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VOCATIONAL EDUCATION AND TRAINING FOR THE FUTURE OF WORK

POLAND

CEDEFOP REFERNET THEMATIC PERSPECTIVES

Vocational education and training for the future of work: Poland

Policy strategies and initiatives to prepare VET (vocational education and training) systems for digitalisation and future of work technologies

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Author: Marta Ponikowska

Contributors: Olga Wasilewska, Barbara Przybylska (proofreading)

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CHAPTER 1.

Introduction – Impact of digitalisation in Poland

Vocational education and training's (VET) response to the advancement of digitalisation, automation and new technologies is addressed in Polish strategic documents and, since 2018, also in the Education Law. Policy and lawmakers understand the global trend and need for a more flexible, modern VET infrastructure, programmes and curricula, and recognise that VET, apart from higher education, has the greatest impact on the preparation of a skilled workforce for the Polish economy. VET reform is a part of the government's key strategic document concerning the mid- and long-term policy of Poland in the perspective of 2020 and 2030 – the Strategy for Responsible Development launched in 2017 by a resolution of the Council of Ministers ([1]). Among the fields that require state intervention, the Strategy for Responsible Development indicates the 'Development of VET for Industry 4.0.' and lists actions and flagship projects to be undertaken on the governmental level. The high public policy importance of 'VET for Industry 4.0.' (hereinafter VET for i.4.0.) was strengthened by an official open letter to employers, co-signed in January 2018 by the Minister of National Education and the Prime Minister of Poland. They invited employers to join in promoting VET among youth and to become more involved in the process of teaching and learning, so that VET graduates can be better prepared for i.4.0. needs ([2]). The strategic significance of VET modernisation mentioned in the Strategy for Responsible Development is reflected in the changes introduced to the Education Law.

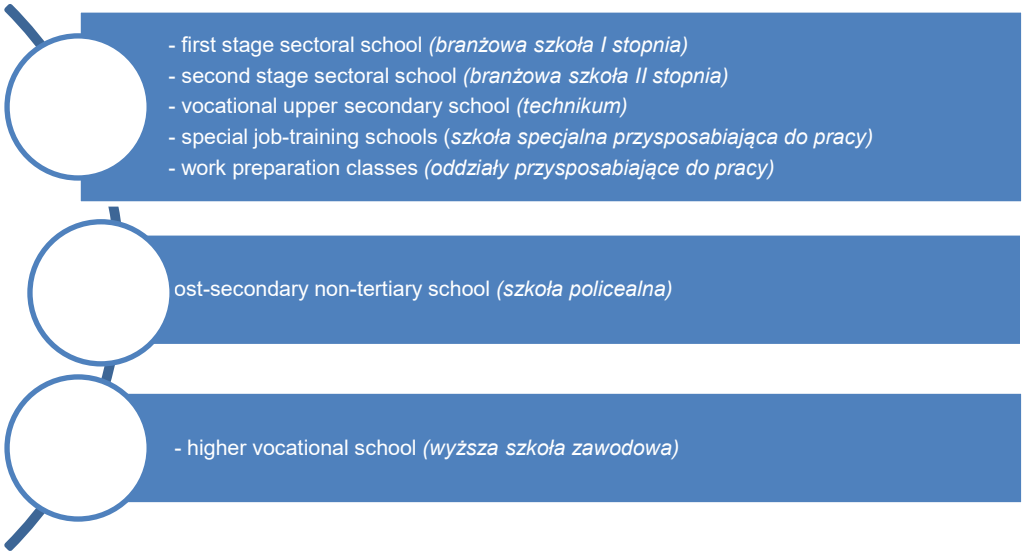
The Act of 22 November 2018 amending the Act on the Education Law, the Education System Act and other acts, is the most recent step in the process of adapting the vocational education system to the needs of a modern economy that is highlighted in the Strategy. The amended Education Law aims to strengthen the VET system in light of the anticipated i.4.0., which is usually not mentioned explicitly, but is rather referred to as 'new technologies', 'modern technologies', 'modern economy', etc. The developments in the education law (including

([1]) Resolution No. 8 of the Council of Ministers of February 14, 2017 on adopting the Strategy for Responsible Development to 2020 (with a 2030 perspective). http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WMP20170000260/O/M20170260.pdf

([2]) Open letter to employers of January 2018: https://www.gov.pl/web/edukacja/wspolny-list-premiera-rp-i-minister-edukacji-narodowej-do-pracodawcow

secondary legislation) concerning VET for i.4.0. will be further explained in Chapter 3.

Figure 1. VET structure in Poland – 2019



Source: own elaboration. For more information on Polish VET see: https://cumulus.cedefop.europa.eu/files/vetelib/2019/Vocational_Education_Training_Europe_Poland_2018_Cedefop_ReferNet.pdf, p. 17.

Beside the reform of the education law, the Ministry of National Education developed a new policy strategy on skills. On January 25, 2019, the Council of Ministers adopted the 'Integrated Skills Strategy for Poland 2030 – general part' (Integrated Skills Strategy, 2019) ([3]). It will play an important role in the further development of VET policies for i.4.0. It is planned that the 'Integrated Skills Strategy 2030 – general part' will be further developed in cooperation with the OECD in document entitled 'The Integrated Skills Strategy – detailed part'. According to the strategy authors, the specific actions to implement the priorities set in the 'Integrated Skills Strategy for Poland 2030 – general part' will be developed based on the experience and knowledge of OECD experts, Polish ministries and stakeholders.

The skills strategy introduces a new typology of basic and transversal skills, also called 'skills of the future', which are to be developed through education and lifelong learning, including VET. 'The Integrated Skills Strategy' sets the framework

([3]) The Integrated Skills Strategy 2030 – general part, adopted on 25 January 2019 by Council of Ministers (Resolution no. 12/2019). http://www.ibe.edu.pl/images/download/Zintegrowana_Strategia_Umiej%C4%99tno%C5%9Bci_2030_cz%C4%99%C5%9B%C4%87_og%C3%B3lna.pdf

for supporting policy complementarity and the integration of activities in the area of broadly understood skills. This includes development skills in the field of education and training, including formal education (general and vocational, higher education), non-formal education and informal learning. It takes into account the demand for specific skills, their availability, adaptation to the needs of the labour market and the economy, as well as the management and coordination system in these areas (Integrated Skills Strategy, 2019, p. 21).

Priorities set by the strategy also relate to the link between VET and innovation in the context of digital transformation. Priority 3 of the strategy – 'Increase the involvement of employers in developing and better utilising skills' – emphasises the need for strengthening links between enterprises and vocational, higher and research education. It is especially important for micro, small and medium enterprises to strengthen their links with the education sector, as the skills shortages influence their businesses the most (Integrated Skills Strategy, 2019, p.65). Also, strategic Priority 4 – 'Build an effective system of diagnosing and informing about the current state and demand for skills' – concerns VET with regard to the development of the skills diagnosis system up-dated in a manner allowing for its effective functioning: 'In order to ensure corrective actions, it is important to reveal skills gaps, not only at the level of professions, but above all at the level of specific skills, which can also be understood as the ability to perform professional tasks in specific job positions or groups of precisely selected learning outcomes required for given occupations.' (Integrated Skills Strategy, 2019, p.64). It is foreseen that the detailed part of the strategy (to be developed in cooperation with OECD) will set up specific actions facilitating VET cooperation in line with the digital transformation of labour market.

The launch of 'The Future Industry Platform Foundation' ([4]) based on the Law on the Future Industry Platform Foundation of 17 January 2019 is another significant step that will influence the process of more systematic discussion about VET for i.4.0 ([5]). The goal of the Platform is to promote the competitiveness of entrepreneurs by supporting their digital transformation in terms of processes, products and business models, using the latest developments in the field of automation, artificial intelligence, ICT, communication between machines and communication between humans and machines. The Platform shall integrate all relevant stakeholders and act as an accelerator of the digital transformation of Polish industry. One of its aims is to 'cooperate with entities conducting technical education aimed at promoting the adaptation of employees' competences to the

([4]) More information about the Foundation: https://przemyslprzyszlosci.gov.pl/

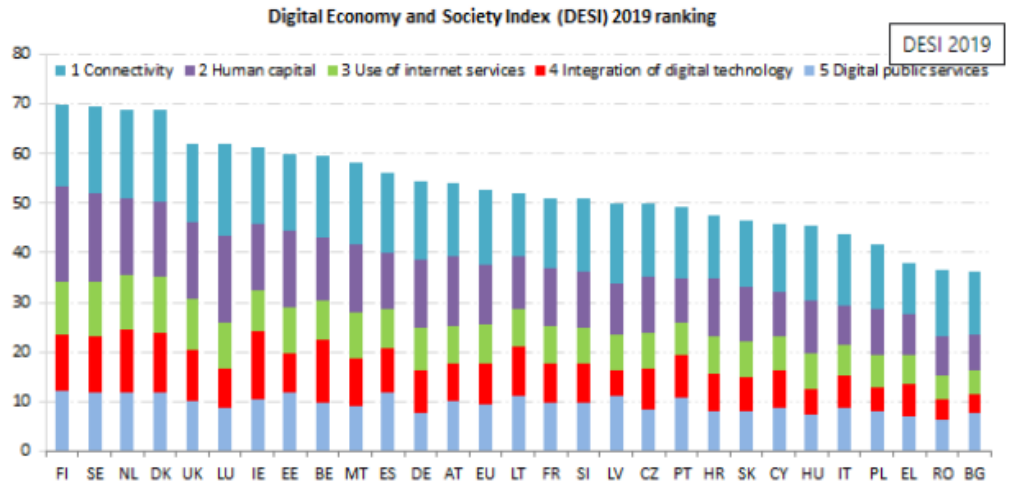
([5]) More information about the Foundation's activities: https://www.gov.pl/web/rozwoj/fundacja-platforma-przemyslu-przyszlosci

needs of the future industry' (Art. 2, para. 9 of the Law on the Future Industry Platform Foundation). The Platform will facilitate educational activities to increase the pool of specialist with the vocational skills needed for the digital transformation of the economy, e.g. the ability to understand all 4.0. manufacturing processes and interactions.

It is important to note that according to the Digital Economy and Society Index (DESI) 2019 ([6]) findings, Poland belongs to the low-performing cluster of countries, at position 25 out of 28 countries. 'Access to broadband for schools is ensured through the implementation of the National Education Network project, which effectively started in 2018. Nevertheless, Poland is still far from achieving goal 2 of the Digital Agenda for Europe (connectivity of 30 Mbps or more for all citizens by 2020). The main difficulties are still related to the geographical conditions that raise the cost of network deployment' (DESI 2019 Country Report Poland, p. 6). In terms of human capital, DESI ranks Poland as 22nd of EU countries, indicating that basic and advanced digital skills remain below the EU average. The lack of an appropriate infrastructure and digital ecosystem may lead to slower VET reforms in the context of the 4.0. industrial revolution than in other countries. This factor should be considered when assessing Polish VET readiness for i.4.0. As indicated in the DESI Poland 2019 report: 'Polish businesses are in favour of using new technologies, a trend reflected in the increasing use of big data, cloud computing and online selling. However, according to the Digital Intensity Index, 56% of companies have a very low level of digitisation (EU: 46%), and only 12% are highly digitised (EU: 18%)' (DESI 2019 Country Report Poland, p. 3). Given the above, VET in Poland cannot be expected to become highly digitalised and prepared for i.4.0. needs if business and industry itself is facing challenges with regard to the introduction of new digital standards.

([6]) https://ec.europa.eu/digital-single-market/en/scoreboard/poland

Figure 2. Digital Economy and Society Index 2019



Source: European Commission https://ec.europa.eu/digital-single-market/en/desi Accessed on 28.11.2019.

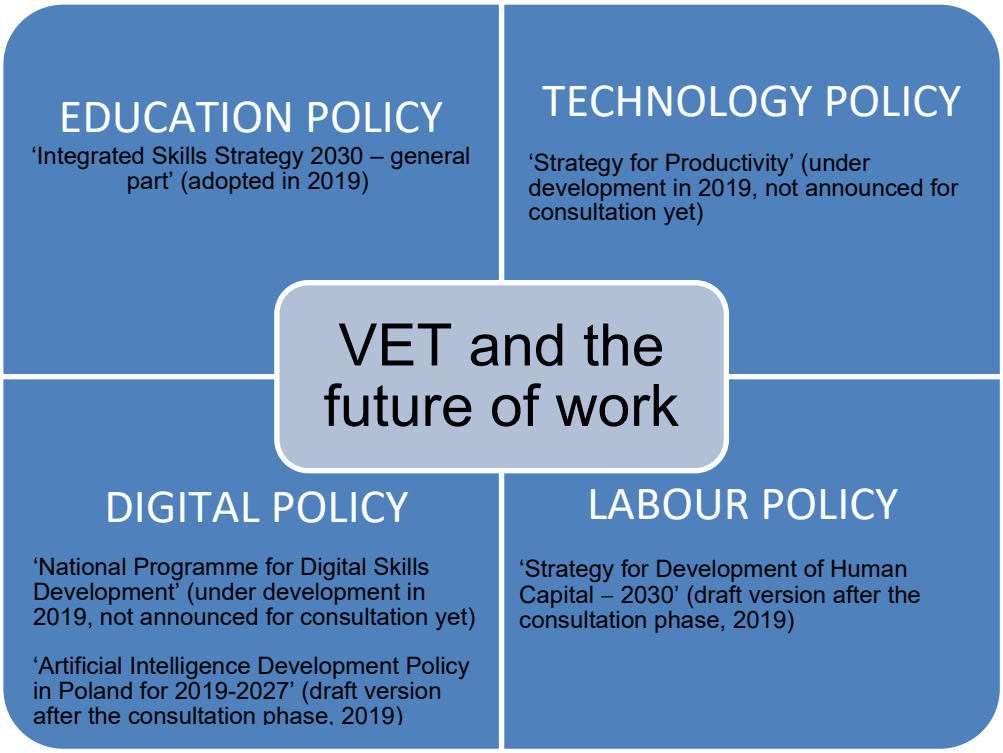
Recognising the very low position of Poland in the DESI, the Ministry of Digital Affairs is developing a national 'Digital Competence Development Programme', which would aim at a constant increase in the level of digital competences by providing everyone in Poland with the opportunity to develop digital skills in accordance with individual needs. The programme is currently in the development phase, which takes into consideration the training of teachers and adjusting the school curricula to the challenges of digital transformation (including algorithmic thinking).

CHAPTER 2.

VET policy strategies to adapt to digitalisation

VET for i.4.0. is a cross-sectoral issue, hence it is addressed in this paper from four angles: education policy, technology policy, digital policy and labour policy.

Figure 3. VET and the future of work in policy documents



Source: own elaboration.

2.1. Education policy

VET reform was one of the policy priorities of the Ministry of National Education in the last three years. Among others, it aimed at increasing the impact of employers, business and industry organisations on vocational education and fostering cooperation between employers and schools. According to the Ministry of National Education, over 3 000 employers joined campaigns (conferences, educational fairs, workshops, trainings, meetings with parents of students) promoting

vocational education in their sectors, and over 1 300 became patrons of classes in schools providing vocational training ([7]).

Adapting VET to the needs of a modern economy, changes taking place on the labour market and the demand for highly qualified staff were indicated as reasons for introducing the Act of 22 November 2018 amending the Act on the Education Law, the Education System Act and other acts, which is described in more detail in Chapter 3.

The Ministry of National Education developed the 'Integrated Skills Strategy 2030 for Poland' (2019). The strategy includes diagnoses and recommendations for the entire education system, including VET. The strategy addresses new technologies as an important factor influencing current VET reforms and accordingly proposes a set of skills crucial for functioning in the new labour market, such as, for example, digital, communication, team-working, planning and problem-solving skills. The strategy clearly emphasises the connection between current VET reforms and the needs of a changing labour market (influenced by digitalisation): 'The challenge, and at the same time the goal, of vocational education reform is to create a modern and attractive education system for students and their parents. (…) On the one hand, vocational training is to be based on the acquisition of skills that can be immediately used by graduates in the labour market and, on the other hand, for the development of key competences. This requires vocational school teachers to be constantly following civilizational, economic and digital changes' (Integrated Skills Strategy, 2019, p. 39).

2.2. Higher education policy

The Ministry of Science and Higher Education led the process of reforming the law on higher education and science (2018), which includes provisions on higher VET. Currently, the law allows for dual studies in higher VET schools, which means more cooperation with business and opportunities for students to acquire skills associated with the fourth industrial revolution during their studies. The new law introduced a clear division between higher VET schools and universities, emphasising the primary role of higher VET schools in preparing students for labour market needs.

([7]) https://www.gov.pl/web/edukacja/3-lata-w-men-praca-dla-polski-dobra-szkola

2.3. Technology policy

The Ministry of Development (former the Ministry of Entrepreneurship and Technology) is developing a 'Strategy for Productivity'. It should be available for consultations in 2020.

The system of Sectoral Skills Councils was introduced in 2016 ([8]) and is currently implemented by the Polish Agency for Enterprise Development ([9]). The Skills Councils are intended to enhance cooperation between VET schools and the needs of respective sectors of the economy, propose recommendations on skills needs in accordance with the changing needs of the sectors, especially taking into consideration the changes stemming from the dynamic development of technology.

Another technology policy tool relating to VET are Special Economic Zones. Some of the zones are introducing VET Clusters, which aim to enhance cooperation between VET schools and regional businesses in order to match VET education with the most up-to-date needs of local employers. The most recent tool is the introduction of the Future of Technology Platform (Industry 4.0. Platform), which among other objectives, will be a body that cooperates with VET schools in order to promote the skills needed for the 4.0. labour market.

Recently, the Ministry of Development in cooperation with the Ministry of National Education launched the programme 'School for the Innovator' ([10]). Its purpose is to develop and test solutions in primary schools for shaping and developing pro-innovative competences in the education system and to prepare recommendations for Ministry of Education in this regard.

2.4. Digital policy

The Ministry of Digital Affairs is currently working on a national Programme for Digital Skills Development. Since 2018, the Ministry of Digital Affairs has been coordinating a Working Group on Digital Skills, which has several subgroups: a group on the digital skills of citizens; a group on the digital skills of ICT specialists; and a group on the digital skills of the civil service. Experts from this group

([8]) https://www.parp.gov.pl/component/site/site/sektorowe-rady-ds-kompetencji

([9]) https://www.parp.gov.pl/component/content/article/57248:posiedzenie-rady-programowej-ds-kompetencji-2

([10]) The project website operated by the Center for Citizenship Education: https://szkoladlainnowatora.ceo.org.pl/

participated in the development of the main documents for the Programme for Digital Skills Development.

In addition, the Ministry of Digital Affairs is implementing the National Education Network project that is to ensure access to high-speed internet for all schools by 2020 (DESI 2019 Country Report Poland, p. 5). The National Education Network ([11]) was introduced by the Law on National Educational Broadband ([12]) and provides schools (including VET schools) with access to the internet, which is often the basis for introducing new technologies in school. Some experts indicate the successful implementation of the National Educational Broadband as a key educational recommendation for i.4.0. development. The National Education Network is also aimed at raising the level of students' digital skills and enabling support for the educational process in schools through access to digital resources available on the internet. The list of schools, including VET schools, that are part of the National Education Network is growing and the Ministry of Digital Affairs anticipates that by 2020 ([13]), all schools will have broadband access to secure internet.

2.5. Labour policy

The development of a modern workforce for Polish industry through VET is highlighted in the Polish Human Capital Development Strategy 2030. The aim of the strategy is to ensure that public projects in the area of human capital in Poland increase the level of social cohesion. The strategy's draft indicates automation as one of the processes influencing the Polish labour market. The Ministry of the Family, Labour and Social Policy does not address automation and AI in the context of VET education and the labour market in the currently binding labour market legislation. It is, however, highly possible that the draft of a new act on the labour market, taking into consideration the influence of technology on labour market institutions and their cooperation with the VET system will be presented for consultations in 2020.

([11]) Official portal of the National Education Network, a public telecommunications network for the provision of publicly available telecommunications services to schools: https://ose.gov.pl/

([12]) Law on the National Educational Broadband of 27 October, 2017. Official Journal of 2017, item 2184.

([13]) More information about the National Education Network: https://ose.gov.pl/czym-jest-ose

2.6. Stakeholders involvement

VET for i.4.0. was also an issue raised during policy debates in governmental working groups:

(a) the Ministry of Development (currently the Ministry of Investment and Development) – Working Group on Education and Training, Skills and Human Resources for Industry 4.0. ([14]) in 2017;

(b) the Ministry of Digital Affairs ([15]) – Working Group on Artificial Intelligence (hereinafter AI) in 2018.

The Report of the Working Group on Education and Training, Skills and Human Resources for Industry 4.0. includes recommendations on adjusting the VET system to the needs of employers and skills needs associated with the fourth industrial revolution (policy recommendations on: infrastructure, investment in technological equipment, teachers' skills assessment, and teachers' professional development). Following this report, a year and a half later, the Ministry of Digital Affairs published a Report on AI in November 2018, which is based on the recommendations of independent experts. The report includes a chapter on education, recommending the development of an educational ecosystem for AI that encompasses all stages of education. However, VET is not treated as a specific part of this report, the recommendations on VET are in a subchapter on the development of AI-related competences, e.g. working with data and programming. The report recommends introducing more training in the field of data processing in VET schools (stage I and II sectoral vocational schools, vocational upper secondary schools). The government continues to work on developing instruments to support setting up the Polish AI ecosystem and integrating AI stakeholders. This issue is further developed in Chapter 6 'Adapting to AI and automation'.

VET for i.4.0. is also discussed by organisations that are members of Sector Skills Councils (operated by the Polish Agency of Enterprise Development, an agency supervised by the Ministry of Development). Examples of councils giving

([14]) Report of the Working Group on Education and Training, Skills and Human Resources for Industry 4.0. https://kometa.edu.pl/biblioteka-cyfrowa/publikacja,90,raport-z-prac-4-grupy-roboczej-ds-ksztalcenia-kompetencji-i-zasobow-kadrowych-dla-przemyslu-40-zespolu-ds-transformacji-przemysl

([15]) Report of the Working Group on Artificial Intelligence https://www.gov.pl/web/cyfryzacja/sztuczna-inteligencja-polska-2118

much attention to adjusting their sectoral education to i.4.0. are the IT Sector Skills Council ([16]) and the Health and Social Care Skills Council ([17]).

Some non-governmental organisations, e.g. the Coalition for Polish Innovations ([18]) and the Digital Poland Foundation ([19]) are very active in organising debates, roundtables and seminars on digital transformation, including the education policy dimension. Discussions most often reflect the questions posed in international fora and concerns observed on the global level (e.g. the privacy of students who use AI-powered edtech tools). Stakeholders emphasise the needs relating to assessing the status quo, namely the potential of developing, implementing and using new technologies and creating an i.4.0. educational ecosystem in Poland. Recently some conferences organised by both governmental and non-governmental institutions on the intersection between industry 4.0. and education have taken place ([20]).

It should be noted that VET in the context of i.4.0. is an example of a cross-policy issue, in which various stakeholders and policy makers have interests. Education is an important part of stakeholder's meetings concerning AI-related policy; however, discussions on the extent to which necessary VET reform and initiatives will be developed are not as mature as discussions on skills shortages or skills mismatches. In their discussions on education in the context of i.4.0., stakeholders are rather focused on a general approach, looking for systematic solutions for all stages of education, e.g. looking for solutions on how to increase innovation among teachers in the entire system (without a specific emphasis on VET). For example, no VET representatives are in the above-mentioned Working Group on AI, hence the more detailed development of general education, higher education and science, given the number of representatives from each of these fields.

([16]) An interview with a member of the IT Sector Skills Council on the need to adapt the curriculum of IT competences to the challenges posed by the growing economy and industry 4.0. https://www.radasektorowa.pl/index.php/119-wyzwania-dla-przemyslu-4-0-wywiad-z-m-senko-z-wielkopolskiej-rady-rynku-pracy

([17]) See more: http://rada.pracodawcyrp.pl/2018/09/20/seminarium-jak-dostosowac-kompetencje-i-kwalifikacje-do-rozwiazan-e-health-narzedzia-zintegrowanego-systemu-kwalifikacji-w-rozwoju-sektora-zdrowia/

([18]) See more: https://koalicjadlainnowacji.pl/en/

([19]) https://www.digitalpoland.org/en/

([20]) Examples of the conferences organised by both government and non-governmental organisations: 'Industry 4.0. – education and qualifications' http://przemysl-40.pl/index.php/2017/07/18/jakich-zmian-w-edukacji-wymaga-przemysl-4-0/; 'Vocational training for industry 4.0 and the growing services market' https://zrp.pl/konferencja-ksztalcenie-zawodowe-na-potrzeby-przemyslu-4-0-i-rozwijajacego-sie-rynku-uslug/

CHAPTER 3.
VET 4.0. Initiatives and programmes

The reform of the Education Law of November 22, 2018 introduced new or amended provisions on vocational education, taking into consideration the rapidly changing needs of the labour market and the economy. There is often no direct reference in the Education Law to i.4.0., automation or AI-powered technology. However, the explanatory documents accompanying the draft Education Law clearly state that the rationale behind the new legislation is the need to answer the anticipated and already observed development of new technologies in different sectors of the economy. The VET sector's approach to Industry 4.0. is also reflected in the secondary legislation adopted in 2019.

The following subchapters present chosen VET developments introduced to the Education Law that are of importance in the context of i.4.0.

3.1. Modernising the system

(a) The new law on VET obliges schools to engage in cooperation with employers relating to the given occupation before launching an education and training programme for that occupation The introduction of this solution is aimed at improving the quality of vocational education, in particular the implementation of educational processes in the context of the actual working conditions relating to training in the given profession. Cooperation between directors of VET schools and employers can take numerous forms, including: creating classes with the patronage of a company, having an employer involved in preparing the curriculum proposal for a profession, the organisation of practical training, participation in the organisation of vocational examinations, teacher training, implementing vocational counselling and promoting vocational education. Cooperation can also have the form of a donation of infrastructure, which will help the school in having workshops that are modern and up to date with i.4.0. needs.

(b) Modifications of the conditions for introducing professions into the classification of vocational education occupations were introduced. This development will enable the Minister of National Education to react more quickly than previously to applications from other ministers with jurisdiction over specific professions to introduce professions due to their demand in the modern economy and labour market. This will also help to avoid situations of having a new profession

introduced without providing information to school directors and other interested parties about the core curriculum for said profession.

(c) The forecast of the demand for employees in vocational education occupations was introduced in 2018 as a new tool to help shape the vocational education and training offer. Starting with 2019, this forecast will be developed annually and published in the form of an announcement by the Ministry of National Education. The forecast will be based on analyses conducted by the Educational Research Institute using various data sources. The forecast will impact VET financing, and includes increased state subsidies to local governments for VET schools educating in the higher demand occupations indicated by the professions and skills forecast. Increased subsidies will also be available for employers involved in training VET students in higher demand occupations.

(d) A new dimension in conducting a pedagogical experiment was provided, enabling the skills of a profession not included in the classification of sectoral education professions by a public school or institution to be learned. The *ratio legis* behind this instrument is to strengthen the active inclusion of employers in the process of the practical education of students.

3.2. Changes in the core curriculum for VET

(a) The core curricula for education in vocational education professions have been developed with the participation of a wide range of experts, employers and social partners ([21]). The proposed changes, through their elaboration in cooperation with employers, create conditions to better adapt the education system to the needs of a modern economy. The regulation on the core curricula provides that skills relating to the organisation of the work of small teams as well as personal and social competences should be developed by the teachers of all compulsory vocational education classes. This provision is of crucial importance, given the forecasted nature of the future of work – demanding inter-sectoral cooperation. The vocational education core curriculum, in the part concerning the conditions for conducting vocational education, also specifies the school equipment needed to implement qualifications education or indicates the equipment which the school must provide to students, e.g. at an employer's or in a vocational training centre. This solution should guarantee

([21]) Regulation of the Minister of National Education of May 16, 2019 on the core curricula for the education in the professions of vocational schools and additional professional skills in selected professions [taught in] vocational education.

that school equipment is up to date and in line with future of work needs. The Regulation of the Minister of National Education of 14 February 2017 on the core curriculum for general education in different types of schools states that 'an important task of the first stage sectoral school is to prepare students for life in an information society. Teachers should create the conditions for pupils to develop the ability to search, organise and use information from various sources using information and communication technologies in the classroom'.

(b) At the same time, an amended version of the Regulation on the classification of occupations for vocational education – Regulation of the Minister of National Education of February 15, 2019 on the general objectives and tasks of education in vocational education professions and classification of vocational education professions – was introduced after a series of sectoral public debates ([22]). The regulation takes into account the professions existing so far in the classification of vocational education professions, introduces changes in the scope of some professions, and also defines new professions introduced into the education system together with the qualifications identified therein. Its intent is to introduce new vocational occupations (e.g. the occupation of mechanic of industrial automation and precision equipment is replaced by the occupation of automation specialist, and a new profession – technician programmer – has been introduced) as well as reform existing ones, taking into account the growing influence and rapid changes of new technologies in all sectors of the economy. In Annex 1 of the regulation, new technologies are directly indicated as one of the most influential factors in VET.

3.3. Adjusting VET teachers' skills to modern labour market needs

(a) Obligatory professional training for VET teachers in companies relating to the occupation being taught by the teacher has been introduced. The new law requires the VET school directors to organise such training for both theoretical vocational teachers and practical vocational training teachers. In this way, the

([22]) In order to adapt knowledge, skills and competences specified in the core curriculum of vocational education to the needs of the Polish economy, industry seminars were organised from October 2017 to the end of January 2018. The Ministry of National Education in cooperation with the Centre for Education Development led extensive consultations with employers, representatives of the relevant ministers for given professions, representatives of industries and other interested stakeholders.

qualifications of teachers will be regularly improved, which will impact their ability to better prepare their students for i.4.0. needs. Teachers undergo industry training e.g. in order to: update professional and specialist knowledge on the new technologies used in the related industry, the technical equipment, including machinery, equipment and tools, as well as the materials being used in production processes or services and the specifics of working in the given industry relating to the profession being taught; acquiring new skills relating to the profession being taught; recognising the needs and employment opportunities for graduates in the regional or local labour market ([23]).

(b) Another piece of secondary legislation important from the VET i.4.0. perspective is the Regulation on practical vocational training of February 22, 2019. It makes the requirements for instructors of practical vocational training more flexible in terms of their pedagogical preparation. Also, the requirement to demonstrate work experience acquired only after obtaining a diploma has been rescinded. The requirement for pedagogical qualifications constituted a barrier for many persons interested in organising the practical education of VET pupils and young employees. As a consequence, it is easier now for practitioners and digital transformation sector leaders to become instructors of practical vocational training.

3.4. Development of new opportunities for VET students relating to the future of work

(a) VET students now have the opportunity to attain additional professional qualifications and skills that are required on the labour market as a part of their official school programme. Within this new possibility, VET students can benefit from the development of the Integrated Qualifications System, which offers a wide range of labour market oriented qualifications. An example of an innovative (i.4.0. related) qualification included (as of December 3, 2018) in the Integrated Qualifications System by the Minister of Digital Affairs is 'Programming and Servicing 3D Printing' ([24]). The rules and procedures of including qualifications in the Integrated Qualifications System are defined in

([23]) Regulation of the Minister of National Education of August 23, 2019 on co-financing the professional development of teachers, specific objectives of industry training as well as the mode and conditions of referring teachers to industry training.

([24]) See more: https://www.kwalifikacje.gov.pl/aktualnosci/492-programowanie-i-obslugiwanie-procesu-druku-3d-wlaczone-do-zsk

the legislation. Both employers and VET schools may submit applications to the system for the inclusion of new market qualifications (non-state regulated) that are needed, e.g. in the context of i.4.0. development.

(b) The introduction of a new form of vocational learning in cooperation with employers – 'student apprenticeship' (dual training) – which will be available to students in vocational upper secondary schools and first stage sectoral schools, who are not juvenile workers. As indicated in the explanatory document accompanying the introduction of the VET reform of 2018, a vocational upper secondary school student will be able to perform a student apprenticeship on the basis of a contract with an employer and learn the profession in actual working conditions, get to know the workplace and get to know specific jobs. The VET reform of 2018 introduced provisions enabling the conclusion of a student apprenticeship agreement between an employer and the student or parents of an under-aged student. The costs of the cash benefits that the student receives during the apprenticeship can be included in the tax-deductible expenses of the employer. The apprenticeship period can be included in the period of employment on which various employee rights and benefits are determined.

3.5. Developments in higher education

Adjusting VET to i.4.0. can be also observed at the higher education level. The Law on Higher Education and Science of 20 July 2018 states that the educational mission of state higher vocational schools is to respond to local socio-economic needs. The 2018 reform of the higher education system introduced provisions on dual teaching and the organisation of higher VET studies in cooperation with the authorities conferring the right to attain respective professional qualifications, business organisations, as well as with entities conducting examination proceedings. The organisation of dual studies will be defined in a written contract among these entities. The introduced provisions are intended to close the gap between the skills set of higher VET graduates and the needs of the labour market, with a special focus on the region in which a given higher VET school is located and the ability to offer short, possibly i.4.0. tailor-made programmes (at Polish Qualifications Framework level 5).

CHAPTER 4.

Using 4.0. Intelligence for VET

4.1. Modernisation of the educational data system

There is no specific application providing AI-powered solutions for Polish VET development. However, a comprehensive educational data system may allow for the design and implementation of AI-powered edtech solutions for VET in the future. Currently, Poland is undertaking the process of integrating educational databases. The Ministry of National Education plans to set up and test a prototype of the National Education Data System, which will integrate 60 different education system databases. The main education system database [System Informacji Oświatowej] (SIO), which includes data on VET schools, teachers and pupils, is going through a phase of modernisation, which will introduce new functionalities ([25]), such as the Register of Schools and Educational Institutions (RSPO) ([26]), which will allow searches to be made of VET schools in a selected region of Poland according to various criteria. The foreseen effect of the data system modernisation is the development of uniform, reliable, consistent and complete data on the education system, allowing for an in-depth analysis of the collected data using external analytical systems.

In 2018, the Ministry of National Education ordered the establishment of the Integrated Education Platform, which will be available to users via a web browser. By developing the platform, the Ministry of National Education aims to: increase access to free e-learning resources, better prepare students for life in an information society, increase students' skills in searching, selecting and critically analysing information, recognise their own educational and learning needs, promote teamwork, increase the use of modern syllabuses, tools and resources supporting the process of general education in developing students' key competences, support experimental teaching, and the methods of an individualised approach towards students by schools.

([25]) The Government IT Centre for Education announcement on the modernisation of the education system database https://cie.men.gov.pl/aktualnosci-modernizacja-sio/wprowadzone-zmiany-w-systemie-informacji-oswiatowej-20/; https://cie.men.gov.pl/projekty-realizowane-4/

([26]) Register of Schools and Educational Institutions: https://rspo.men.gov.pl/

An example of a nation-wide project aimed at developing the VET digital dimension is 'Creating e-resources for vocational training' ([27]), implemented by the Centre for Education Development (a key teacher training institution supervised by the Ministry of Education). The purpose of the project is to increase the use of information and communication technologies in vocational education, including the teaching of disabled students, developing digital competences, individualising the didactic process, and implementing teamwork. The project assumes a synergy of activities in this area with projects of the Ministry of National Education that have developed or are developing e-resources for vocational and general education. All of the above-mentioned e-resources, if properly implemented, can influence the quality of VET and better align it with i.4.0.

4.2. Analysing job offers and qualifications using new technologies

The consortium of the Institute for Structural Research, University of Łódź and the Institute for Labour and Social Studies ([28]) is working on a project entitled 'System for forecasting the Polish labour market', to develop an innovative forecasting method for the main labour market indicators for Poland. The project is funded by the ESF and the results are expected in February 2020. One of the new dimensions of the system will be the Internet job offers web crawler, which will automatically browse, analyse and classify the job offers advertised online. The main goal of the project is to implement an innovative method of forecasting labour demand, labour supply and the supply and demand gap, and to develop a new tool for setting detailed forecasts for the labour market in the 2050 horizon. The extension of the thematic scope of available forecasts and the functionality of the tool will enable labour market institutions to obtain additional information and data, and thus support employment services in planning effective actions. In the fall of 2019, drafts of the new tool and preliminary forecasts were presented to representatives of employment offices (county level) ([29]).

The Educational Research Institute is the operator of the Integrated Qualifications Register, which includes information on all qualifications included in the national qualifications framework system available in Poland. Currently the Institute is working on further developing the functions of the Register and the

([27]) https://www.ore.edu.pl/2019/07/tworzenie-e-zasobow-do-ksztalcenia-zawodowego-informacje-o-projekcie/

([28]) http://ibs.org.pl/research/system-prognozowania-polskiego-rynku-pracy/

([29]) http://ibs.org.pl/news/harmonogram-wsparcia-w-projekcie/

possibilities of implementing AI solutions. The scope of the above-mentioned developments may include the introduction of tools that allow for the use of neuro-linguistic programming in automatic analysis, the grouping and comparison of qualifications (in terms of learning outcomes) included in the Integrated Qualifications Register. The other tool that may be developed is a virtual assistant that will provide automatic support for communication with Register users. Some of the ideas concerning the implementation of AI for the Register were among the problems assigned in the field of education during the Warsaw Hackathon Yeah! (November 2018) ([30]). Among others, the Educational Research Institute plans to develop an application that allows learners to choose qualifications (grouped e.g. by industry or sector) that match their interests and competences. The application foresees a special functionality, tailor-made for the qualifications that can be attained in vocational schools. Its aim is, e.g., to support parents in their role of assisting with the educational choices of their children.

([30]) More information on the hackathon: https://hackyeah.pl/index.html

CHAPTER 5.

VET 4.0. Initiatives and programmes

Many activities relating to VET for i.4.0. are co-funded by EU programmes aimed at increasing the attractiveness and quality of vocational education. The following list includes examples of such projects. The first group of projects involves employers on the regional level. The second group provides examples of VET school projects aimed at modernising the infrastructure in order to keep up with technological changes. The last group of projects provides examples of practices at the school level to improve knowledge and competences relating to i.4.0. in the VET school environment (teachers, students).

5.1. The involvement in VET for i.4.0 of regional technology parks and special economic zones

- In September 2017, the Information Technology School of Puławy (eastern Poland) participated in workshops and lectures organised by the Puławy Science and Technology Park together with Grupa Azoty, Zakłady Azotowe Puławy SA (general sponsor of a Science Festival offering workshops on virtual and augmented reality, coding in Python for VET IT students). During the workshops, VET IT students learned e.g. the basics of the Python programming language and had the opportunity to create a simple game ([31]).
- The Starachowice Special Economic Zone located in the Świętokrzyskie region operates the Świętokrzyskie Region VET Cluster. VET Cluster's activities include enhancing cooperation between VET schools and regional businesses in order to match VET teaching with the most up to date needs of local employers. The Cluster is also a partner in supporting local VET schools' infrastructure and developing the training of staff and students ([32]). Similarly, the Legnica Special Economic Zone operates the Lower Silesian Education Cluster. The Cluster supports the cooperation of local VET schools with global

([31]) More information: https://www.zs2.pulawy.pl/stronabaza/index.php?option=com_content&view=article&id=779:xiv-lubelski-festiwal-w-puawskim-parku-naukowo-technologicznym&catid=1:nowiny&Itemid=47

([32]) More information: http://www.sse.com.pl/skez/

corporations and facilitates local VET development in response to socio-economic changes ([33]).

5.2. Modernisation of VET schools' infrastructure

- 'Kompleksowo i zawodowo z CK Technik' Project. The project is to improve the quality and attractiveness of vocational education at the Mechanical School Complex and the Electrical Schools Complex, both in Kielce, by having 40 students acquire knowledge, skills and key competences, and 10 vocational teachers improve their skills and qualifications, as well as by equipping schools with modern materials and equipment for practical vocational training. The project is co-funded by the ESF and is being implemented from September 2018 to November 2019 ([34]).
- The Mazovia region project 'Integrated VET development'. The project is to strengthen VET in the context of new technologies and local market needs (e.g. drone operators, programmers, robotics sector personnel). The project is mainly funded by the EU (approx. 25 million Euros) and will operate from 2018 to 2023. Project activities include introducing new programmes, developing a modern school infrastructure, courses for 1040 VET teachers and 10 000 VET students from the Mazovian region ([35]).
- The modernisation of VET school infrastructure by providing modern equipment for the CNC machine workshop (numerically controlled machine tools) in the Vocational Schools Complex in Turku. The local authorities of Turku County emphasise the connection between modernising the VET school and opportunities for the region's development, among others in the fields of automation, robotics and materials processing ([36]).

([33]) More information: http://lsse.eu/klastry/dolnoslaski-klaster-edukacyjny/partnerzy/

([34]) More information: http://www.ckp.kielce.pl/pl/ksztalcenie_zawodowe/kompleksowo_i_zawodowo_z_ck_technik

([35]) More information: http://www.armsa.pl/rekordowe-wsparcie-dla-szkol-zawodowych

([36]) More information: https://www.zst.net.pl/index.php/start-43299/1204-przemysl-4-0-w-zst

5.3. Training courses and awareness raising activities for VET teachers and students

- Between September and December 2018, the governmental Centre for Education Development offered e-learning courses for teachers (VET teachers could apply) under the 'Digital portfolio' project, which covered a range of topics, from algorithm languages to information and security in communication and media ([37]).
- The eduDrone project supports the implementation of Industry 4.0 in the European Union by developing learning tools for vocational education and training (VET) relating to drone technology. This two-year project is co-funded by the European Union within the Erasmus+ Programme's Strategic Partnership for VET. eduDrone is targeted to VET teachers, trainers, mentors and VET training providers, as well as to VET students and learners. The expected project outcomes include guidelines on using drones in VET, guidelines on the use of Industry 4.0 and drones in entrepreneurship for VET students, curriculum for a drone technology course, an e-learning platform that includes a drone technology course, trainer guidelines and evaluation tools ([38]).
- In April 2018, the VET Mechanical Schools Complex of Rzeszów signed an agreement with Pratt & Whitney Rzeszów S.A. on opening a new patronned class in the profession of mechatronics technician. The patronned class will follow an original curriculum based on the Industry 4.0. approach (digital models of products manufactured in intelligent factories) ([39]).
- In December 2018, Synerise S.A. (a Polish R&D company working in the field of big data and AI) together with partners and supporters from the private sector (including Microsoft, EY, Orange, Carrefour) launched a nation-wide CSR project 'AI Schools & Academy' in Gorlice. The project is open to pre-schools and schools, including VET (one VET school has already participated in the launch of the project – Zespół Szkół Rolniczych in Hańczowa). As part of the AI Schools & Academy programme, Synerise and its partners intend to finance the teaching (in the form of additional classes) of a minimum of 10 hours per month in 1500 pre-schools and schools. The classes will allow students to

([37]) More information: https://www.ore.edu.pl/2018/09/e-kursy-cyfrowe-portfolio-2/

([38]) More information: https://www.edudrone-project.eu/pl/

([39]) More information: http://www.zsm.resman.pl/index.php?option=com_content&view=article&id=2455:industry-40-czwarta-rewolucja-przemysowa

develop their skills, broaden the range of interest in modern technologies, and activate the teaching staff to develop their competences. Institutions that would like to participate in the programme will receive access to a broad knowledge base, cloud computing, online courses and a targeted subsidy for starting additional classes. Classes will be conducted by teachers from schools that have declared their willingness to participate in the programme. They will be trained in online courses and paid for classes on a monthly basis. The programme will be implemented in the Open Data format, which will allow for the transparent evaluation of the financing and learning outcomes. Outstanding students and teachers will be awarded with additional scholarships ([40]).

- The P-TECH educational and professional development programme was announced in August 2019 by IBM. It is implemented in cooperation with the Educational Research Institute, Samsung and Fujitsu Technology Solutions. Also, the programme is implemented with the support and cooperation of the City of Katowice and under the honorary patronage of Prime Minister Mateusz Morawiecki and the Ministry of Digital Affairs. Thanks to the P-TECH programme, the Complex of Technical and General Secondary Schools No. 2 in Katowice will start working together with IBM Poland, Śląskie Techniczne Zakłady Naukowe from Katowice will begin working with Fujitsu Technology Solutions, and Technical School No. 1 'School of Forestry' in Wronki in the Szamotuły district will begin working with Samsung. 'As part of the programme, for five years of study, students will obtain a high school diploma and a diploma as an IT technician or mechatronics technician, learning under the their mentor supervision and acquiring new skills. P-TECH does not require any changes to the core curriculum. A partner company in cooperation with the teaching staff of a given school provides additional substantive input or tools to already existing subjects and classes to equip students with specific skills needed in the labour market. The partner company also undertakes to support P-TECH graduates in the process of entering the labour market ([41])'.

([40]) More information: https://synerise.com/company/ai-schools

([41]) More information: https://www.ibe.edu.pl/pl/aktualnosci/1032-rusza-pilotaz-programu-p-tech

CHAPTER 6.

Adapting to AI and automation

Currently there is no official AI strategy for Poland. On the governmental level, four ministries, namely the Ministry of Digital Affairs, Ministry of Investment and Development, Ministry of Science and Higher Education, Ministry of Entrepreneurship and Technology, signed a 'Memorandum on the development of AI in Poland' on 26 February 2019 that calls AI a 'ground-breaking horizontal technology of the 21st century'. The Memorandum, among others, calls for coordinated actions in order to equip citizens (not only students but also adults) in knowledge in the field of data science and for including the digital skills policy in the 'Strategy for Productivity'.

On the basis of a memorandum, the inter-ministerial analytical and editorial team of the Ministry of Digital Affairs and the Ministry of Entrepreneurship and Technology published a proposed 'Artificial Intelligence Development Policy in Poland for 2019-2027' in August 2019 for public consultations ([42]). The social consultations phase is closed and further action by the Ministry of Digital Affairs is awaited.

The 'Strategy for the Development of Human Capital – 2030' (draft version after the consultation phase, 2019) developed by the Ministry of the Family, Labour and Social Policy includes automation as one of the processes that relates to the strategic objective: 'Growth and improvement of the use of potential human capital on the labour market'. The strategy notes that in connection with digitisation, automation and quick labour market forecast changes, the Polish labour market should be modernised, which should provide easy and quick methods of creating new jobs and hiring. The strategy also foresees the development of the educational offer for professions to be classified as 'not likely automated' or adjusted to the needs of the digital environment as one of the strategic, national activities to be undertaken. This should be realised through changes in the system of career counselling and the qualifications system.

The strategy is not implemented yet, therefore we cannot claim that Poland currently has an operational national training programme with a specific focus on assisting adults who may be displaced from the labour market due to automation. There are, however, some free educational tools available with a specific focus on

([42]) More information: https://www.gov.pl/web/cyfryzacja/konsultacje-spoleczne-projektu-polityki-rozwoju-sztucznej-inteligencji-w-polsce-na-lata-2019--2028

enabling all citizens, adults to understand the implications of artificial intelligence (AI) and learn AI methods:

- 'Sztuczna inteligencja' [Artificial Intelligence] ([43]) – the educational portal operated by the Information Processing Centre–National Research Institute and the Ministry of Science and Higher Education. The portal presents information on AI that can be easily understood by adults. The platform also offers a dictionary of terms relating to AI and a free course 'Machine learning for the inquisitive' – certificates are not issued in association with this course.
- Scientific and Academic Computer Network National Research Institute – NASK (public institute supervised by the Ministry of Digital Affairs) operates an IT School project offering online courses: 'Artificial Intelligence' and 'Algorithmics and Programming' ([44]). Each course ends with an interactive knowledge test. After obtaining a positive test result, course participants can generate a personal automatic certificate confirming the completion of the course in 'distance learning' at no charge. The next step may be confirmation of acquired skills in a more formal way, i.e. in the form of an authorized IT School certificate.

([43]) More information: https://www.sztucznainteligencja.org.pl/

([44]) More information: https://it-szkola.edu.pl/

CHAPTER 7.
Conclusions

A modern VET system based on cooperation between industry, public administration and local government is perceived in the public debates as a building block of industry 4.0. Polish policymakers and stakeholders are gradually engaging in a discussion on the reforms to VET systems required to equip students with the skills enabling them to utilise i.4.0 technologies and cope with the changing skills needs implied by them. VET reforms in the context of i.4.0. are being discussed both on the level of drafting national sectoral strategies as well as in stakeholders' ministerial working groups. A significant number of policy recommendations were included in the VET law in November 2018 and came into force in 2019.

The reform of the Education Law (2018) introduced or amended: provisions on adopting modern technologies in VET teaching as a task to be supported by the ministries responsible for specific sectors of the economy; provisions on a pedagogical experiment concerning e.g. new professions that are not yet included in the official classification of vocational occupations; provisions on strengthening the participation of employers in VET; provisions enabling schools to organise short learning cycles (vocational skills courses); provisions on introducing mandatory industry training for VET teachers; provisions on funding for employers who train VET students in high demand occupations; provisions on an educational subsidy for VET schools educating for the professions having a higher demand in the labour market as indicated in forecasts; provisions on the requirement for VET school directors and employers to work together.

The development of the 'Integrated Skills Strategy for Poland 2030 – general part' (2019), which is at the stage of further development by the government and OECD experts, was consulted both traditionally and online, which allowed stakeholders to express their standing on VET and i.4.0. The draft of the 'Strategy for Productivity' (to be adopted by the Government in 2019) has not yet been officially released for public consultation, however, discussions on VET will most likely be part of the public debate on the final wording of the strategy. The case of the national digital skills strategy, which is under development, is similar. In the context of i.4.0., Polish analysts already noted that 'Education policy has to put greater emphasis on developing the skills needed to perform non-routine cognitive tasks' ([45]).

([45]) Lewandowski P. (2018). 'How does technology change the nature of work? Poland vs. the EU', Institute for Structural Research Policy Papers, p. 1.

Both the Ministry of National Education and the Ministry of Development are cognisant of the policy instruments that could be better aligned and coordinated to result in greater synergy. This approach was seen in a common session of the Integrated Qualifications System Stakeholders Council (operating under the Ministry of National Education) and the Programme Council on Competences [Rada Programowa ds. Kompetencji] (RPK) ([46]), held for the first time in December 2018 ([47]). Ministry of National Education representatives expressed the need for more coordinated work of the two systems: Integrated Qualifications System and system of Skills Councils (they are operated by two different ministries). Pursuant to Article 1a of the Education Law, introduced in November 2018, vocational education is to be supported, among others, by Sector Skills Councils and the Programme Skills Council. Better coordination of interconnected systems, namely the qualifications system and skills councils system, could impact the better implementation of VET reform and adjustment to the needs of a 4.0. labour market.

Despite the developments already introduced, stakeholders emphasise a need for the further alignment and synergy of the education sector with 4.0. labour market needs during public debates on the future of work. They also emphasise the lack of data on the equipment and infrastructure in VET schools and teachers' digital skills, which are the basis for further evidence-based VET reforms ([48]). In the field of AI, Poland is indicated as a country having the potential to become a regional centre for AI development ([49]). Experts emphasise that investments in education and increasing numbers of AI specialists in Poland are among the prerequisites for developing a national AI ecosystem.

The main challenges faced by the VET system in the context of i.4.0. mainly concern the skills of school staff and infrastructure. According to the Report of the Working Group on Education and Training, Skills and Human Resources for Industry 4.0. ([50]), despite the continuous modernisation of VET schools, their

([46]) The Council operates under the Polish Agency for Enterprise Development, which is a public agency supervised by the Ministry of Entrepreneurship and Technology.

([47]) https://power.parp.gov.pl/home/wspolne-posiedzenie-rady-interesariuszy-zsk-oraz-rady-programowej-ds-kompetencji-podsumowanie-roku-2018-i-wyzwania-roku-2019

([48]) VET related issues (cooperation between business and VET schools, innovative education paths in VET) were highlighted during the latest conference on Work 4.0. organised by the Lewiatan Confederation of Polish Private Employers (November 2018). https://www.praca4zero.pl/program

([49]) McKinsey (2017). The AI Revolution. How artificial intelligence will change Polish business, p. 6.

([50]) Report of the Working Group on Education and Training, Skills and Human Resources for Industry 4.0, p. 17. https://kometa.edu.pl/biblioteka-cyfrowa/publikacja,90,raport-z-prac-4-grupy-roboczej-ds-ksztalcenia-kompetencji-i-zasobow-kadrowych-dla-przemyslu-40-zespolu-ds-transformacji-przemysl,

infrastructure does not reflect the equipment of production lines or the modern technologies used in the market. Training facilities are not aligned with the rapid growth of technology. Vocational school staff have too little direct contact with industry and business. ‘However, the main challenge that remains is increasing the involvement of enterprises in VET education’ (Chłoń-Domińczak et al. 2018).

The other challenges are of a more systemic nature:

(a) the process of VET reform may be slowed down by the lack of sufficient coordination between ministries and governmental agencies/institutions that impact VET development, technological challenges and the labour market;
(b) incentives are lacking for businesses to develop new-technologies-powered products and services for VET intelligence;
(c) the mapping of VET resources is lacking in terms of infrastructure and staff, which may hinder decision-makers in introducing further VET policy reforms based on data and to better allocate financial resources;
(d) there is also a lack of information ‘brokers’, advocates of ‘VET for i.4.0.’ and a map of Polish new-technologies-powered companies that may be interested in cooperating with VET schools.

Experts emphasise that the Ministry of National Education should take into consideration the good educational practices, know-how and success stories of global technology companies that have already trained and educated Polish specialist in new technologies and digital transformation (Michałowski, 2018). Some good models of cooperation between private entities and public VET schools with regard to the VET 4.0. learning practices are already in place. However, to keep up with the pace of technological changes, the Polish VET system needs to be constantly improving and aligned with interventions developed in other policy areas.

Abbreviations and acronyms

DESI	Digital economy and society index
RSPO	Register of schools and educational institutions
SIO	System Informacji Oświatowej [main database of the education system]
VET	Vocational education and training

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