transformed into a sound Graduation Project.

During the development of the *industrial problem* into a *Graduation Project* and then into a *useful product/service*, the university and industry know each others expectations better and help bridging the gap between the universities and the industry.

Developed countries had almost completed the first stage of digital transformation where the connection problem, the establishment of the wideband network infrastructure and installing the basic networking software are almost completed. On the other hand, the developing and underdeveloped countries had been very slow in building the necessary cultural drive and the courage to begin even the first stage of the digital transformation process due to issues such as, lack of funding, lack of adequate qualified IT professionals and academics, lack of government support in terms of policy guidelines and technology and finally lack of awareness of the end users. The method proposed in this article could help creating a framework where most of the disadvantages listed above could be easily overcome.

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