https://doi.org/10.52326/ic-ecco.2022/KBS.02

Implementation of dual education at Technical University of Moldova

Viorica Sudacevschi [1], ORCID: 0000-0003-0125-3491
Larisa Bugaian [1], ORCID: 0000-0002-4478-5124
Dumitru Ciorbă [1], ORCID: 0000-0002-3157-5072,
Ion Fiodorov [1], ORCID: 0000-0003-0938-3442
Irina Cojuhari [1], ORCID: 0000-0003-2248-1338
Silvia Munteanu [1], ORCID; 0000-0003-0749-8457
[1] Technical University of Moldova, Chișinău, Republic of Moldova, http://www.utm.md,
viorica.sudacevschi@calc.utm.md, larisa.bugaian@adm.utm.md, dumitru.ciorba@fcim.utm.md,
ion.fiodorov@ati.utm.md, irina.cojuhari@ati.utm.md, silvia.munteanu@calc.utm.md

Abstract — **The article analyses the implementation of the dual study model for higher education at the Technical University of Moldova. This goal was one of the basic ones within the Erasmus+ COOPERA project "Integrating Dual Higher Education in Moldova and Ukraine". The development vision and needs of the national economy define the leading arguments for the pilot programs at the Technical University of Moldova. The faculty team proposes a Dual higher education model appropriate for students from two engineering programs. The model specifies the roles of the student, university and company in dual education and the benefits of all involved actors. In the designing phase of the project, the teaching staff consult students, company administrators and specialists to fit all interests into one joint model and curricula.**

Keywords—dual higher education; Dual Higher Education Model; study process, company tutor; university tutor; partner companies.

I. INTRODUCTION

Higher education has been under a detailed evaluation, and new principles have reconceptualised some teaching and learning processes during the last decades. The main reason, in many cases, was that the job requirements hadn't reached the expected level of competencies and skills of the graduated students.

Trying to cover company needs in specific skills, the Technical University of Moldova introduced innovative methods in the teaching and learning process in another Erasmus+ project, PBLMD. So, some COOPERA project team members implemented a complementary methodology to Dual education called PBL - problem-based learning. This experience defines an advantage in implementing Dual education at TUM [1-2].

Dual education was introduced to overcome this shift between labour expectations and the professional level of candidates. Dual education represents a form of study where the development of the abilities, skills and competencies is emphasised in the formation of practical skills based on the actual work environment, with a high degree of involvement in the work process [3-4].

There is a paradigmatic difference between practical and theoretical education. Practical education has a more specific context, focusing on functional knowledge and skills obtained by practising.

In the case of theoretical education, it tends to be more fundamental and universal. Dual education increases the acquisition and achievement of knowledge from practical learning in the work process. In this way, Dual studies offer two possibilities for acquiring professional abilities and competencies from academia and the workplace.

"Dual education" comes from vocational training in German-speaking countries. The first model was developed in the German region Baden-Württemberg at the beginning of the 1970s.

In 2009, it was launched the next step in the state of Baden-Württemberg, which supposed the transferring of all colleges of advanced vocational studies into a newly created Baden-Wuerttemberg Cooperative State University.

The CEDEFOP's glossary defines dual training as a form of alternating training that combines teaching periods at the educational institution with other periods of work stages in a workplace [3-4]. This alternation can keep different periods daily, weekly, and monthly, depending on the university regulation and study plans. In

2016, the CEDEFOP's glossary underlined that dual education supposes that students involved in the process of dual education should have the employee role and, due to this, should receive the salary for the work. These two facts make dual education complete in the sense of involving the students in the labour activities with a combination of fundamental theoretical studies at the education institution and supposes the contractual relationship between student, company and university, the actors involved in the dual education.

For the last decades, dual education has achieved its primary goal, increasing the employability of graduates with a lot of practical and theoretical skills. But as disadvantages, it can be mentioned that companies are often highly specialised and unable to train apprentices in all needed areas and offer all necessary skills and competitions [5].

The current social environment and high youth unemployment afflicting Europe have led European policy to favour education seeking to promote the employability of young people. The crisis and the effect it has on the high unemployment rates, especially among the youth, has led some countries to give great importance to dual education at all educational levels and to speed up policies and reforms for the development of this system of education [4].

The adjustment of higher education in the Republic of Moldova to the changes in modern society requires implementing innovative forms of education for the young generation.

At the Technical University of Moldova, dual education is implemented for the Bachelor's degree programs in *Robotics and Mechatronics* and *Automatics and Informatics*.

The paper analyses the opportunities dual higher education (DHE) offers for all actors involved: university, company and student. The dual education model approved at the Technical University of Moldova is described.

II. ERASMUS + COOPERA PROJECT

The introduction of dual education at a higher level of training in Moldovan universities is the most crucial goal of the Erasmus + COOPERA project "Integrating Dual Higher Education in Moldova and Ukraine", ref. No. 617490-EPP-1-2020-1-MDEPPKA2-CBHE-SP [5].

Implementing this concept in Moldova will allow practical knowledge, skills and attitudes development appropriate to each context by collaborating with the business environment and providing opportunities to capitalise on theoretical skills in the real sector. COOPERA is a project with national and regional impact. The Academy of Economic Studies of Moldova (ASEM) coordinates the project, having as partners other two institutions from the Republic of Moldova – Technical University of Moldova (TUM) and Free International University of Moldova (ULIM), the Ministry of Education and Research and ten institutions from the EU and Ukraine.

The project aims to integrate dual higher education in partner countries, in general, improve work capacity and individual development, increase compatibility and continuity between the requirements of the business environment and the initial training of university students and achieve a better high economic efficiency and social integration, in particular.

Specific project objectives are:

a) To identify the needs and specific requirements of companies in different industrial sectors and businesses for DHE and to find companies willing to participate in pilot implementations of DHE during the project;

b) To develop a flexible and generic Dual Higher Education Model (DHEM) to support the different needs and interests of employers, higher education institutions (HEIs) and students in various industries and business sectors and to provide recommendations to HEIs for the implementation of Dual Higher Education;

c) To test the specific DHE models generated from the developed generic DHEM by realising their pilot implementations during the project and to analyse achieved results;

d) To propose changes to legislation/regulations to adapt Dual Higher Education in the Partner countries.

III. BACHELOR'S DEGREE PROGRAMS WITH DUAL STUDY AT TUM

TUM selected two undergraduate study programs to implement dual education: *Robotics and Mechatronics* and *Automatics and Informatics*.

The *Robotics and Mechatronics* study program aims to train industrial and research engineers in robotics and mechatronics, stimulate creativity and innovation, adapt to new labour market conditions, and develop the necessary skills in four essential areas of engineering: automation, computers, electronics and mechanics.

The *Automatics and Informatics* study program is part of the general field of Engineering and Engineering Activities and provides training and education for specialists in Electronics and Automation. A specialist in Automatics intends to show an integrated set of knowledge, skills and abilities necessary to develop industrial equipment, control systems, communications and information systems for process management in different sectors of human activity.

The curriculum trains graduates to design automation systems, robotic and mechatronic equipment and systems, to use, operate, or integrate them into flexible

manufacturing systems, to program and operate integrated computer production systems, and to solve application and research problems specific to the domain.

Both are bachelor's degree programs in interdisciplinary science and technology, which integrate with a systematic conception of such fields as Automation, Informatics, Electronics, Computers, Communications, Robotics, industrial, technological and manufacturing processes.

In previous decades, Robotics and Automatics were the prerogatives of the top industries (e.g., aerospace, aeronautics, military, and car manufacturers). In the recent period, based on advanced concepts and technology, both conventional and renewable energy production and distribution, intensive agriculture, food industry, light industry, pharmaceutical, chemical industry, management of biotechnological processes, constructions, transport systems, roads, and other can efficiently implement the most advanced approaches of technologies provided by Robotics and Automatics.

Several factors influenced the selection of these two undergraduate programs:

a) Continuous automation and robotisation of technological and production processes in the Republic of Moldova are based on the integration of engineering knowledge in computer systems, networks and information technologies, power electronics, mechanical devices, Etc, led to the need to train specialists who will acquire professional skills and abilities directly in the workspace of companies;

b) Different companies in the Republic of Moldova already have complex automation production systems based on the theoretical and practical concepts of state-of-the-art automatic, robotic and mechatronic systems. Thus, the internships at companies, the direct interaction with this equipment and the possibility to learn from professionals will allow the acquisition of the necessary competencies for future engineers;

c) The need to develop new methods and technologies for the design and production of automated, mini-, micro- and nano-robotic systems (that have found vast fields of application in technology, construction, medicine, Etc.) leads to the creation of favourable conditions for the development of dual education in the field of Automatics and Robotics.

IV. Dual Higher Education Model at TUM

The main goal of the Dual Higher Education Model is to improve work capacity and individual development, to increase compatibility and continuity between the requirements of the business environment and the initial training of university students, and to achieve a better high economic efficiency and social integration [6].

The particular scope of DHEM related to students is to become actively involved in the decision-making processes within the enterprise as their practical experience grows. The aim is to put students in a position from which they can develop and try their ways of solving problems during the practice phases [7].

TUM will follow an integrated model in existing programmes Robotics and Mechatronics and Automatics and Informatics, introducing changes in the study process.

The faculty team developed the dual education model in consultation with specialists in the fields of electrical and electronic engineering, computer science, information technology, automation and mechanical engineering: Arobs Software, Inther Software Development, Mechatronics Innovation Center, ICG Engineering, ElectroTehnoImport, Steinel Electronic, Bucuria, EFES Vitanta Moldova Brewery, Glass factory, Etc. to train the professional skills and abilities specific to the field and adapt to the requirements of the labour market. Also, teachers, graduates and students participated in various surveys. The implementation team studied their opinions and changed according to the curriculum.

According to the model approved at TUM after the discussions with representatives of the enterprises and industry organisations, students from these two programs, in the 2nd year of study, will have the possibility to select a free choice discipline/activity in-company training (120 hours), starting with 3rd year of study. They will have the opportunity to choose one of two ways to continue their studies: dual or classic. The model imposes the reorganisation of students into separate groups, in which they will study both traditional and Dual ways. It is essential to mention that students from both study forms will also have common disciplines they will attend during two days of study. Students who choose the classic form of study will continue with the courses according to the curriculum, and students who will select DHEM will leave for three days at the company, where they will have the opportunity to receive practice vocational training or work experience.

The distribution of the training hours (theoretical and practice) in the university and at the dual partner economic agent is specified in Table I.

TABLE I. Distribution of the Training Hours

	N. of weeks	Structure for the study in the university		Structure for the in-company training study		Total hours
		Hours/days per week	%	Hours/days per week	%	
1. Semester	15	15	100	0	0	900
2. Semester	15	15	100	0	0	900
3. Semester	15	15	100	0	0	900
4. Semester	15	15	100	0	0	900
5. Semester	15	300/2 days	33,3	600/3 days	66,7	900
6. Semester	15	355/2 days	39.4	545/3 days	60,6	900
7. Semester	15	310/2 days	34,4	590/3 days	65,6	900
8. Semester	15	100	11,1	800	88,9	900
Total		4565	62,7	2775	37,3	7680

The collaboration between TUM and the companies has to be dynamic and deep at all stages of the realisation of Dual higher education. Thus, the representatives of the economic agents will be involved in the development of curricula following the needs of the labour market; in the selection of potential students in the second year of study and the training of professional skills in the production environment; in ensuring the student's salary during the entire training process. The company will delegate a tutor, who will be responsible for training students and developing practical skills. The tutor will supervise the progress of studies, training plan, realised projects, issuing assignments to the students, examination of the practice students' reports, and drafting the competency of the student's profile for the company. Also, the company will be responsible for students' involvement in solving real problems; facilitating the employment of graduate students, who will carry out practical training in the partner company.

In the first year of testing the dual education within TUM, the program will use the existing curriculum for the study programs: Robotics and Mechatronics and Automatics and Informatics. Following years, the departments will adjust the curriculum to the demands of the labour market and the specifics of the study process of the dual format. These changes will require tight cooperation with company representatives to consider their needs for training future specialists in these fields. At the same time, the partner companies will offer teachers the opportunity to realise internships.

The university administration chose the "Computer Science and Systems Engineering" and "Software Engineering and Automatics" departments to pilot the dual education programmes. So, these departments are responsible for ensuring the educational process's quality in a Dual format. These departments are responsible for delegating the person who will coordinate the dual education and collaborate with the company's tutors.

The essential responsibilities of company and university tutors are:

a) to examine the learning process in the two places and to identify where the knowledge, skills and competencies envisaged in the curriculum can be acquired;

b) to monitor the student's learning progress. The aim is to stimulate the student to reflect on their learning and to be willing to share these reflections;

c) taking measures to reinforce learning and to correct failures in the process together with the university person-in-charge;

d) coordination of interaction between the student and the co-workers in the company.

V. CONCLUSIONS

Dual education in higher school represents an alternative form of study that places a significant emphasis on the formation of practical skills of students in the professional environment, with a high degree of involvement in this process by representatives of the business environment. Implementing dual education for the bachelor's degree programs in Robotics and Mechatronics and Automatics and Informatics at the Technical University of Moldova will increase interest in these two programs crucial for our country's economy.

The proposed dual education model imposes a close collaboration with the companies, which must be actively involved in this process.

Following the implementation of this form of education, both students and companies will benefit. The advantages for students are noticeable: an excellent opportunity to test their capabilities in the chosen career, financial independence (during the internship, the student receives a salary), trainers both from the university and from companies, and the experience gained during the training is helpful for the future career. Companies also benefit from this study method: partner companies can notice selected students' talent in advance, and the interaction with qualified employees can sharpen it.

ACKNOWLEDGEMENT

The results obtained in this paper are part of the work conducted under the Erasmus + COOPERA project "Integrating Dual Higher Education in Moldova and Ukraine", ref. No. 617490-EPP-1-2020-1-MDEPPKA2-CBHE-SP.

REFERENCES

[1] BALAN, Mihaela; CALIN, Rostislav; CIORBĂ, Dumitru. Bypassing curricula constraints by means of ICT. In: *When students take the lead: enhancing quality and relevance of higher education through innovation in student–centred problem–based active learning.* 27-28 octombrie 2016, Chișinău. pp. 126-132. ISBN 978-9975-45-504-6.

[2] CIORBĂ, Dumitru; COJUHARI, Irina. The PBL model implementation within the software engineering study program. In: *Electronics, Communications and Computing*. Editia a 10-a, 23-26 octombrie 2019, Chișinău. p. 84. ISBN 978-9975-108-84-3.

[3] *Dual Study programmes: An effective symbiosis of theory and practice*. https://www.ub-cooperation.eu/pdf/cases/W_Case_Study_Duales_Studium.pdf, (accessed 14.08.2022);

[4] HESSER W. *Implementation of a dual system of higher education within foreign universities and enterprises*, Hamburg, 2018, 245 p.

[5] Integrated programs: a combination of theory and practice. https://www.whu.edu/en/programs/bachelor-program/advantages-of-an-integrated-program, (accessed 12.08.2022);
[6] NAGHI D.I., Învățământul professional în system dual–o alternativă mai bună de intrare a tinerilor pe piața muncii? Școala profesională Germană Kronstadt, Brașov. Studiu de caz, *Calitatea vieții*, XXVII, nr. 4, 2016, p. 324–342;
[7] *Report of companies needs for Dual Higher Education in the Republic of Moldova and Ukraine* https://coopera-project.ase.md/wp-content/uploads /20 21/12/A1.2 COOPERA Report-on-companies-needs-fro-DHE_MD_UA_FINAL.pdf, (accessed 10.08