


ADVANTAGES AND CHALLENGES OF DUAL EDUCATION IN THE DEVELOPMENT OF THE PROFESSIONAL IDENTITY OF ENGINEERS

ABSTRACT: The authors consider the strategic directions of the development of higher education in Republic of Serbia, especially in the light of legislative news regulating dual education at higher education institutions. In this context, they have paid a special attention to the analysis of legal acts and by-laws important for the development of the professional identity of engineers educated under the dual model of education. They have also perceived the number and structure of accredited study programs at higher education institutions in our country, which represent significant indicators of the direction of the development of the domestic economy mapped through the interest of employers for the engineers educated according to the dual model. So, we can conclude that there is an obvious influence of the fourth industrial revolution and the information age on all aspects of the society. Starting from all those changes that are happening and will happen, the Government of Republic of Serbia adopted the Education Strategy for the period from 2021 to 2030, in which there are

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given the vision, goals, and principles of education in the future. Talking about the dual model of higher education, the most important act is the Law on the Dual Model of Studies in Higher Education being in the focus of the authors in this research.

Keywords: *Higher education, dual education, The Education Development Strategy of Republic of Serbia, legislation, engineer.*

1. Introduction

Quality education is the motor of Serbia's development, while scientific and technological results and innovations based on the responsible and creative engagement of educated personnel are precisely cause-and-effect connected with educational processes, and that is why the valid Strategy for the Development of Science and Technology has the motto The power of Knowledge (Strategy of Science and Technology development of the Republic of Serbia for the period from 2021 to 2025 »The power of knowledge«, 2021). The belief that the expected return effect of education will lead to an economic boom has been fulfilled in some countries that have managed to integrate science, education, and development. The priority given to education and science in the countries of Western Europe (primarily in Germany), Japan, and the USA is closely related to their embarking on the path of rapid economic and economic expansion and development (Dukić Mijatović, 2022, p. 7). Now, after the development progress in the Republic of Serbia, it becomes necessary to determine the current state of education, and project development, and to have an active attitude toward the development and education of future generations in a much more interconnected world. All of this leads back (or leads) to issues of achieved and future quality of education and development, especially for young people. Reflections on the various possibilities of the education role in young people's development can be found in the fact that it is indisputable that education (knowledge) and science are the consequence and condition of the development of society, and that they are most closely connected with it. Only a qualitative analysis shows how much education and scientific achievements contribute to the development of society. Education in the 21st century is not only one of the many instruments of development but also one of its constituent parts and essential goals (Čukanović Karavidić, Dukić Mijatović, Pejanović & Karavidić, 2021, p. 75). Drafting of the current Education Development Strategy of Serbia (SROS) was initiated by the Ministry of Education, Science and Technological Development of the

Republic of Serbia (MPNTR), as the competent proponent under Article 29, paragraph 1 of the Law on the Planning System of the Republic of Serbia. The strategy for education development in Serbia, for the period from 2012 to 2020, was of great importance. This strategy laid the foundations for the development of pre-university and university education in the 21st century and contributed to the increase in the quality and efficiency of education as a whole. In addition, the Strategy enabled the creation of conditions for the personal and professional development of each individual and the development of society based on knowledge. The reasons for starting the initiative to create the current Education Development Strategy in the Republic of Serbia were numerous, one of which is certainly that it included the harmonization of policies in education with scientific, technical, and technological development and contemporary trends in society and the economy, and that it included issues of harmonizing regulations in education with international documents of the UN, EU, Council of Europe (Dukić Mijatović, 2021, p. 15).

Law on Amendments to the Law on Higher Education, brought by the dynamic legislative activity in 2021, enabled the return to full membership of the European Association for Quality Assurance in Higher Education (ENQA). Furthermore, the Law on Student Organization was adopted, which regulates this field after a long period, as well as the Rulebook on Amendments to the Rulebook on Standards and Procedures for the Accreditation of Study Programs as a by-law that enables the implementation of the Law on the Dual Model of Studies in Higher Education.

2. Challenges of higher education development in the Republic of Serbia

In the previous period, several key activities were carried out to improve the evaluation of the quality of doctoral studies – each doctoral dissertation became publicly available in an online repository. The share of highly educated people engaged in research and innovation in higher education institutions (HEIs), institutes, and companies has increased. Ensuring and strengthening the availability of all three study levels to students from vulnerable groups, as well as the share of highly educated people engaged in research and innovation in higher education institutions (HEIs), institutes, and companies. Despite the negative demographic trends in the RS, an increase in higher education was observed from 48% in 2015 to 54.7% in 2019. Moreover, a continuous increase in the percentage of the population with higher education was observed – from 18.7% in 2015 to 20.4% in 2019 (EUROSTAT). Achieving an equal system

of higher education, with fair and equal access for all groups in society, is one of the priorities in all countries participating in the Bologna process. In Serbia, it is still noticeable that certain social groups are underrepresented in higher education. Reports on the social dimension in the implementation of the Bologna Process in Serbia (EQUIED Tempus Project) show reduced participation of young people from the poorest families, from families with the lowest level of education, from Roma families nationalities, and persons with disabilities. We can conclude that, although the necessary conditions for the realization of the principle of »equal access for all« have been created in higher education in Serbia, that process is not complete and requires the definition of additional regulations and other measures (Dukić Mijatović, 2021, p. 16). The entire system of higher education, as well as the HEIs themselves, should undergo a transformation process towards a modern and socially responsible university, which is based on the application of academic principles and values in the realization of their basic functions (education and research). In the framework of higher education, it is necessary to ensure the transfer of technologies and innovations, continuous learning, and engagement in solving social challenges of the local and/or wider community. It is necessary to direct the Higher Education Institution in the direction of the Third Mission in the development of the university, where the issue of social responsibility of the university occupies a special place, which obliges the university to be actively involved in the social, economic, economic, political and cultural development of society. Thus, to increase the success and quality of education at all levels (from VVO to higher education) and to develop key competencies in the 21st century, it is particularly important to harmonize monitoring systems and the assessment of appropriate indicators, because the education system must not be viewed in a fragmented way (Education and Education Development Strategy in the Republic of Serbia until 2030, 2021).

The vision of education aims to provide quality education for all children and young people in the Republic of Serbia to ensure their full potential. The mission of education aims to provide a quality education that should contribute to the development of society as a whole. The vision of the development of education must ensure general progress in the development of society and economy based on knowledge while respecting the principle of solidarity and respecting and strengthening an inclusive approach in education that enables quality education for all and an economy that will be competitive on the European and world economic market. The vision of the development of education and the entire SROS 2030 should ensure changes in different areas of education as well as at different levels, and the most important of them are

listed below. One of the important goals in the field of education that emerges from the »UN Agenda Sustainable Development Goals by 2030«, to which RS is a signatory, is that every young person should master the basic levels of reading and math literacy, which requires a commitment to achieving these goals. The education development strategy until 2030 has two general goals, the first of which is dedicated to preuniversity education and the second to higher education. At the same time, General Goal 1 implies an increased quality of teaching and learning and the availability of pre-university education, and General Goal 2 implies an increase in the quality of higher education while improving its relevance and fairness.

The fulfillment of this goal implies an increase in the number of students who received support based on the new Rulebook on financial support for students. Additionally, it implies an increase in the number of scholarship students, the increase in the number of highly educated students who participate in short cycles at the Higher Education Institution, and an increase in the number of persons with a completed four-year education who participate in short cycles at the Higher Education Institution. The introduction of digital platforms, electronic index, and electronic register of students are also significant; the development of the register of competencies and the register of qualifications (Dukić Mijatović, 2021, p. 18). The Law on Amendments to the Law on Higher Education traced Serbia's path toward full membership in ENQA (NAT, 2022). For this reason, the current legal provisions regulate the procedures for the election of members of the Board of Directors of the National Accreditation Body, directors, members, and presidents of KAPK, then the National Council for Higher Education, and the Appeals Commission at NAT, considering that the appeals procedure for accreditations both higher education institutions and study programs were moved from NSVO to NAT.

Important provisions of the Law are also the provisions of Article 100, which govern the introduction of the state matriculation exam, which will begin in 2023/2024. The higher education institution, by its general act, determines which general, professional, and artistic matriculation exams are evaluated when enrolling in studies. For more, it determines the criteria based on which the classification and selection of candidates for enrollment in studies are carried out and compiles a ranking list of registered candidates for enrollment in first-degree studies based on the general success achieved in the four-year secondary education and on the matriculation exams, the results of the examination for checking special knowledge, aptitudes, and abilities and, if necessary, based on the success in national and international competitions, following the general act of the higher education institution.

3. Strategic aspects of the development of dual academic and vocational education in the Republic of Serbia

In the period covered by the previous Education Strategy, significant results and progress were achieved in various areas. At the level of vocational studies, significant results were achieved through the introduction of research into vocational studies, the reform of the organizational structure of vocational education institutions, the improvement of expected study outcomes, the improvement of the competencies of teaching staff in vocational studies, the strengthening of cooperation between higher education and the economy, and other measures. With the adoption of both the *lex specialis* and by-laws, a step forward was made. It should be borne in mind that technical-technological transformation implies a new way of organizing production processes, the result of which are smart products, services, and solutions. New technologies bring the potential for manufacturers to be significantly more efficient and productive, as well as less wasteful. This imposes an obligation for companies to undergo some form of business transformation. New business models are emerging, and learning and organization happen »on the fly«. The labor market is also adapting to new conditions. Namely, new skills and competencies are needed. The necessary managerial and IT skills and competencies are constantly changing, which is why appropriate education is also necessary. The fourth industrial revolution introduces deep and systemic changes in the economy and society. Namely, there should be: expansion of digital technologies (new computer technologies, blockchain, and distribution technologies, internet of connected things, supercomputers, cyber risks, etc.); reforming the physical world (artificial intelligence and robotics, advanced materials, multidimensional printing, drones, etc.); changes in the human being (biotechnologies, neurotechnologies, virtual augmented reality, changes in art and culture, etc.); integration of the natural environment (use of renewable energy sources, its storage, and transmission, geoengineering, space technologies, etc.). In Serbia, significant efforts are being made to create conditions for the changes required by digitalization (Strategy of Scientific and Technological Development of the Republic of Serbia for the period from 2021 to 2025 »The Power of Knowledge«, 2021, p. 75). In this goal, the following was adopted: a Law on innovation activity in 2021, a Strategy for scientific and technological development of the Republic of Serbia for the period from 2021 to 2025 »The power of knowledge«, and an Action plan for the period 2021-2023 for the »The power of Knowledge«, Strategy for the Development of the Startup Ecosystem of the Republic of Serbia from

2021 to 2025, Action Plan for the period until December 31, 2022, for the implementation of the Strategy for the Development of the Startup Ecosystem of the Republic of Serbia from 2021 to 2025 and Recommendations on the Ethics of Artificial Intelligence was adopted on the panel within the 41st General Conference of UNESCO, in November 2021, as well as the Artificial Intelligence Development Strategy adopted in 2019 for the period 2020-2025. The power of knowledge leads to the improvement of science, as well as that the development of science creates the future, and the development of science and higher education are inseparable, especially in the segment of new technologies and dual academic and vocational education. From the 2021/2022 school year for the first time, dual study programs were implemented at higher education institutions in the Republic of Serbia (29 accredited, while dual education is realized in 150 secondary vocational schools, for a total of 54 dual educational profiles with qualification standards). Over 10,000 students and 880 companies are involved in the dual education system. It is precisely the enactment of *lex specialis* in this area and by-laws that connects education and the economy in the best way. The goals of the dual model are: providing conditions for the acquisition, improvement, and development of students' competencies following the needs of the labor market; contributing to strengthening the competitiveness of the economy of the Republic of Serbia; providing conditions for easier employment after completing higher education; providing conditions for further education and lifelong learning; developing entrepreneurship, innovation and creativity of each individual for his professional and career development; providing conditions for personal, economic and general social development; developing the ability for teamwork and a sense of personal responsibility in work; developing awareness of the importance of health and safety, including occupational safety and health; developing the ability to self-evaluate and express one's own opinion as well as independent decision-making and promoting the socially responsible role of the employer in society.

The law stipulates that a higher education institution that wants to realize study programs according to the dual study model forms a network of employers who need to employ persons with qualifications acquired at that institution. The basis for the implementation of the dual study model is a study program accredited under accreditation standards and a qualification standard established by the law regulating the national framework of qualifications. The dual study model can be accredited as an independent study program or as one of the modules within the study program and in addition to the elements prescribed by the law governing higher education and accreditation standards,

it contains a description and scope of learning through work expressed in hours and ESPB points. The ratio of hours of active teaching conducted at the higher education institution to learning through work at the employer is determined by the study program, with the fact that active teaching (lectures, exercises, and other active teaching forms) must be represented by at least 450 hours per year on average at the level of the whole study program, and learning through work with at least 450 hours per year on average at the level of the entire study program. The mutual relationship between the higher education institution, the employer, and the student in the study programs, i.e. modules according to the dual model, is governed by a contract. The mutual relationship between the higher education institution and the employer is governed by the contract on the dual model, while the mutual relationship between the employer and the student is governed by the contract on learning through work. The contract on the dual model is concluded between the higher education institution and the employer, in written form, for a term that cannot be shorter than the number of years of study program duration. The employer's mentor must possess the competencies for learning through work implementation defined by the general act of the higher education institution. A student who is learning through work is entitled to compensation. Compensation for learning through work is paid once a month, no later than the end of the current month for the previous month, for each hour spent on learning through work in the net amount of at least 50% of the basic salary of an employee who works in the same or similar jobs, by the law. Therefore, dual education represents an extraordinary platform for connecting the educational and economic process, where the higher education institution will have benefits in the form of the development of a study program based on the latest technologies, the company will employ personnel fully prepared, qualified and competent to respond to the challenges of modern production processes and the most advanced technologies, while students, except for certain employment, due to the competencies they acquired during the educational process and were paid during the same. All of the above greatly contributes to the development of the professional identity of an engineer.

Based on the conducted empirical research on the availability of data on the so far accredited study programs conducted by the National Accreditation Body, i.e. the Commission for Accreditation and Quality Control, the following accredited programs according to the dual study model within higher education were recorded in the period from September 23, 2021, to October 10, 2022. Within this period, 30 decisions were made on the accreditation of study programs under the dual model. Analysis of collected data in a

given domain indicates certain trends. First, when it comes to the number of accredited programs, and taking into account the beginning of the legal basis for the accreditation of study programs according to the dual model in higher education, the number of 30 accredited programs is significant (National body for accreditation and quality assurance in higher education, 2022). It is a relatively short time cycle in which accreditations are submitted and programs are accredited. If such a trend in the number of programs continues to be constant in the coming period, we can talk about a relatively significant number of programs that will be offered within higher education. Other observed indicators related to the list of accredited programs are related to the type of study, that is, the degree of study. In this regard, a significantly larger number of study programs are accredited within professional studies, that is, only three programs are accredited as study programs of academic studies. This data is to a significant extent determined by the fact that the creation and implementation of study programs according to the dual model is significantly easier in the context of the implementation of the program itself in the field of professional studies as opposed to academic studies. Finally, when it comes to the degree of study in the context of accredited study programs, the programs are primarily accredited at the first degree of study, with a few programs at the second degree. This data indicates that the focus of higher education institutions in the domain of accreditation of study programs according to the dual model is primarily focused on basic studies since at this level of study, titles that are of greatest need for the labor market are concentrated. Analyzing the names of accredited study programs, and higher education institutions that created such programs and started their implementation, a significant number of programs are in the field of technical and technological sciences. Taking into account the character and goal of studies according to the dual model, it is expected that the creation of given study programs is predetermined in synergy with the acquisition of knowledge and skills specific to certain scientific fields. The trend of development of information and communication technologies, and general technological progress imposes the needs of the labor market in a given domain, in which higher education institutions must respond to such needs through the creation of new programs. At the moment, the trend is such that there is a high degree of need for qualified labor in a given area. Thus, the role of higher education institutions is to offer competent experts and future labor for the needs of the labor market through the creation and accreditation of their programs according to the dual model, which is also one of the goals of introducing a dual study model in the field of higher education.

Table 1. Accredited programs according to the dual study model in higher education

Number	Name of the institution	Name of the program	Type and degree of study
1.	The Academy of Applied Technical Studies, Belgrade	UPS – Energy Efficiency and Clean Energy	Undergraduate professional studies
2.	University of Novi Sad – Faculty of Agriculture	UAS – Landscape architecture	Undergraduate academic studies
3.	University of Kragujevac – Faculty of Technical Sciences, Čačak	UPS – Apparel Engineering and Design	Undergraduate professional studies
4.	The Academy of Applied Technical Studies, Belgrade (Department of Traffic, Mechanical Engineering and Protection Engineering)	UPS – Road traffic	Undergraduate professional studies
5.	The Academy of Applied Technical Studies, Belgrade (Department of Belgrade Polytechnic)	UPS – Recycling technologies	Undergraduate professional studies
6.	The Academy of Applied Technical Studies, Belgrade	MPS – Phytomedicine	Master professional studies
7.	The Academy of Applied Technical Studies, Belgrade	MPS – Food technology	Master professional studies
8.	The Academy of Applied Technical Studies, Belgrade	UPS – Mechanical Engineering	Undergraduate professional studies
9.	The Academy of Applied Technical Studies, Belgrade	MPS – Mechanical Engineering	Master professional studies
10.	College of Applied Technical Sciences, Niš (Department Niš)	UPS – Construction Engineering	Undergraduate professional studies
11.	The Academy of Applied Technical Studies, Belgrade/ Department of Belgrade Polytechnic	UPS – Fashion design of leather products	Undergraduate professional studies

Number	Name of the institution	Name of the program	Type and degree of study
12.	The Academy of Applied Technical Studies, Belgrade/ Department of Belgrade Polytechnic	MPS – Graphic Design	Master professional studies
13.	College of Applied Technical Sciences, Niš / Department Pirot	UPS – Business Information Systems	Undergraduate professional studies
14.	College of Applied Technical Sciences, Niš / Department Niš	UPS – Food technology	Undergraduate professional studies
15.	College of Applied Technical Sciences, Niš / Department Niš	UPS – Industrial Engineering	Undergraduate professional studies
16.	College of Applied Technical Sciences, Niš / Department Niš	UPS – Furniture and Interior Engineering	Undergraduate professional studies
17.	The Academy of Applied Technical Studies, Belgrade (Odsek Primenjene inženjerske nauke, Požarevac)	MPS – Electrical Engineering and Computing Master	Master professional studies
18.	The Academy of Applied Technical Studies, Belgrade	UPS – Graphic engineering	Undergraduate professional studies
19.	Akademija strukovnih studija Južna Srbija – Odsek za poslovne studije, Leskovac	UPS – Management of Food and Gastronomy Technology	Undergraduate professional studies
20.	University of Niš – Faculty of Mechanical Engineering, Niš	MAS – Mechanical constructions, development and engineering	Master professional studies
21.	Academy of Applied Studies Šumadija – Department Kragujevac	UPS – Business Engineering – Mechanical Engineering	Undergraduate professional studies
22.	The Academy of Applied Technical Studies, Belgrade	UPS – Interior Design	Undergraduate professional studies

Number	Name of the institution	Name of the program	Type and degree of study
23.	Academy of Technical and Art Applied Studies Belgrade (Department of the High School for Information and Communication Technologies Belgrade)	UPS – Postal and Logistics Systems	Undergraduate professional studies
24.	Academy of Vocational Studies Southern Serbia Leskovac, (Department for Agricultural and Food Studies Prokuplje)	UPS – Food technology	Undergraduate professional studies
25.	Academy of Vocational Studies Southern Serbia	UPS – Textile Engineering	Undergraduate professional studies
26.	University of Kragujevac – Faculty of Technical Sciences, Čačak	MAS – Information technology	Master professional studies
27.	Academy of Vocational Studies Southern Serbia, Department of Business Studies Blace	UPS – Tourism	Undergraduate professional studies
28.	Academy of Applied Studies Belgrade	UPS – Vocational Medical Laboratory Technologist	Undergraduate professional studies
29.	Academy of Applied Studies Belgrade	UPS – Vocational beautician esthetician	Undergraduate professional studies
30.	College of Applied Technical Sciences, Niš / Department Vranje	UPS – Environmental Protection	Undergraduate professional studies

Source: Author's research

4. Conclusion

The strategic commitment of the RS Government and MPNTR is to provide quality education for all citizens through openness, fairness, accessibility, and democracy of education, with a commitment to providing equal opportunities for all children. The mentioned and other changes that are happening and will happen in the economy and society lead to the conclusion that quality education is needed that will follow modern changes in society. Namely, we are talking about a society based on knowledge, which is based on the knowledge economy. The knowledge economy has an economy based on knowledge, that is, an economy that dominantly builds its competitiveness on technological strength and highly educated human resources. Following Europe, Serbia has declared itself as a society based on knowledge, which obliges us to take care of the quality of education. The strategy for the development of education in Serbia until 2020 (SROS 2020) produced significant results in the field of pre-university and university education and contributed to the creation of conditions for the personal and professional development of each individual, as well as the development of society and the state as a whole. Furthermore, when it comes to higher education, the valid Education Strategy should contribute to the improvement of the quality of education outcomes and the quality of human resources, then to the improvement of the relevance of higher education at the national and international levels. Additionally, it is expected to improve the coverage and fairness of higher education and the definitive digitization of higher education. Higher education should, directly and indirectly, serve the purpose of realizing the concept of sustainable development. It is a concept based on knowledge and innovation, ecological sustainability, development of culture, and technology, and nurturing diversity and critical thinking. However, how much an educated individual will contribute to the growth of the social groups product with his increased accumulated knowledge and expertise depends, first of all, on the possibility of employment. Those instruments and measures that encourage the mobility of human resources, to apply the acquired knowledge in practice, are significant, and current legislative changes can be affirmatively assessed in that direction. Adequate choice of an occupation in conditions of rapid structural changes is a complex process. If long-term determinants are not taken into account in the correct choice of occupation, saturation or shortages occur in the labor market, and one cannot speak of the adequate formation of human capital, but of social cost, i.e. about the inadequate allocation of resources in certain segments of education. Education (knowledge) is the most important driver of development, long-term investment in progress, and a flywheel of

social development, while dual academic and professional education is a significant step forward in improving the development of the professional identity of engineers. The initiated process of accreditation of study programs based on new legislative solutions is moving in the direction of achieving society's goals. The model of dual education in higher education represents the possibility of creating study programs with the inclusion of the economy for better profiled future human resources for the needs of the labor market. The importance of higher education institutions in the field of creating study programs and competencies of graduates is of crucial importance for the future sustainable development of the economy and society in general. Empirical data have shown that institutions in the field of higher education have recognized that the new model of education can contribute to the transfer of knowledge and skills to future students, creating new competencies in the function of the needs of the labor market. The full effects of the new study model are expected in the medium term, taking into account the trend of creating new programs according to the given model and the time required to complete these studies.

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PREDNOSTI I IZAZOVI DUALNOG OBRAZOVANJA U RAZVOJU PROFESIONALNOG IDENTITETA INŽENJERA

REZIME: Autori razmatraju strateške pravce razvoja visokog obrazovanja u Republici Srbiji posebno u svetlu legislativnih novina, kojima je regulisano dualno obrazovanje na visokoškolskim ustanovama. U tom pravcu posebnu pažnju su posvetili analizi zakonskih i podzakonskih akata značajnih za razvoj profesionalnog identiteta inženjera školovanih po dualnom

modelu obrazovanja, te sagledali broj i strukturu akreditovanih studijskih programa na visokoškolskim ustanovama kod nas, koji predstavljaju značajne pokazatelje pravca razvoja domaće ekonomije mapirane kroz interes poslodavaca za inženjerima obrazovanim po dualnom modelu, te je očigledan uticaj četvrte industrijske revolucije i informatičkog doba, na sve aspekte društva. Polazeći od svih tih promena koje se dešavaju i koje će se dešavati Vlada Republike Srbije je usvojila Strategiju obrazovanja 2021-2030. godine, u kojoj su dati vizija, ciljevi i principi obrazovanja u budućnosti, dok je za dualni model visokog obrazovanja najznačajniji akt Zakon o dualnom modelu studija u visokom obrazovanju, koji je u fokusu autora u ovom istraživanju.

Ključne reči: *Visoko obrazovanje, dualno obrazovanje, Strategija razvoja obrazovanja Republike Srbije, legislativa, inženjer.*

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