

Dual-Study Electrical Engineering at Al-Quds University in Palestine

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Abstract—Dual studies was launched at Al-Quds University in 2015, which is aimed at contributing to raising the professional level of Palestinian youth, providing good job opportunities for students after graduation, as well as bridging the gap between the outputs of academic education and the needs and requirements of the Palestinian labor market. One major ingredient of Dual Studies is the Electrical Engineering program, which equips the student with both theory and practice at the same time. During the four years of studying in this program, the student spends half of his/her time in partner companies that are interested in employing electrical engineers. The full-time employment after graduation represents one of the major success indicators of DSEE that would be possible to assess when the first DSEE cohort will graduate and finish their study after two years

Keywords— *Dual Studies; Electrical Engineering; Work-based Learning; Co-operative Education*

I. INTRODUCTION

The idea of combining theoretical study at the college and in the workplace, which is nowadays known as work-based learning or co-operative education, is not new and was firstly introduced at the University of Cincinnati in 1906 [1]. Co-operative education is based on the idea that students learning starts in classrooms, then applying that knowledge in a job matched to their educational goals. This cycle repeats itself until the end of the study. In many respects, the dual-study program implemented at Al-Quds University (AQU) since 2015 can be also seen as work-based learning approach, representing very specific educational programs that bring the university and work organizations to create learning opportunities in workplaces. Amongst other things, work-based learning programs typically share the following main characteristics [2]:

1. A partnership between an external organization that can be in the private, public, or community sector of the economy and an educational institution is specifically established to foster learning.
2. Learners involved are employees of, or are in some contractual relationship with, the external organization.
3. The program follows derives from the needs of the workplace. Commonly, work learning exigencies do not map on to the disciplinary and professional structures of educational institutions.
4. A significant element of work-based learning is that learning projects are undertaken in the workplace.

Another designation for work-based learning is work-integrated learning [3]. Here, this learning or education, in which part of the learning time spent in the workplace, forms an integrated part of an academic program of study. More specifically, it can be described as a strategy of applied learning which is a structured program, developed and supervised either by an educational institution in collaboration with an employer or industry grouping, or vice versa. This type of educational programs are commonly highly structured and possess formal academic and employer supervision and assessment [4].

AQU launched Dual Studies (DS), to which the Dual Study Electrical Engineering (DSEE) program belongs, in 2015 with funding from the German government [5]. DS is not only the first academic system of its kind in Palestine, but also in the Middle East. It combines theoretical study with practical application. DS was established in order to contribute to raising the professional level of Palestinian youth, providing good job opportunities for students after graduation and bridging the gap

between the outputs of academic education and the needs and requirements of the Palestinian labor market. Dual studies in Germany serves as a reference model to the Palestinian one during its implementation. The German dual studies were established over forty years ago, and its philosophy is centered on the idea of linking and integrating the student to the work environment from his/her first day of study.

Currently, there are three dual study programs in operation at AQU, namely Electrical Engineering, Information Technology, and Business Administration. In DSEE, there are about 75 students enrolled, and the number of partner companies cooperating with DSEE exceeds 70 companies. These companies provide DSEE students with training at their enterprises in such a way that each quarter of three months at the university is followed by a three-month phase of internship during the study time of four years.

II. JUSTIFICATIONS TO OFFER DUAL STUDIES AND ITS CONSISTENCY WITH THE PALESTINIAN NATIONAL STRATEGY

DSEE was designed to satisfy the current and future job market needs of the Palestinian Electrical Engineering sector by supplying highly qualified engineer graduates. DSEE will be able to provide students the traditional classes accompanied with hands-on training. Many studies have shown that most Palestinian universities are lacking practical training towards Electrical Engineering students and graduates. From the moment, that the Palestinian National Authority received command of some Palestinian territories there is great interest in the development of a vocational and technical education and training system (VTET) [6]. In addition, the education system in Palestine still depends on memorization and old style teaching methods and lacks practical application. Thus, as the private sector demands practical experience, the opportunities for employment with a bachelor degree are very limited.

AQU decided to incorporate more practical training into the curriculum similar to the approach followed by several higher education institutions in Germany e.g. the Cooperative State University Baden-Württemberg (Duale Hochschule Baden Württemberg - "DHBW" [7]. A feasibility study, initiated by the German Development Corporation (GIZ), was conducted in order to research the opportunity of establishing Dual Study programs in Palestine [8]. The results showed a strong interest of the private sector in this new style of study. Consequently, GIZ was open for cooperation with AQU in funding the establishment of Dual Study programs.

As a result, AQU established a dual study program under the provision of the Deanship of Dual Studies. A curriculum of a Bachelor of Electrical Engineering (DSEE) was developed in collaboration with a German Dual Studies expert and Palestinian Electrical Engineering companies who agreed to become official partners of Dual Studies. AQU conducted a workshop with the Electrical Engineering partner companies and together developed a curriculum that corresponds to the needs of the Palestinian market.

AQU positions itself as a leader in creating new job opportunities through Higher Education. The main aim of the Dual Studies program is "More Job Opportunities for the Palestinian Youth". Thus, AQU shares the vision of the

Palestinian's Government employment strategy, which is "Reversing the Perspective for Youth – from High Unemployment and Low Paid Jobs to a Qualitative Perspective with Career Possibilities" [9].

III. LABOR MARKET STUDY: GRADUATES SPECIFICATIONS AND EMPLOYABILITY OPPORTUNITIES

The lack of an adequate infrastructure during nearly four decades has impeded any real growth on the energy front and created chronic energy problems: there is a high unit price of energy when energy resources are either dwindling or non-existent. Renewable energy has not reached a satisfactory level of utilization. Despite of these problems, electrical engineering and especially electrical power plays a very important role in Palestine. In general, the Palestinian electric companies deal with electricity distribution only. In some Palestinian cities, we can find a very limited production capacity. Thus, almost all of the electricity is supplied from Israel to the Palestinian Territories. The main electricity distribution companies that operate in Palestine are the Jerusalem District Electric Company (JDECO) that serves East Jerusalem, Jericho, Ramallah and Bethlehem, the Northern Electricity Distributed Company (NEDCO) is operating in northern of Palestine, and the Southern Electric Co. (SELCO) is serving the southern areas.

Due to the facts that electricity is marked by high prices as well as limited by capacity constraints, there is a strong interest in establishing sources of renewable energy. Analyses of energy potentials for the Palestinian Territories show a high potential in this sector. Solar energy is mainly used for solar thermal applications, such as water and space heating. Here is a chance for the Palestinian economy to create new jobs. Access to modern energy forms is essential for the fight against poverty and an important fact for economic growth. The growth of this sector will create a high demand for well skilled electrical engineering professionals.

The universities in Palestine offer Electrical Engineering programs. However, collaborations with local and regional potential employers, which usually lead to more job opportunities, are very limited. DSEE at AQU offers the student both theory and practice at the same time. During the 4 years of studying in DSEE, the student spends half of his/her time in partner companies that are interested in employing electrical engineers. This is the first program not only in Palestine but also in the whole region, which contains cooperation with the private sector through offering the students theory and practice at the same time [10]. More than sixty companies from north, central as well as from the south of Palestine are official partners of DSEE. The curriculum of Dual Study Electrical Engineering was jointly developed with the private sector during a workshop and several meetings. Table 1 clarifies the structure of the DSEE curriculum.

TABLE I. STRUCTURE OF THE DSEE CURRICULUM

Courses' Type	Credits
University Requirements	6
Dual Study Requirements (Soft Qualifications and Competences)	18

Program (Electrical Engineering) Requirements	62
Specialization (Electric Power Engineering) Requirements	31
Program Elective Courses	3
Practice Periods Requirements	30
Graduation Project Requirements	10
Total: 160	

This new form of higher education decreases the gap between university and private sector, which is frequently discussed in workshops, conferences and with the Ministry of Education and Higher Education [11]. According to statements of many companies' owners, DSEE graduates have definitely a greater chance to continue their employment in the partner company where they have completed their practical periods. Here, they will not only learn engineering issues but also soft skills and customers' relations.

IV. OBJECTIVES AND CHARACTERISTICS OF DSEE

A. Educational Objectives of DSEE

- The educational objectives of DSEE are centered on the graduation of qualified engineers with solid foundations in the areas of electrical engineering, who are characterized by the following characteristics:
- The ability and creativity in solving problems, and dealing and coping with the pace of modern technologies in the different areas of electrical engineering.
- Demonstrate proficiency in the design, analysis, improvement, and implementation of modern electrical systems.
- Compete effectively in a world of rapid technological changes, and to become leaders, businesspersons and managers, innovators, or teachers in a broad context of electrical engineering.
- Work effectively in a professional environment, and show the necessary communication skills, leadership, and commitment to professional ethics.
- Pursue post-graduate studies and research in the disciplines of advanced topics and electrical engineering, as well as to become consultants in their respective fields.
- Work professionally bolstered by a technical background and solid scientific and adequate skills in the field of electrical engineering, and the ability not only to design electrical power systems, but also to deal with all types of electrical systems and problems.
- Adapt to different roles and responsibilities in a multicultural work environment through respect for diversity and professionalism within the organization and society at the national and international levels.

B. Consistency and comparison

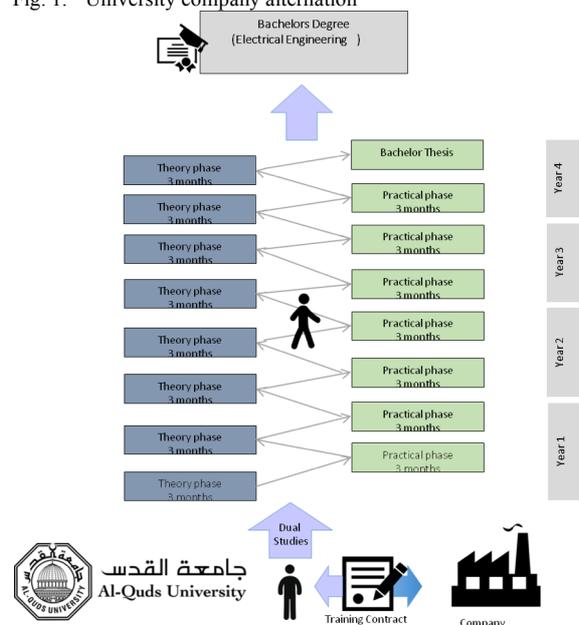
The curriculum of DSEE differs from the normal university engineering programs at certain points. The degree "Dual Study Electrical Engineering" accentuates the application specific character of engineering which is essential for the business oriented creation and operation of manufacturing facilities. Students are taught specific skills from the area of application, implementation and electrical engineering in the business environment. Skills necessary for creating and applying these skills are from various areas. The mathematical foundations are also geared to the area of application. However, such a program, as described here, has also to fulfill all the standard national requirements for accreditation. Incorporating practical periods in the curriculum concludes in a reduction of the time for pure theory and, at the same time, an increase of the time for exercising and application of the knowledge.

Thus, the main difference of DSEE versus normal studies is the method of delivering the skills and competences to the learner. We have to identify which subjects are better learned in the working environment and which have to be taught at the university. It has to be stressed that both places have to undergo quality assurance processes, because credits can be given only if quality and learner's success are assessed.

V. EXECUTION PLAN OF DSEE CURRICULUM

DSEE combines academic learning with the direct application and expansion of knowledge in professional practice. A dual study student will spend an essential part of his study time (approximately 50%) in a training company and the rest at the University. The DSEE B.Sc. degree program lasts four years. The year is divided in two semesters where each semester (24 weeks) consists of 12 weeks theory and 12 weeks practice (4 quarters). As shown in Figure 1, the student will generally change every 3 months between the two places of learning.

Fig. 1. University company alternation



VI. GRADUATES' SPECIFICATIONS AND INTENDED LEARNING OUTCOMES (ILOS) OF DSEE

DSEE will enable students to know: How do electric utilities provide power? What equipment is necessary to generate, transmit and distribute electric power? How does the electric power industry improve reliability, security and safety of the electric power grid? The ILO's of DSEE program adhere to international accreditations (based on ABET [12]). Thus, upon completion of this program, students will have:

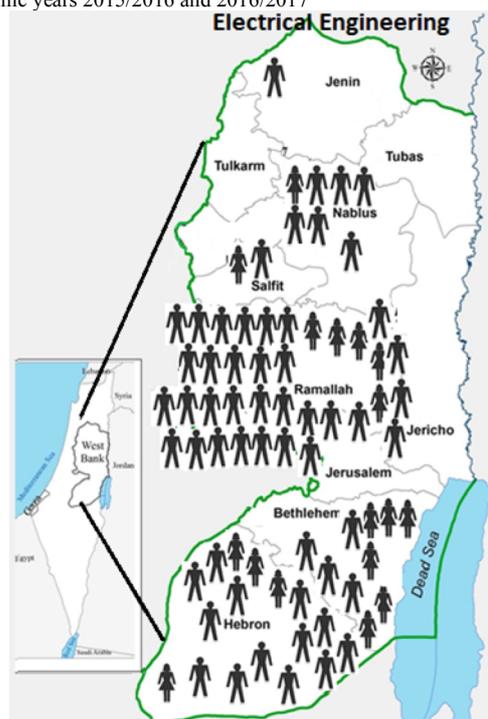
- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs.
- An ability to function on multidisciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context.
- Recognition of the need for, and an ability to engage in life-long learning.
- Knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- An ability to transfer theoretical knowledge into practical applications.
- Knowledge of the professional environment.
- Well-developed social competences.

It is to point out that the last three ILOs are specific for our DSEE program in which the practice phases in the partner companies forms an important ingredients of its structure.

VII. PRACTICE MODULES AT DSEE PARTNER COMPANIES

The recruitment of companies in the dual study program requires a massive effort to reach, inform and motivate companies to participate as a training partner. In order to recruit a company as DSEE partner, there are minimum criteria that must be fulfilled such as technical ability, the number of staff employed in the company, the readiness to assign a qualified tutor, adequate infrastructure and equipment and willingness to pay the student a small amount of money. As of June 2017, about 75 students and 60 companies are enrolled the DSEE program in their first or second academic year. Figure 2 shows the distribution of the DSEE students in partner companies in Palestine.

Fig. 2. Student-company distribution in the West Bank for the two academic years 2015/2016 and 2016/2017



In the practical phases, students link their acquired knowledge from the theory phase with the practical activity in their company. The practice schedule should be adapted in time and content to the specificities of the company and must take into account the individual level of knowledge of students. Adjustments of the plan according to the priorities and needs of the company are possible. The students transferred projects and tasks contribute to the personal and professional development and creating value for internal and external customers.

VIII. ASSESSMENT

DS at AQU as work-integrated learning or cooperative education complements the typical theoretical learning in a higher education setting, and provides students with industry experience prior to graduation, facilitating their move into full-time employment [13]. The full-time employment after graduation represents one of the major success indicators of DSEE. After two years, the first DSEE cohort will graduate and finish their study. At that time, it would be possible to assess whether this major goal is achieved or not. However, there are many indicators showing that the progress of DSEE is on the right way. This includes:

- Interest from the private sector as obvious from the number of partners that joined.
- Teacher notice improvements in the students after each practical phase in terms of characters and skills, but also often in terms of knowledge.
- Knowledge exchange between students from different companies.

On the contrary, there are many challenges and obstacles facing DSEE:

- Matching students with companies is a very complicated and time-intensive process as DS is still unknown for the Palestinians. Most of the new graduated high-school students are impatient regarding ensuring their university study place. The admission in DS requires that the student must be accepted by one of the DS partner companies to be trained there.
- As previously mentioned, DSEE requires that 50% of the study time must be at the university and the rest at a company. As the theory and practice terms in DS are alternating with duration of three months, it was of great significance to condense the credit hours of a regular four-month semester into a condensed three-month semester representing a huge challenge for the students.

IX. CONCLUSION

Establishing DSEE at AQU was not an easy process as this type of learning is new to the region. However, the problem that this program addresses (mismatch between university outcomes and market requirements) is well known and is negatively affecting the lives of young graduates and the private sector alike. Thus, it was not hard to convince students and partners of the benefits of DSEE compared to traditional Electrical Engineering programs. The program is running since two years only and thus has no graduates yet. Therefore, it is still not possible to determine whether it has succeeded in its main objective in bridging the gap between the university outcomes and the market requirements, and thus improve the employability of the university graduates. However, the feedback that is coming from the partners indicates that it will be successful as several partners say already now that they will employ the DSEE students immediately upon graduation.

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