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Implementation report

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| Project full title: | Dual Education for Industrial Automatization and Robotics in Kazakhstan |
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| Abstract | This is a narrative account of the implementation of a new dual undergraduate education program |
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DISCLAIMER

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1. Development and accreditation of educational programs

The project developed a methodology aimed at ensuring comparability of educational programs. A joint educational program and curricula were developed in all three universities of Kazakhstan, with mandatory mastering of at least 240 academic ECTS credits (In accordance with the order of the Minister of Education and Science of the Republic of Kazakhstan dated May 5, 2020 No. 182I on amendments and additions to the order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 604I On Approval of State Compulsory Education Standards for all levels of education), implemented jointly by the three partner universities.

Attention is paid to professional competencies, i.e. the ability to practically use the knowledge, skills and abilities acquired during training in professional activities. The SOSE specifies that universities implementing elements of dual system of education plan and organize educational activities on the basis of combining theoretical training with practical training in the workplace. In this case, it is necessary to master up to 40% of the teaching material of the discipline directly at work.

The name and direction of the developed joint dual education program "Robotics Systems" was chosen after the discussion of the Atlas of New Professions.

The field of education is defined as 6B07 "Engineering, Manufacturing and Construction Industries", the direction of training is 6B071 "Engineering and Engineering".

The educational program passed the expertise of universities of the program countries, non-academic partners (Ural Transformer Plant, SaryarkaAvtoProm), as well as external experts.

Result:

1. Educational programs are included in the register of the Ministry of Education and Science of the Republic of Kazakhstan and have received positive assessments from experts.

2. Educational program of WKATU 6B07107 "Robotics Systems" was accredited in 2022 for a period of 5 years.

3. Educational program of KEnEU 6B07138 "Robotics Systems" was accredited in 2022 for a period of 5 years.

4. Educational program of INEU 6B07109 "Robotics Systems" was accredited in 2023 for a period of 5 years.

2. New and updated courses

The curriculum includes new, and also updated, courses.

The new WKATU courses are: Information Systems in Robotics, Algorithms and Data Structure, Programming, Electric Drives of Robotics System, Analogue and Digital Electronic Devices, Basic Robotics and Microprocessor Technology Devices, Control of Robotics Systems, Modern Automation Technologies, Software for Mechatronic and Robotics Systems, Computer Modeling of Processes and Systems in Robotics.

The total volume of developed disciplines is 35 credits.

The updated WKATU courses are: Integrated and Microprocessor Circuitry, Industrial Controllers, Microcontroller Programming, Computer Aided Design and Construction Systems, Assembly and Operation of Robotics Devices, Automated Metal Cutting Equipment, Programming for CNC Machining.

The total volume of updated disciplines is 29 credits.

The new INEU courses are: Information Systems in Robotics, Algorithms and Data Structure, Programming, Electric Drives of Robotics System, Analog and Digital Electronic Devices, Basic Robotics and Microprocessor Technology Devices, Control of Robotics Systems, Modern Automation Technologies, Software for Mechatronic and Robotics Systems, Computer Modeling of Processes and Systems in Robotics.

The total volume of the developed disciplines is 34 credits.

The updated INEU courses are: Integrated and Microprocessor Circuit Engineering, Industrial Controllers, Microcontroller Programming, Computer Aided Design and Construction Systems, Assembly and Operation of Robotics Devices, Automated Metal Cutting Equipment, Programming for CNC Machining.

The total volume of updated disciplines is 22 credits.

The new KEnEU courses are: Introduction to Mechatronics and Robotics, Technosphere Safety, Fundamentals of Mechatronics and Robotics, Components of Machine Vision Systems, Microcontroller Based Control Devices, Industrial Programming, Automation Systems Design, Interface Device and Communication Protocol, Hydraulic and Pneumatic Actuators of Mechatronic Systems, Group Control Systems for Intelligent Robots, Interchangeability, Standardization and Technical Measurements.

The total amount of developed disciplines is 44 credits.

The updated KEnEU courses are: Algorithms, Data Structures and Programming, Object Oriented Programming, Technological Processes of Machine-Building Productions, Automation of Typical Technological Processes and Productions, 3D Modeling in CNC Machines, Elements and Devices of Automation, Robotics Processes and Systems, Programming for Part Processing on CNC Machines, Industrial Controllers, Automated Metal-Cutting Equipment, Methods of Adaptive Control of Robotic and Mechatronic Systems. All courses have been updated taking into account the specifics of the new EP, its orientation on the study of robotic and mechatronic systems.

The total volume of the updated courses is also 44 credits.

Result: All courses have 3 or more credits and are listed in the curricula of the Robotics Systems education programs.

3. Student recruitment

Kazakhstan universities on a regular basis conduct career guidance work with pupils, college students and their parents.

8 students were enrolled in WKATU in 2021-2022 academic year. Vocational guidance work was also conducted with students of profile specialties. As a result, 10 students out of 113 students expressed their desire and chose a set of disciplines (modules). These disciplines were completed by them in 3-4 courses and their results were written in students' transcripts (8 disciplines, 32 credits and 4 credits of practical internship). The training was conducted from November of 2021-2022 academic year and completed in July of 2022-2023 academic year. The same work was conducted for the following academic years and 42 students were enrolled in additional training in the 2022-2023 academic year.

6 students were enrolled at KEnEU in the academic year of 2021-2022, 3 students in the academic year of 2022-2023, and 5 students in the academic year of 2023-2024.

At INEU in 2023-2024 academic year, 1 student was enrolled under this EP. Vocational guidance work was also conducted with students of profile specialties. As a result, 12 students out of 120 students expressed their desire and chose a set of disciplines (modules). These disciplines were completed by them in 3-4 courses and their results are written in the students' transcripts (8 disciplines, 32 credits and 4 credits of practical training).

The principle of learning outcomes and competencies is necessary to ensure that curricula, course units and modules are oriented towards the learner and specific learning outcomes. According to this principle, the key knowledge and skills to be acquired by the student during the learning process determine the content of the program of study. The competencies and learning outcomes, in turn, are established based on the requirements of a particular academic discipline, as well as on the social objectives for the formation of civic maturity and employability of graduates.

Result:

1. Admission to WKATU educational program 6B07107 "Robotics Systems"

| Educational program | Number of students | | |
|--|-------------------------|-------------------------|-------------------------|
| | 2021-2022 academic year | 2022-2023 academic year | 2023-2024 academic year |
| 6B07107 Robotics systems | 8 | - | - |
| Additional education for EP 6B07107 Robotics systems | 10 | 42 | 32 |
| Graduates of EP 6B07107 Robotics systems | - | 10 | - |

2. Admission to KEnEU educational program 6B07138 "Robotics Systems"

| Educational program | Number of students | | |
|--------------------------|-------------------------|-------------------------|-------------------------|
| | 2021-2022 academic year | 2022-2023 academic year | 2023-2024 academic year |
| 6B07138 Robotics systems | 6 | 3 | 5 |

3. Admission to INEU educational program 6B07109 "Robotics Systems"

| Educational program | Number of students | | |
|--|-------------------------|-------------------------|-------------------------|
| | 2021-2022 academic year | 2021-2022 academic year | 2021-2022 academic year |
| 6B07109 Robotics systems | - | - | 1 |
| Additional education for EP 6B07109 Robotics systems | - | - | 12 |

4. Students accepted to the EP "Robotics Systems" master the curriculum, the programs of which are registered in the register of the Ministry of Education and Science of the Republic of Kazakhstan.

4. Realization of dual education

As part of the educational process it is planned to conduct field practice-oriented classes and lectures by representatives of employers.

In the production conditions of "Urals Transformer Plant" LLP practice-oriented classes are held for 3rd year students of WKATU on the discipline "Modern automated technologies". In the laboratory conditions of the university on disciplines "Analog and digital electronic devices", "Basics of mechatronics and robotics" and "Technological processes of machine-building production" dual training is carried out. In the specialized disciplines "Fundamentals of Mechatronics and Robotics" and "Installation and Operation of Robotics Devices" the classes are taught by R.S. Gubashev, Chief Engineer of Relay Protection and Automation of Zhaik Munai LLP.

KEnEU students are taught at the enterprise "SaryarkaAvtoprom" LLP, as well as at "Kostanaijobakkurylys" LLP (2 students), "KST Beton" LLP (1 student), "Maslo-Del" LLP (1 student). Practical classes on disciplines "Algorithms and Data Structures, Programming", "Introduction to Mechatronics and Robotics", "Materials Science and Technology of Structural Materials", "Fundamentals of Leadership", "Theoretical and Applied Mechanics", "Interchangeability, Standardization and Technical Measurements", "3D Modeling on CNC Machines", "Automation of Typical Technological Processes and Production", "English Language in Professional Communication Situations", "Fundamentals of Mechatronics and Robotics", "Industrial Programming", "Technological Processes of Machine Building", "Technology of Production and Repair of Machines", "Technology of Production and Repair of Machines", "Technology of production and repair of machines".

Academic policy is an integral part of and is developed in accordance with the quality policies of higher education institutions. Teachers, students, department staff, and employers take an active part in the discussion of the quality assurance policy of educational programs. At the meetings of the Academic Committee with the participation of employers and students the current issues of the labor market and the main requirements for the competence of graduates are discussed. Based on this, the EP is updated, new disciplines are introduced on the recommendation of employers, adjustments are made to the title, content and scope of disciplines. As a result, the catalog of elective disciplines is updated annually.

The content of all types of professional internships and practice-oriented classes is closely related to the specifics of a graduate's future professional activity. Various trainings are organized for students on CV writing and interviewing.

Result:

1. Laboratory equipment was purchased within the framework of the project to conduct practice-oriented classes at the university.
2. Contracts were signed with enterprises to implement dual education.

5. Educational and methodological support

For the implementation of educational programs "Robotics Systems" educational-methodical complexes of educational program (EMCEP) and educational-methodical complexes of disciplines (EMCD) were compiled, as well as all materials of EMCD were placed on the project platform (<http://qnap.kineu.kz:8080/share.cgi?ssid=86981906792849bebf42741821a2751>).

Result: Training and methodological complexes of disciplines were prepared and placed on the DIARKAZ project platform.