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TRANSFORMATION OF DIGITAL EDUCATION IN THE ERA OF THE FOURTH INDUSTRIAL REVOLUTION AND GLOBALISATION

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The monograph discusses the theoretical, methodological, conceptual and praxeological foundations of the formation and development of the digital person and digital society, examines the conceptual and categorical apparatus, methodology for analysing the philosophy of the relationship between the digital person and digital society. The complexity methodology, AGILE methodology, system and informatics methodology of the digital person and digital society as a factor in the development of the Fourth Industrial Revolution are substantiated. The author analyses foreign concepts of digital society: digital economy and digital management, which are developing in the context of technological changes and breakthrough digital technologies. The author examines the praxeological foundations of the development of the digital society, which is evolving due to the introduction of robotics, artificial intelligence, the development of "big data", 3D printing and manufacturing. The monograph focuses on the philosophy of creative society and human development. This is the first broad look at the world of digital society in the context of the development of philosophical thought, at the world of modern creative management, which is just beginning to appear on the horizon and is gaining more and more influence every second. The monograph develops practical recommendations on the path of digitalisation, which allow to take advantage of all the opportunities offered by the modern world. Recommended for researchers, teachers, students of all levels of higher education.

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CONTENS

INTRODUCTION

The global community is currently confronted with a significant crisis in education. In response to this pressing challenge, nations worldwide must engage in a thorough reassessment of educational paradigms, striving towards a future that is characterized by fairness, sustainability, and peace. In the contemporary landscape, we are witnessing an acceleration of a fresh wave of technological advancements and industrial transformations. Innovative breakthroughs and technological progress are propelling digital transformation, thereby reshaping societal structures, labor dynamics, and the trajectory of employment opportunities. In this process, the importance of education has become increasingly prominent. With the continuous improvement of connectivity and the widespread use of various hardware and digital software, the demand for digital skills is growing, and the digital transformation of education continues to advance. The digital transformation of education is the process of continuously using digital, networked and intelligent technical means to transform the education and learning system. The digitalisation of education on a global scale is a complex historical process, and there are still some practical challenges in the implementation process. At the same time, the global pandemic of the novel crown epidemic has also brought huge challenges to the global education industry. Since 2020, more than half of the face-to-face courses for some 147 million students have failed to take place, and more than 90 % of children worldwide face learning difficulties. In 2021, 244 million children and youth will be out of school. During the epidemic, the relevance of wide-scale online teaching has reached unprecedented heights, further accelerating the digital transformation of education. The United Nations Summit on Education Transformation, held in September 2022, named high-quality digital learning as one of its five action areas. Most participating countries have included digital learning as an important content in their national commitments. Therefore, strategic actions should continue to be taken to digitise national education, enrich the supply of digital educational resources, create a broad and open learning environment, accelerate the exchange of learning platforms of different types and levels, and promote new technologies and education Integrating learning accelerates the digital transformation of education.

The purpose of the monograph is to conceptualise the changes in education and discuss how to promote education recovery

in the post-epidemic era through the digital transformation of education to ensure equity of high-quality educational resources and contribute to the UN Sustainable Development Goals. The monograph focuses on the digital transformation of education, aimed at developing and applying digital learning resources, improving the digital literacy of teachers and students, and digital education management. Efforts should be made to turn the national smart education platform into an important public product in this area. education, promote the integration and development of digital technologies and traditional education, and call on all countries to work together to promote integrity and innovation so that the results of digital education benefit more people around the world. The world's leading countries attach great importance to promoting equity in education, improving the quality of education, and enhancing education governance through the digitalisation of education, leading the reform of educational concepts, generating new ideas, methods, and practices, and providing strong support and a driving mechanism for reform and development. Digitalisation is empowering a new ecology of education. With the development and application of a new generation of digital technologies to drive industrial transformation and innovation through digitalisation, digital education has become a global topic. The digital transformation of education is an important driver and innovative way for the quality development of higher education, it has caused systemic changes in higher education methods, school models, management systems and guarantee mechanisms, and is changing higher education ecology.

The modern world is accelerating a new round of technological revolution and industrial transformation.

Digital transformation is changing society, the labour market and the future of work, due to innovative developments and technological advances. Education has become increasingly important in this process. With continuous improvements in connectivity and the widespread use of various hardware and digital software, the demand for digital skills is growing, and the digital transformation of education continues to advance.

The International Telecommunication Union's 2022 statistical report Measuring Digital Development: Facts and Figures shows that two-thirds of the world's people are now online, but 2.7 billion people are still offline, with significant age and regional disparities. Digital barriers, also known

as digital protectionism, are a specific manifestation of trade protectionism in the digital economy. It mainly manifests itself in restrictions on hardware and software cooperation between different countries.

The development of digital education in the world has probably also experienced such a development process. In September 2022, the Education Transformation Summit led by UNESCO took the digital transformation of education as one of the five major issues of educational transformation and will put forward basic principles and proposals for the implementation of digital transformation of education. The US National Education Technology Programme (NETP) has released 6 editions with topics ranging from "meeting the tech literacy challenge" to "the changing role of technology in education", which increasingly focuses on the role of technology in education. In 2022, the American Association for Higher Education Informatics released the Horizon Report: Teaching and Learning Edition", proposing 6 key tech practices that will impact teaching in higher education in the future, such as artificial intelligence for learning analytics and artificial intelligence for learning tools. Singapore has released 5 editions of its plan for the development of education informatisation. "The Education Technology Plan (2020–2030), issued in 2019, proposes to use e-formative assessment, e-school assessment, and national e-examination to conduct learner-centred assessment and facilitate the digital education transformation process. Countries and governments should harness the power of the digital revolution to ensure the provision of quality education as a public good and human right, with particular attention to the most marginalised.

Countries and governments should harness the benefits of digital technologies to promote national and international requirements for education and lifelong learning. Such actions will help to promote beneficial changes in all aspects of education, including pedagogy, curriculum, assessment, social care and the organisation of learning activities within and outside formal learning settings. This will further contribute to improving learning outcomes, thereby better ensuring that all learners, whether children, youth or adults, acquire basic literacy skills, develop knowledge and skills relevant to their lives and livelihoods, and contribute more to a sustainable future.

The President of the European Commission, Ursula von der Leyen, stressed the need to harness the enormous potential of digital technologies

in education, to use digital technologies to transform traditional teaching and learning methods, and to provide sufficient conditions and resources for learning digital skills for all. The EU hopes to promote equality in education through digital education, strengthen interconnection equipment and institutional capacity, and ensure that all citizens can benefit from digital education. Due to the accelerated development of innovative technologies such as the Internet, big data, cloud computing, artificial intelligence and blockchain, digital technologies are fully integrated into the economy, politics, culture, society and the construction of ecological civilisation with new ideas and new formats.

This process will inevitably have a major impact on economic development, national and social governance systems, changes in industrial relations and people's lives.

Promoting the digitalisation of education is an internal driving force for social progress. Promote the digitalisation of education and build a learning society and a learning country with lifelong learning for all. A new round of scientific and technological revolution and industrial transformation is developing in depth. Digital technologies have become the leading force driving fundamental changes in the way human society thinks, organises and functions, and reshaping the way it is shaped in all directions. Both offer new and significant opportunities, as well as new challenges. It is possible to deepen the implementation of the strategic action of digitalising education, to promote digitisation of resources, intelligent management, personalisation of growth and socialisation of learning, so that high-quality resources can be copied, distributed and shared, creating large-scale personalised education. Therefore, developing digital education and promoting the digital transformation of education is a general trend, a development need and a reform direction, as well as an ambition, responsibility and contribution that educators should have. Due to numerous factors, such as the COVID-19 pandemic, the new generation of information technology and the bilateral expansion of technology and education, higher education has accelerated its digital transformation in the face of new opportunities and challenges. The development of higher education requires rethinking traditional education, rethinking the learning model, actively promoting integrated online and offline education, seizing new educational infrastructure as an opportunity, building an intelligent learning environment, and comprehensively promoting the digital transformation of higher education.

CHAPTER 1
STRATEGIES FOR THE FORMATION OF DIGITAL EDUCATION IN THE ERA OF THE FOURTH INDUSTRIAL REVOLUTION AND GLOBALISATION: INTERNATIONAL EXPERIENCE

1.1 Global Digital Education in Action

Currently, driven by digital technologies represented by cloud computing, big data, artificial intelligence and blockchain, the cross-integration of biotechnology, new material technologies and new energy technologies is driving a new round of global technological revolution and industrial revolution. The comprehensive development of new technologies creates conditions for economic and social progress, profoundly changes the comparative and competitive advantages of countries, and affects the global structure. In this regard, countries around the world have introduced national digital development strategies to plan technological and economic development, and are paying more attention to promoting digital transformation in education to seize opportunities for future development (Azhaja M. A., 2020). In July 2015, India's Modi government proposed the Digital India initiative, planning to lead the country's future with two wagons, "Made in India" and "Digital India". Improving digital literacy is an important component of this

initiative. In December 2015, the Australian government released the National Innovation and Science Agenda report, with "talent and skills" as one of the four key areas proposed in the report, and set out a plan to "improve digital and STEM literacy for all Australians". In March 2016, Germany's Federal Ministry for Economic Affairs and Energy published its "Digitalisation Strategy 2025", which proposes "digital education at all stages of life". In 2016, the United States released three reports in succession: "Planning for the Future, Embracing the Artificial Intelligence Era", "National Strategic Plan for Artificial Intelligence Research and Development", and "Artificial Intelligence, Automation, and the Economy", which comprehensively explain the development of the United States' plan in terms of artificial intelligence. The educational application of AI technology is one of the report's contents. "Talent and education" is one of the five main areas of development proposed in the plan. in artificial intelligence" was proposed to ensure the UK's leadership position in the artificial intelligence industry, to grow the relevant specialists and to invest £406 million in skills development, with a particular focus on mathematics, digital and technical technologies. education. In September 2018, the Cabinet of Ministers of Japan published the "Draft Strategy for Japan's Artificial Intelligence", aimed at comprehensively promoting Japan's "Artificial Intelligence Strategy", and included in the draft strategy the digital literacy training of high school students and artificial intelligence professionals.

The European Union, as a political and economic community, also officially released the European Strategy for the Digitalisation of Industry in 2016, aimed at integrating EU member state industrial digitalisation strategies to accelerate the digitalisation of European industry. The strategy proposes to explore and formulate an "EU Skills Agenda" to improve the skills people need to work in the digital age.

The Organisation for Economic Co-operation and Development (OECD) has twice released Digital Economy Outlooks in 2015 and 2017, which comprehensively present trends in the digital economy, policy development, supply and demand side data, and how to fully implement digital transformation. affects every area, including education. The new orientation of education policy in different countries is digital transformation, which responds to the opportunities and challenges

posed by digital technologies, and therefore countries are consistently adjusting their education policies to promote a comprehensive digital transformation of education (Andriukaitiene, Regina, Voronkova, Valentyna, & Nikitenko, Vitalina, 2021).

First, digital learning equipment and resources need to be improved. In 2015, France launched the "Digital Campus" strategic plan for education, proposing to invest €1 billion over three years to implement a comprehensive digital transformation of primary and secondary schools, including increasing the penetration of personal mobile digital devices and addressing the issue of Internet access in rural areas with a nationwide digital platform to provide teachers and students in primary and secondary schools with rich and diverse interdisciplinary online educational resources. In 2019, the German federal government officially launched the School Digital Deal. Over the next five years, the federal government will invest €500 million annually in school digitalisation. States are also introducing policies and measures to develop school digitalisation. Finland's innovative project in basic education, represented by the FINNABLE 2020 project, aims to create a digital platform, build a reliable online learning community, overcome traditional time and space constraints, and implement anytime, anywhere learning (Ažaja, M., & Ostenda, A., 2022).

Second, to include digital literacy education in the curriculum of primary and secondary schools. Digital literacy is seen as the ability to use digital resources in the new technological environment and to participate effectively in social processes. The development of digital literacy is gradually being incorporated into the basic education curriculum in different countries (Azhazha M. A., 2019). Germany has developed the Digital Literacy System for German Students. Based on it, state ministries of education use the digital literacy framework to make timely adjustments to curricula and education standards, as well as to teach digital literacy in all subjects in primary and secondary schools. Japan actively develops relevant teaching materials and teaching aids, and comprehensively improves information technology literacy at all stages of basic education from elementary school to high school to achieve the goal of improving basic information technology literacy for all. The French strategic education plan "Digital Campus" incorporates digital and coding

courses into the general education system to comprehensively develop students' information literacy in an intelligent learning environment. The Australian Curriculum (Version 4.0), adopted and implemented in 2015, lists "digital technology" as one of eight areas of study in Australia from primary to year ten. The medium – and long-term education policy direction and strategy for an intelligent information society released by South Korea's Ministry of Education in late 2016 requires junior high schools to implement compulsory software education from 2018.

Thirdly, improving teachers' digital literacy is an important condition for the digital transformation of education. In the face of the rapid development of digital technologies and the lack of digital literacy among teachers, the French strategic plan for digital campus education proposes to fully launch a project to train teachers in information literacy. South Korea has proposed to adapt the existing curriculum of regular universities in the "Medium – and Long-Term Education Policy Direction and Strategy for Intelligent Education. Information Society", develop the core abilities of reserve teachers, and ensure that more than 600 full-time teachers are added by 2020 to expand the team of full-time teachers in the field of information and computers. In response to the shortage of specialists in artificial intelligence and other fields, various countries' policies are primarily aimed at expanding the training of specialists in general digital technologies. Japan's "Draft Artificial Intelligence Strategy" proposes to train 250,000 artificial intelligence talents in various professional fields such as medicine, agriculture, and disaster prevention, independent of art and science, and to develop professional curricula and teaching materials on artificial intelligence. The French Ministry of Higher Education has stated that it will increase the number of students studying in the field of artificial intelligence and double the overall scale of talent training.

In addition, some countries are paying special attention to the cultivation of high-level digital talent. The UK's Industrial Strategy: Action for Artificial Intelligence is investing an additional £45 million to support the training of doctoral students in artificial intelligence and related disciplines. In December 2018, Australia's Department of Industry, Innovation and Science published a policy

document entitled "Australia's Technology Future – Delivering a Strong, Secure and Inclusive Digital Economy", which plans to allocate a dedicated doctoral scholarship of A$1.4 million to support newly graduated AI researchers. The Japanese Cabinet of Ministers also proposed in its report "Talent Training for Society 5.0" to introduce "super-level" training for artificial intelligence talent.

The development of digital technologies is mainly driven by data and algorithms. While making human life smarter and more convenient, it will also raise unprecedented new challenges in law, morality and ethics. The construction of ethical and legal norms for digital technologies has attracted widespread attention.

The UK's Artificial Intelligence Action Plan proposes to invest £9.09 million in the creation of a Data Ethics and Innovation Centre to analyse the current situation with data management and provide the government with information on how to ensure the safe, innovative and ethical use of data. In April 2019, the European Union released an ethical framework for artificial intelligence – "Ethical Framework for Trustworthy Artificial Intelligence". Australia's technological future is about creating a strong, secure and inclusive digital economy, which suggests developing an ethical framework (Andriukaitene Regina, Metelenko Natalia, & Voronkova Valentyna, 2022).

Alongside the construction of digital ethics and legal norms, strengthening education in digital ethics and raising awareness of self-discipline have begun to be included in the cultivation of digital literacy. To propose learning objectives that are in line with the new technological revolution, the Korean Ministry of Education revised the general objectives of the curriculum standards for primary and secondary schools in 2015, which equally focus on the applications of information technology and emphasise the development of information ethics awareness and the ability to protect information of primary and secondary school students.

The fourth chapter of the German Student Digital Literacy Framework pays particular attention to "safety and security", which includes teaching students to understand and reflect on risks in the digital environment, to be aware of the protection of personal data and private domains, and to prevent potential harms such as internet addiction. The Digital Campus strategy in France

explicitly calls for teaching students the ability to exercise self-control and self-discipline when faced with complex information in the networked world, learning to select accurate, reliable and objective useful information and gradually establishing a critical attitude in the virtual networked society as a thinking and independent person. The UK Investment Framework for Science and Innovation 2004–2014 proposed specific measures to strengthen science, engineering and mathematics education in terms of the school curriculum, continuing education, higher education and teacher professional development. At the end of 2017, South Korea changed the original "Science Education Promotion Act" to the "Science, Mathematics and Information Education Promotion Act", emphasising the need to establish science, mathematics and information education, as well as an interdisciplinary integrated educational environment for students to learn science, mathematics and information literacy through the integration of two or more disciplines, cultivates integrated talents with innovative practical abilities (Alshammari, K. H., 2023)

In Germany, MINT is synonymous with STEM education. In 2017, Germany launched the School Cloud project to provide a cloud-based learning support system for the development of MINT, and building on strong feedback from industry by participating in university pilot projects and incorporating enterprise experience. Training and other means allow children and young people to gain a deeper understanding of family professions in the process of solving specific problems. France has taken a number of measures to effectively engage students in their choice of science and engineering professions, including efforts to build student relationships, in-depth interventions into students' family backgrounds, and attention to the balance of men and women in science and engineering professions. Digital technologies are an important driving force leading to a new round of scientific and technological revolution and industrial transformation. cooperation, cross-border integration, co-creation and sharing. At the same time, countries around the world have also realised that education will be a key force in building the world order in the digital age, so they need to develop education in the context of the trend of global digitalisation, identify breakthroughs

and key areas, and cultivate talents capable of technological and social development of the digital age, to become leaders of different countries, to form a new mission of education.

1.2 Strategies of Digital Transformation of Education in the Context of International Space

In September 2022, UNESCO released the Chinese version of the Future of Education report, which explores the development of future education and the possible direction of education reformatting from many dimensions, and puts forward proposals for action that have important reference value for global education reform. Intergovernmental cooperation in digital education is mainly carried out within the framework of regional cooperation or international organisations. Within the United Nations, to facilitate policy information exchange between countries in the field of digitalisation, the International Telecommunication Union launched the Partner2Connect digital alliance in 2021 to help global interconnectivity and digital transformation. The project has received 500 pledges from 247 organisations in 111 countries and regions, totalling USD 28.34 billion. Relevant parties can share information and understand risks through a global networking platform.

In 2019, the UNESCO Higher Education Innovation Centre launched the IIOE International Network Education Institute project. The platform promotes global higher education through multiple channels, such as co-creation and sharing of course resources, digital learning for teachers, ICT software and hardware support, and knowledge production and dissemination. IIOE's cooperative member institutions include 11 higher education institutions in the Asia-Pacific and African regions, 4 Chinese universities, and 8 information technology companies serving more than 10,000 registered teachers in 135 countries and regions. In addition to the UN system, other intergovernmental international organisations are also actively promoting international cooperation in the field of digital education. The G20 Higher Education and Research Ministers' Meeting in 2022 proposed to jointly lead the implementation of the digital

transformation of education, promote the sharing and co-creation of high-quality digital education resources, facilitate the reform of the educational ecology, school uniforms and teaching methods, and jointly promote the digital transformation and green transformation of education. Against the backdrop of accelerating global digitalisation, countries are learning from each other and cooperating to narrow the digital divide, remove digital barriers, and foster the development of cooperation points. The concept of cooperation, inclusiveness and mutual benefit, to make full use of respective advantages and promote common development. All countries should join hands to strengthen communication and exchange, and through open digital education cooperation, more countries and people will be able to share the achievements of digital education development. Deepening international cooperation in the field of digital education is a general trend to create a global digital education ecosystem that is open, collaborative, equitable, mutually beneficial, healthy and secure. (Andrushchenko, V., Yershova-Babenko, I., Kozobrodova, D., Seliverstova, A., & Lysakova, I., 2022).

First, there are differences in information infrastructure between countries, and the digital transformation of education is at different stages. Considering the informatisation of education from the perspective of digital transformation, the following stages of development can be distinguished: 1) equipment for informatisation; 2) curricula; 3) support for informatisation and educational empowerment; 4) leadership in informatisation and educational reform. Due to the uneven development of the global economy and the growing digital divide between countries, there are significant differences in education funding, network infrastructure, and public service delivery capabilities.

Second, countries have different social cultures and education systems, and have different requirements for international cooperation. The educational system is constrained by society and culture, and involves an institutional structure and norms. International cooperation often faces challenges such as inconsistent policies, different governance systems, and mismatched school systems. In addition, the goals and requirements of digital transformation in different countries are also quite different, so it is still difficult to find a mutually beneficial meeting point.

Third, different countries have different standards for the interface of resources and technologies, and there are obstacles to the exchange of educational concepts and resources. Due to the rapid development of digital technologies and the rapid progress of digitalisation of education worldwide, the formulation of standards still lags behind practice, and the international standards system has not yet been formed in terms of resource development and application, digital education platform construction and interoperability, which to some extent hinders the interconnection and integration of educational data, the efficient flow of resources, the mutual recognition of courses and academic qualifications, and the exchange of research results.

Fourth, the rapid iteration of technology and the explosive scale of data have increased the risks of personal privacy and data security. Thanks to data, algorithms and computing power, the scale of data is growing exponentially and accumulating in huge quantities, increasing the risk of sensitive data leakage. Countries have imposed stricter supervision on cross-border data use, which objectively restricts the healthy development of international cooperation. In order to build a global digital education ecosystem that is open, collaborative, equal, mutually beneficial, healthy and secure, it is necessary to cooperate with other countries in the world to further deepen international cooperation in digital education within the framework of equality, mutual learning, dialogue and tolerance.

Fifth, spread China's information development experience and establish an international system of public digital education services, make full use of the leading advantages in the field of education informatisation, actively promote cross-border and inter-agency cooperation around the world, and create a digital education system consisting of information infrastructure, core teaching resources, adaptive technical support for online learning, which should remove digital barriers, bridge the digital divide, and promote the restoration of global education in the post-electronic era.

Sixth, to support multilateral and diverse dialogue and cooperation, and to establish a strong global partnership for digital education. The development of international digital education requires the formation of close partnerships between governments, schools,

businesses and society, as well as multi-subject, multi-level and multi-formal dialogue and cooperation. Governments should strengthen high-level planning and policy guidance, focusing on transforming teaching methods, building smart learning environments, and developing forward-looking policies to promote smart education. Districts and schools should introduce innovative teaching and learning methods supported by technology, promote personalised and differentiated learning, and monitor the quality of teaching. Businesses should actively invest in digital education and provide technical support and solutions. Stakeholders, such as research institutions and NGOs, should promote international cooperation mechanisms by jointly building international digital education centres, holding international conferences, and conducting joint research.

Seventh, actively participate in the International Organisation for Standardisation and lead the development of an international system of digital education standards. It is very important to improve the development level of digital education to realise efficient resource allocation, digital technology development and improve the management system through quantifiable, controllable and comparable standards or norms. The standard system mainly includes three aspects: one is the technical standard system, including platform architecture, login access, information security, data exchange, knowledge graph, property rights management, etc.; the other is the quality standard system, including digital learning materials, online courses, learning interactions, etc. (Afanasieva, L. V., Muzya, E. M., Koleva, K., & Oleksenko, R. I., 2017).

Eighth, to initiate global research on smart education, monitor and promote the sustainable development of digital education. Smart education is a targeted form of digital transformation of education. Promoting global collaborative research and monitoring of smart education will help assess the challenges and development trends faced by the use of digital technologies in education. Intelligent education monitoring at the national level should focus on the input, output, process nodes and data collection channels of education informatisation. In 2022, the “Joint Research Programme on National Smart Education Strategy”, jointly launched by international organisations such as the UNESCO Institute for Educational

Information Technology and Beijing Normal University, released a series of national indicators for assessing smart education.

In the face of changes in the world, times and history, there is an urgent need to collectively rethink the future vision of education and take action. Digital technologies are now rapidly changing the way knowledge is created, accessed, shared, tested and used, and the digitisation of education has become a new way to reform global education. The digital transformation of education is an important part of the Digital China, Digital Finland, and Digital Estonia strategies. The programmes serve as an important measure to accelerate the modernisation of education, accelerate the construction of a strong educational country and ensure "education that satisfies people", "promoting the digitalisation of education and building a learning society and a learning-centric country where all people are lifelong learners".

Looking at the world, the United Nations and many countries around the world are taking active action and generally consider the digitalisation of education as an important strategic measure to overcome the crisis and challenge and open up the future of education. Digitalisation of education has become a common strategy for global education reform. In recent years, many countries and international organisations around the world have introduced strategies to develop digitalisation of education, using digital technologies to expand opportunities for education reform.

In October 2017, the European Council called for "adapting learning and education systems to the digital age", and the Gothenburg Summit in November of the same year announced the implementation of a special "Digital Education Action Plan". So far, the EU has released two action plans, namely the Digital Education Action Plan (2018–2020) and the Digital Education Action Plan (2021–2027). The plan presents a shared vision of high quality, inclusive and accessible digital education in Europe and aims to support Member States' education and training systems in adapting to the digital age (Bilohur, Vlada, Andriukaitiene, Regina, & Makieshyna, Yuliia, 2021).

In September 2020, the Organisation for Economic Co-operation and Development (OECD) put forward four visions for the future of education: expanding schooling, outsourcing education, school

as learning hub, ubiquitous learning, and indicated that digital technologies are key to implementing these visions of driving factors, and also published a report "Digitalisation strategies for education in OECD member states: a study of education policies on digital technologies", which analyses the priorities and policy challenges of digitalisation strategies in member states. From 16 to 19 September 2022, the United Nations will hold a summit on education change, and "promoting digital learning and transformation" is one of the five main action areas proposed at the summit. The special session on "Digital Learning and Transformation" emphasised that countries must step up investment and action, seize the fertile opportunity of the digital revolution, take full advantage of digital technologies, transform education and lifelong learning and make them more inclusive. Equity, efficiency and sustainability.

On 28 September 2022, the US Federal Department of Education organised the National Digital Equity Summit and the Office of Educational Technology published the recommendations "Promoting Digital Equity for All" to guide the formulation of effective plans for digital equity, bridging the digital divide, and enabling technology-based learning. The guidelines state that in order for all learners to have equitable access to reliable, high-speed broadband and technology tools for learning, three elements must be fully considered: accessibility, affordability and efficiency. The recommendations analyse the existing barriers to achieving digital equity, propose appropriate strategies to overcome them, and identify key steps. On 27 January 2023, the "Strategy for the Digitalisation of Education 2023–2027" issued by France stated that digitalisation is changing every sphere of society, and digital technologies are playing an increasingly important role in people's work and lives. This is a critical issue for economic growth, innovation and even national development strategies. In the future, most students will pursue digital careers, so schools need to educate students with the appropriate literacy and skills. The strategy proposes a series of initiatives to strengthen students' digital skills and promote student success through digital tools (Bilohur, Vlada, & Andriukaitiene, Regina, 2020).

The digitalisation of education requires planning and designing the system at the highest level. In its report "The Age of Digital

Interdependence", the UN High-Level Panel on Digital Cooperation put forward five recommendations for the international community to work together to optimise the use of digital technologies and reduce risks, including building inclusive digital economies and societies, developing human resources and institutional capacities, protecting human rights and human autonomy, promoting digital trust, security and stability, and facilitating global digital cooperation. These recommendations provide important guidance for the use of digital technologies in education. In addition, from the strategies of educational digitalisation in different countries and related initiatives of international organisations, we can identify important principles that should be followed in the top-level design and systematic implementation of educational digitalisation (Bilohur, Vlada, 2019).

United Nations "Our Common Agenda" and "Roadmap for Digital Cooperation", as well as the UNESCO "Declaration on the Changing Global Education Connection" and the International Commission on the Future of Education's "Rethinking Our Common Future: A New Future" Important reports such as the Social Contract on Education (Rethinking Our Common Future) reaffirmed that countries should make full use of digital technologies to ensure that education is a fundamental human right and public good to promote the development of all people. Digital learning initiatives and implementation strategies should target marginalised groups from the outset and by design to ensure that publicly accessible digital learning platforms such as websites, tools and apps provide rich and engaging content.

Development of learning resources accessible to all learners, teachers and other education stakeholders, with a particular focus on expanding educational opportunities for learners who are disadvantaged by disability, geography, conflict, poverty, race, language, gender or other factors.

Infrastructure design is fully aligned with quality learning content. Strengthening infrastructure and connectivity through digital tools is a critical step in preparing students for life and work in the digital age. Learning styles based on mobile networks and digital devices open up more opportunities for education not only to make changes

to formal learning, but also to facilitate non-formal learning, helping disadvantaged youth find a way back into formal education or to improve their professional competence. While emphasising the 'hardware' of building infrastructure, it is also necessary to particularly strengthen the building of 'software', i.e. digital learning content. Currently, many countries still do not have publicly accessible educational digital platforms. To do this, it is necessary to establish strong privacy protection mechanisms, strengthen responsibility for digital ethics, formulate and enforce comprehensive rules to ensure order in digital spaces, and educate teachers, students and their families on the safe and responsible use of digital platforms and online spaces.

Actively coordinate and strengthen public-private cooperation and international cooperation. On the one hand, strengthen public-private cooperation. Digitalisation of education requires joint efforts of stakeholders. While governments are at the centre, the involvement of stakeholders such as the private sector and civil society is critical, so effective solutions and policies should focus on engaging with the private sector, technology companies and civil society from the outset. On the other hand, strengthen international cooperation. Creating and managing digital platforms and high-quality learning content provides opportunities for cross-border collaboration. While each country and region has unique needs, significant cost savings can be achieved through sharing and collaboration. UNESCO and UNICEF have launched the Global Initiative on Public Digital Learning Platforms to describe and analyse existing public platforms and content, help countries build and strengthen national platforms, share best practices, and establish international norms and standards to guide the development of platforms to contribute to national and international education goals. (Buhaychuk, Oksana, Nikitenko, Vitalina, Voronkova, Valentyna, Andriukaitiene, Regina & Malysh, Myroslava, 2022).

To conclude, the digitalisation of education will bring about profound changes and innovations in education, and to shape a peaceful, just and sustainable future, education itself must be transformed. As we enter the digital age, we need to rethink what, how, why, when and where we learn. High-quality educational

resources are interconnected and interoperable, overcoming the limitations of traditional educational elements. Traditional education has always been limited by various factors such as space, time, learning materials and teachers. The flexibility, sustainability, flexibility and adaptability of school education are insufficient. Due to the imbalance of educational resources, the development of schools and regions is also uneven. The digital transformation of education has brought important opportunities to address these issues. Digital education strategies in various countries continue to strengthen the supply of public education products and services, which will facilitate the collection and sharing of high-quality educational resources, and gradually narrow the gap between regions, urban and rural areas, and schools. In the future, digital technologies will make educational content richer, educational forms more diverse, and teaching methods more flexible, demonstrating more fully the equity and quality of education.

Different levels of education are connected vertically and horizontally to build a personalised lifelong learning system. From a vertical perspective, current education is mainly divided into pre-school education, primary education, secondary education, higher education and other levels of education. From a horizontal perspective, there are many types of education, which are divided into formal education, non-formal education and informal education, and by the subject matter of implementation into school education, family education and social education. Deeper implementation of the digitalisation of education will promote vertical and horizontal integration of all levels and types of education, multiple combinations of different types of education, resources, elements, etc., and joint learning between schools, families and society will help build higher education that can be learned by everyone, learned everywhere and at any time. High-quality personalised lifelong learning system. Comprehensively deepen education reform and innovation and introduce a new ecology of smart education. Digitalisation of education is a new stage in the development of education informatisation. A new generation of information technology represented by 5G, big data, cloud computing, artificial intelligence, etc. Deep reform and innovation, promoting the digital transformation

of all elements, all services, all fields and the entire education process, making education more open, collaborative, interactive, shared and ubiquitous, and promoting the formation and development of a new ecology of smart education.

1.3 China on the Way to a Global Digital Education Ecosystem

Digitalisation is driving education reform step by step. China's main goal is to transform the static potential energy of digital resources into powerful kinetic energy for education reform, to support and lead the modernisation of education, and to create Chinese characteristics and Chinese paradigms on the map of global education. China has proposed to promote the digitalisation of education and build a learning society and a learning-centric country where all people are lifelong learners. At the World Conference on Digital Education in 2023, "Digital Transformation and the Future of Education" emphasised that international cooperation is an important driving force for the global transformation of education, especially digital transformation. Therefore, China attaches great importance to the development of digital education and regards it as an important part of the country's digitalisation, and calls on all countries to join hands to promote integrity and innovation so that the results of digital education can benefit more people from all countries. The strategic impact of the digitalisation of education is a key content of modern educational reform and development (Digital Transformation of Open Educational Environments: A Collective Monograph, 2019). The key to the digitisation of education is to build a data-driven, human-integrated cross-border open digital education ecosystem through a thorough and comprehensive digital transformation, creating a more flexible, equitable and sustainable digital education system and providing learners with a comprehensive and rich learning experience. In the process of digital transformation of education, digital technologies are deeply integrated with traditional education, giving rise to digital education. Digital education refers to the use of core digital technologies, such as big data and artificial intelligence,

to facilitate the optimisation and re-engineering of educational processes and structural reorganisation, to develop more innovative intelligent educational programmes and platforms, to improve students' digital literacy and abilities, and to realise personalised education. Digital education aims to build a new education system based on deepening reforms in four dimensions of education – people, school management models, governance systems, and safeguard mechanisms to build inclusive, equitable, sustainable education that adapts to the digital age. The main goal of digital education is to create a concept of high-quality lifelong learning focused on talent development in the digital age, which is comprehensive and personalised, and includes the following areas. First, it is a dual approach to knowledge and data. Relying on big data and other empowering intelligent technologies, the digital education process can accurately collect massive learning data from teachers and students in multiple dimensions, conduct personalised and accurate analysis to ensure knowledge – and data-driven teaching, assessment and management (Nikitenko Vitalina, Metelenko Natalia, Voronkova Valentyna, & Vasylchuk Gennadiy, 2023).

Secondly, it is the sharing of high-quality educational resources, which include resources for teachers, learning materials, intellectual tools and other aspects. Digitisation can ensure the efficient circulation, accurate distribution and effective sharing of high-quality resources between different regions and schools, and unify scale and personalisation.

Thirdly, it is a focus on improving abilities as the most important goal of knowledge acquisition. In the digital era, the goal of education is to focus on the comprehensive development of students' abilities based on the acquisition of traditional knowledge. A variety of digital technologies can provide students with a comprehensive learning experience, promote the improvement of students' comprehensive abilities in the teaching process, and build an educational model focused on student development.

Digital education in China is developing on the basis of audiovisual education and network education. The first national conference on audiovisual education, held in 1983, marked the initial stage of the development of informatisation of education. Early audiovisual

education focused on the use of audiovisual media technologies and resources, and later changed in educational forms and educational processes, i.e. in the organisation and design of information transmission, information storage and information control. By the end of the 1990s, audiovisual education began the process of transitioning from multimedia teaching design to information-oriented education. Due to the rapid popularisation of Internet technologies, online education has become the centre of educational informatisation development, and schools at all levels have begun to make extensive use of networked information technologies for teaching and learning.

Entering the era of digital education, China is actively responding to changes, coordinating the implementation of education informatisation and digitalisation strategies, and gradually forming a digital education system with Chinese characteristics: modernisation of education through education informatisation. On this basis, the "Education Informatisation Action Plan 2.0" and "Modernisation of China's Education 2035" have been published in succession, and a number of national engineering research centres and strategic research bases are being actively developed. The implementation of the strategic action of digitalisation of education and the determination of directions for the development of education in the digital age have been clearly defined.

The national smart education public service platform is an important carrier for promoting the digital education process. As of February 2023, the primary and secondary school platforms have 44,000 existing resources, and the vocational education platform has access to 1,173 national and provincial vocational learning resource banks. The platform has collected 27,000 high-quality MOOCs, essentially creating the world's largest library of educational and training resources. The first International Conference on Artificial Intelligence and Education was held in 2019, the first MOOC Conference in 2020, the World MOOC Alliance was established, and the World Digital Education Conference was held in 2023.

Today, the digital learning environment of China's primary and secondary schools has been completely upgraded. In China, national primary and secondary schools (including teaching sites) have reached a 100 % internet connectivity rate, up 75 percentage

points from 2012. 99.9 per cent of schools have an export bandwidth of more than 100MB, and more than three-quarters of schools have achieved wireless coverage 99.5 per cent of schools have a multimedia classroom. With the development of the economy and society, people's demand for education has changed: providing high-quality educational resources for students across the country is an important connotation of educational equity (Nikitenko, V. O., Oleksenko, R. I., & Kyvliuk, O. P., 2022).

In March 2022, the national public service platform "smart education" was officially launched, focusing on the five core functions of student learning, teacher teaching, school management, social empowerment and educational innovation. The section contains 53 columns covering 30 editions and 446 textbooks. According to statistics, the total number of views on the platform has now exceeded 6.7 billion, the total number of visitors has exceeded 1 billion, and users have spread to more than 200 countries and regions on five continents. With a collection of vast resources, online courses are available to everyone, all the time and everywhere; with strong support for new technologies such as artificial intelligence, cloud computing, big data and blockchain, teaching, learning, management, assessment, examination, and employment have begun to shift into a distinct mode.

Digital education has changed the way we learn and reshaped the form of education. On the state-owned national intelligent education platform, the primary and secondary school platform uses high-quality resources to serve rural schools in the central and western regions, helping rural areas to discover and fully open up nationally-accessible courses. Large-scale standardised teacher training is also entering a new phase in the digital age.

During last year's summer holidays, the Education Department for the first time conducted trainings for teachers of all levels and types of schools across the country using the national platform of public services "smart education". A total of 13.13 million teachers were trained online, about 71.2 % of the number of full-time teachers of all levels and types in the country. Provide new support for the cultivation of high-quality talents with comprehensive development of morals, intelligence, physical ability, art and work.

The Beijing Dongcheng District Education Committee coordinated the collection of electronic homework, introduced an artificial intelligence homework analysis system, reduced the number of homework assignments and improved the quality; Digital technology is deeply integrated with education and training, and the continuous "double reduction" service realises the implementation of the education model turnaround. It not only helps students obtain relevant learning resources, conduct independent learning, and supplement classroom learning, but also helps families establish correct educational concepts and promote joint learning at home and school. The era of digital education will provide technical support for everyone, anytime and anywhere, and the development of multiple resources, the display of multiple scenarios and multi-formal communication will change the original classroom methods of learning (Marienko V. Y., 2023). MOOCs are massive open online courses. Since 2013, MOOCs in China have developed from scratch, from small to large, from weak to strong, and have grown rapidly. Statistics show that as of November 2022, there will be more than 61,900 online MOOCs in my country, 402 million registered users, 979 million learners, and 352 million students who have received MOOC credits, ranking first in the world. China continues to make efforts to promote the digital transformation of education, intellectual upgrading, integration and innovation, and accelerate the construction of a learning society and a learning country where all people are lifelong learners. In every progress of society, technology plays a vital role.

The establishment of the Digital Education Centre of the Guanghua School of Management is precisely our response to the great challenge of the times. Guided by science and technology, with digital infrastructure as the main driving force, we try to discuss and build new paths and new scenarios for future education, and create a unique, modern and collaborative creative new learning experience for lifelong learners of business knowledge. Experience and continue to realise our mission of "creating management knowledge, educating business leaders and contributing to social progress". era of ever-changing times, only change remains constant.

The pace of rapid development of enterprises is driving a change in the demand for talent, and the corresponding business education

must also change, keeping pace with the times and integrating digital technology. The Guanghua Digital Education Centre will create an entirely new ecology of digital business education – innovatively applying digital tools, flexibly "teaching" and "learning", exploring and creating limitless learning opportunities through technology.

A completely new learning experience is emerging in China. Technology and digital tools are making students not just recipients of knowledge, but better people who are "self-learning" through their flexibility, timeliness and interactivity. The Centre will use digital tools to make the learning process social, interesting and spontaneous. Through multi-scenario learning modalities, online discussions between learners, and gamified stimulus design, a high quality and holistic learning community is created so that learners can truly understand the meaning of "learning" while gaining the best experience possible. Identifying problems, exploring step by step, using one problem to lead to the next better problem, and acquiring a lifelong learning capability. Digital technologies are enabling teachers and making knowledge better for learning. "Learning" is no longer a mechanical and isolated transmission. Drawing on the long-term analysis of Guanghua School of Management and in-depth research on economic development and corporate practice, the Digital Education Centre has elevated the long-term development direction, strategy and abstract methodology from practice to the level of management theory through analytical analysis. Learning is an environment focused on the practical application of business together with top managers of the enterprise to shape the path to achieving the goal. Keeping pace with the needs of the times, the centre condenses the common problems of enterprises, develops classic core management courses and implements the improvement of students' basic management skills and concepts. Digital education takes into account the individual development needs of enterprises and establishes four areas: innovative thinking, industry depth, state-of-the-art hotspots, and comprehensive literacy, which gives enterprises an open, cross-border, forward-looking, and flexible outlook. Different from traditional learning, digital education increases the use of interactive tools, enhances the learning experience, breaks the constraints of time, space and crowd, uses

social interaction as a medium, and makes "learning" a spontaneous action, thus realising the self-realisation of learners. Guanghua Digital Education Centre is implementing a new educational concept, focusing on technology and focusing on the real needs of enterprises to provide more flexible service and knowledge delivery models. Chinese colleges and universities are based on the realities of China, consciously integrate Chinese and foreign countries, and export high-quality educational resources to the world. Xi'an Jiaotong University of Liverpool (XJTLU for short) is a new type of international university jointly established by Xi'an Jiaotong University and the University of Liverpool, approved by the Chinese Ministry of Education. Its faculty and students come from nearly 100 countries and regions. Since the school was founded in 2006, it has implemented an online learning management system combined with classroom teaching to implement digital learning before, during and after classes, covering all courses in the school. During the epidemic period, international traffic was blocked and XJTLU's teachers and students were distributed around the world. The school quickly upgraded the online learning system and software applications, and conducted online training and teaching methods training. And stability to ensure the smooth running of teaching and upgrades to a dual-platform "learning supermarket" in the process. As a global community of learners, XJTLU Learning Supermarket actively creates dedicated pages on relevant UK websites and the school's own platform to share digital teaching experiences from frontline teachers, compiles and releases "Suggestions for Course Design and Development Process and Quality Standards", and actively participates in international university exchanges (Dzhurylo, A. P., & Shparyk, O. M., (2019).

Through the establishment of international alliances with many institutions from different regions, we will join together, China has confronted challenges and crises in education and jointly promoted the development of education. The "World MOOC and Online Education Alliance", established in 2020, covers 17 universities and 3 online learning institutions in 14 countries on six continents, promoting bilateral and multilateral cooperation in educational technology innovation, promoting equitable and inclusive lifelong

education. Actively share digital educational resources and expand the use of high-quality resources. Since the launch of the national platform of public intelligent education services, its functions have been continuously optimised and improved, and its influence has continued to expand. It has now effectively created the world's largest library of resources for education and learning, with users in more than 200 countries and regions. In 2020, the Ministry of Education launched the project to create an international platform for online learning in colleges and universities "MOOC Going to Sea" and launched a multilingual version of the international platform and course resources that represent the level and quality of China. It has been chosen to provide multilingual courses and learning services for students from all over the world. Focusing on the four aspects of platform, data, resources and literacy, it provides important support for the construction and application of the smart education platform system, comprehensively promotes the development of international digital education standards, and builds a digital education standardisation community.

In recent years, China has actively carried out international comparative research and international cooperation to strengthen international exchanges of digital education research and practice. On the one hand, promote the co-creation and sharing of high-quality digital resources, create a digital space for shared learning and shared growth, and jointly promote global educational innovation and reform in the digital age. On the other hand, promote the overall improvement of the development level of digital education, actively cooperate with other countries on digital education planning, standards, monitoring and evaluation, learn from each other and promote common development; improve the level of research, design and implementation of digital education, pay attention to intellectual property protection, data security management, prevention of digital ethics risks, and contribute to China's strengthening of digital education in the world.

The digital divide and digital barriers are not only reflected between countries, but also between different regions and groups of people, which poses challenges to the development of digital education. The digital divide manifests itself as an imbalance in the level

of penetration of digital education, digital literacy and the quality of digital resources. That is, there are differences between different groups in access to digital devices, use of digital technologies and development of digital abilities, which can be understood as limitations of different actors.

The digital era has brought us an effective platform for open collaboration, and open collaboration has also become a key element in driving educational reform and innovation into the new era. International cooperation is an important driving force for global education reform, especially digital transformation. In my country, on the one hand, we strive to narrow the digital divide in domestic education, and on the other hand, we play a leading role in reducing digital barriers between countries. In 2022, China launched a national platform of public services for intelligent education, which has become the world's largest educational and training resource bank with more than 13 million registered international users (Voronkova V., Oleksenko R., & Nikitenko V., 2023). Education of the future

In the era of the digital economy, digital technology innovations will bring great opportunities and new challenges for future education, and it is urgent to actively respond and stimulate endogenous motivation for education. The biggest feature of the education of the future is the combination of human and machine education. A series of new artificial intelligence technologies such as ChatGPT will further accelerate the pace of human-machine cooperation, promote a new form of human-led education of the future. machine cooperation and create a universal model of lifelong learning in society and enhance digital competitiveness. Digital education builds on digital transformation, coordinates the use of digital technologies, and explores equitable, high-quality, efficient, individualised, smart, and future-oriented education. It will change the traditional model of education, expand access to education, and make education more inclusive, equitable, quality, sustainable and open. In an era when digitalisation is leading to educational reform, more active digital education, an open strategy of cooperation and improvement has been introduced. The scope and level of international cooperation facilitates learning from each other's strengths, jointly promoting educational reforms in the digital age, and building a high-quality education system.

1.4 Digital Education in Finland

Finnish education has been impressing the world year after year and has become Finland's most successful export. In recent years, this remote polar country on the border of Northern Europe has received a steady stream of visitors. Educational institutions and executives from the United States, South Korea, Japan, the United Kingdom, South Africa and other countries have travelled extensively to learn from the experience of Finland No. 1. "The Economist even suggested in an article last year that European leaders should temporarily suspend all activities and "return to Finnish schools". Since 2000 AD, the Organisation for Economic Co-operation and Development (OECD) has been conducting the Programme for International Student Assessment (PISA), a test for 15-year-olds every three years. Finnish teenagers have won two competitions in reading and science two years in a row, with problem-solving and maths coming in second. "Finland can do it, why can't Sweden?" On the bookcase is a portrait of Guan Gong, presented by Minister of Education Du Zhengsheng during his visit in September. Speaking about Finland's excellent results, Bertil Ostberg, Deputy Minister of Education in Sweden, is unemotional. Although the performance of Swedish secondary school students in PISA is still above average, the Swedes are obviously not satisfied. After all, when Finland started its education reform 30 years ago, it was still learning from Sweden. Not only Sweden, but also Denmark and Norway, which spend the most money on education in the Nordics, have specifically hired Finnish education experts across the sea to help their education systems take the pulse and formulate prescriptions. Over the past two decades, countries around the world have invested huge resources in education reforms. Formulating long-term strategies, adhering to core values and reforming teachers are the three pillars of Finnish education's success.

In the early 1970s, the Board of Education undertook the biggest reform since Finnish independence. Their mission was to provide high quality compulsory nine-year education and to prepare the next generation to make the country more competitive. The Board of Education decided to adopt a "comprehensive school" model,

allowing primary and secondary school students aged seven to fifteen, regardless of grade, to attend the same school. During the nine-year sequential education, students' textbooks, transport and lunch costs are covered by the state, with the central government providing 57 % of the funds and local governments 43 %. This decision has been in place for 30 years and has not changed due to the rotation of political parties. The main value of education that runs through the context of the reform and contributes to the success of the policy is the spirit of equality "no one less" (Voronkova, Valentina, & Nikitenko, Vitalina, 2022). While other countries are still implementing elite education, Finland does the opposite, never flaunting the elite and insisting that every child receives a fair education. From system design to resource allocation, Finnish education starts with equality. With 600,000 primary and secondary school students spread across 4,000 comprehensive schools, the average number of students per school is around 150, and the number of classes is less than 20. The system of small classes and small schools contributes to No Child Left Behind, and there is no distinction between noble and civilian schools. Looking through various educational materials in Finland, there is never a loud "happy learning". To be honest, happiness is not an issue for them. However, all Nordic countries emphasise equality, and the key to Finland's ability to stand out as a dark horse is to use the right strategy.

Instead of spending more money on education, Finland has chosen a strategy of "focus", allocating resources where they are "most needed", namely junior high schools (the equivalent of junior high school in Taiwan) and those with learning disabilities. According to the OECD's national assessment, Finland is one of the countries with the most efficient use of educational resources. The difference is that in most countries, tertiary students receive the most funds on average; in contrast, Finland invests an average of US$8,200 in primary school students, the highest of any school age group.

Improving the learning abilities of people with learning disabilities is another area of focus for Finland. The goal of the Board of Education is that "every" child should have basic abilities. When a student has short-term learning difficulties, the teacher will immediately offer a correction plan. Or individual tutoring

after school, the cost of which is covered by the state. Almost 20 % of primary and secondary school students in Finland receive additional support in learning, compared to an average of only 6 % in OECD countries. Following early intervention by a teacher, all children with mild learning disabilities made rapid progress. After one or two months, they no longer needed a 'remedy'.

Another advantage of adopting a resource-based strategy is that there is no significant urban-rural gap in the learning achievement of Finnish students. In the PISA test, the gap between schools in Finland is the second smallest in the world, at less than 5 % (the smallest gap is in Iceland with a population of only 300,000). Whether it's the capital Helsinki or a secondary school in the remote Arctic Circle, test results don't differ much. In Finland, there are no bad students, even the worst students are good The population is decreasing year after year. for children in need of tutoring can create the greatest national interest. "We cannot afford to turn anyone away". Wait a minute! What about those who are fast learners? Could this be another kind of injustice? The Finns have their own logic: "The fast learners learn on their own, and the slow learners need help".

At first glance, Finnish schools look inconspicuous and even a little boring, but the more she looks, the more she realises that this is the feature of Finnish education that "sees the power in the ordinary". Teachers' classes always spend the most time "teaching slow people". "It is better to leave those who learn quickly to wait than to let those who cannot continue to fail", said Zhang Jiaqiang. The Finnish teacher does not feel pressured to keep up with the schedule. Even if she is studying Finnish at university, the teacher always has to wait until everyone is finished. Only after learning, continue to teach new courses. Finland is against any form of "classification" or "ranking" of students. Saying that the "gifted" and "elite" are not such, let alone being able to classify them. The value of educational equality is best exemplified by the Finnish government's attitude towards immigrant children. Immigrant children, regardless of their Finnish nationality, can attend school free of charge, and the government has allocated an additional budget to enable them to learn their mother tongue twice a week for four years. The hourly rate and transport fees are paid by the state. In addition to a dedicated

strategy and a core value of equality, the smooth progress of education reform in Finland should also be attributed to a group of highly qualified professional teachers. Without strong teacher support and cooperation in decision-making on teacher reform, Finnish education would never have healed to where it is today. Since 1979, the Board of Education has set the tone that primary and secondary school teachers are "research-oriented" and must have a master's degree, perhaps the most stringent standard in the world. Teacher education has been extended from the original three to five years. When high school graduates apply to regular schools, they must not only have their school grades verified, but also undergo numerous interviews to prove their enthusiasm for teaching and innovative thinking ℅ normal narrow door. The sole objective of the Finnish teacher education system is to produce capable teachers and to develop the necessary professional qualities to ensure continuous progression in the career of teachers. In other words, in Finland, teachers must have the ability and willingness to learn throughout their lives. "Only with the ability to learn can we innovate in teaching, and education will continue to improve". Finnish teachers are famous for their love of learning. When a university summer school starts, most of the teachers in the classroom are primary and secondary school teachers. The biggest headache for the Finnish Minister of Education is the shortage of teachers, and willing teachers leave to pursue doctoral studies; Finnish companies also like to hire teachers and compete with the government for talent. According to a survey conducted by the Helsinki Post, Finland's largest newspaper, Finnish youth most aspire to be teachers; primary and secondary school teachers are even more respected than the president and university professors.

What Finnish teachers teach is not "knowledge" but "learning how to learn". When a child asks a question, the teacher does not directly give the right answer, but gives him or her the direction to think, find and learn for himself or herself. There is no noise or impatience, every child has a learning goal developed by the teacher for them and they know what they are going to do next. Despite its high barriers to entry and popularity, teaching is not well paid in Finland. According to an OECD survey, the average salary of Finnish teachers is lower

than in developed countries and the European Union, whether they are new or experienced teachers, even lower than in South Korea and Spain, which have lower national income levels than Finland. Shi Yali, who has a big beard and has been teaching high school physics for 24 years, estimated that his monthly income after taxes is about 2,000 euros (roughly NT$80,000), which is about the same as a college graduate's income. He laughed and said that he takes time off to care for the two children in the family because his wife earns much more than he does. "Being a teacher is not for the money, but because we really believe that this job is very important for Finland". The better the teachers, the stronger the country (From disruptive technologies to the digital economy: a monograph, 2022).

The quality of teachers is strictly required, and the Finnish government also relatively gives teachers and schools the most autonomy in teaching. The Board of Education and the Ministry of Education formulate and publish the structure of the core curriculum every four years. Other issues, such as teacher recruitment and management, are left to the autonomy of each school. For example, the school has full responsibility for class size, course content, student schedules and even the number of semesters per year. As for what to teach, how to teach it and what textbooks to use, the teacher has free choice.

Finnish primary and secondary schools do not have nationally agreed common assessments, and schools rarely conduct exams; Finnish officials do not evaluate teachers. When asked whether teachers should be evaluated, Laukanan, a senior consultant who has worked for the Board of Education for 30 years, was almost offended and asked, "Why do you want to evaluate teachers"? He proudly said that there are no bad teachers in Finland. Every teacher is very self-disciplined and does not need to be evaluated. The central ministry of education or the local authorities responsible for education do not implement school evaluation systems, and they have absolute trust in schools. No matter how small a school is, it also has absolute administrative autonomy.

Latokartano Primary School in Helsinki has decided to run classes independently of the classes in the school. The school has 180 students, each with their own schedule. Some go to school at 8:30,

while others go to school at 9. At 1:00 or 9:30, the time of leaving the school is different. The decision-making body for the school is the board of directors. The seven directors include one teacher representative, one staff representative, and the other five are elected by parents and the local community. The board of directors decides on the school's educational policy and budget, and hires teachers. The principal has a dual master's degree in law and education, and said that at the beginning of each term, the class teacher will invite parents and students to sit down and discuss the child's learning goals. The assessment of students' learning is not based on comparison with others, but to see if the goals originally set are being achieved. They do not have transcripts, only research reports.

Finnish education emphasises learning, not competition. Finland will never use competition to drive quality, in Finland the goal of education is learning, not competition. The tradition of reading at home has been passed down by Finns for over 400 years. They are the people who love to borrow books from libraries around the world. Each person borrows an average of 17 books a year. According to a survey, reading is the most frequent "leisure activity" for 41 % of Finnish secondary school students.

1.5 Inclusive Digital Education in Estonia as a Leading E-state

Estonia has a very strong digital education sector and many innovative e-learning projects in digital education that has changed everything. The impact of the Internet on humans, the impact of humans on communication systems, humans and humanity in the system of digital life. In education, we see that the models of education honed over millennia cease to work when the consciousness of humanity changes significantly. Such a change occurred with the virtual revolution. Students were the first to abandon the old models and perceive the world through the mass of knowledge circulating in the virtual world. This is interesting to them: the student has the mental freedom of choice, which is in harmony with the basic nature of knowledge – free knowledge.

The central actors of the digital life system are people belonging to a community, with digital technological tools being supporting parts. In other parts of the world, the term digital ecosystem is used in the same sense (ecosystem comes from the Greek language: oikos – habitat), but here we leave the ecosystem to ecologists. In a functioning life system, people are involved on an equal footing as partners in cooperation – this is an important difference between a digital life system and the information systems designed today, where a person is only a client, a consumer of a service (Voronkova, Valentyna, Nikitenko, Vitalina, Oleksenko, Roman, Andriukaitiene, Regina, Kharchenko, Julia, Kliuienko Eduard, 2023). In education, the digital life system was the first to emerge, and under pressure from students. The new digital generation quickly embraced the internet and challenged the standard education system. Thanks to the students and our digital learning enthusiasts, Estonia has a comprehensive e-learning system, from primary and vocational schools to universities. Thousands of learning modules are freely available to everyone in the repository of the Education Information Technology Foundation's (HITSA) innovation centre. All of this is powered by free information technology software. The general educational system of digital education is part of society, and only the national educational knowledge base can be its manager and developer. Although it is clear that digital education is the inevitable future, education in general has irreversibly changed in the digital age. Educational knowledge is becoming freely accessible to all and easy to obtain. Future students can freely choose study programmes, subjects, teachers, time and place of study from Estonian, European and global digital education systems. The COVID-19 pandemic has greatly affected the education sector and increased the need to use blended learning methods in schools. Quality digital education should be accessible to everyone. To do this, we need to invest in digital infrastructure and equipment and provide quality digital education. However, digital developments and digital learning and technology can only support learning. On the recommendation of the Council, it was agreed that additional resources should be provided to schools so that local support can be provided based on needs to compensate for the gaps in student learning that result from distance learning.

In 2022, Estonia has allocated 40 euros per pupil, or 6 million euros, to schools, and another 12 million will be allocated from the 2023 state budget to fill the gaps in learning, and it is planned to continue cooperation with the ASÕP teacher replacement programme and send students from the Universities of Tallinn and Tartu to schools to help. Member States also agreed that the physical and mental well-being of students, teachers and parents should be a priority. This should include integrating embedded learning into in-service teacher training to help teachers cope with different environments and conditions.

In order to support the mental health of students, parents and educators, Estonia has established a school psychologist helpline, which aims to provide an easily accessible opportunity to communicate with a qualified school psychologist in a convenient, anonymous and confidential manner, free of charge.

The adopted recommendation sets out the next steps for connecting learning environments and tools in primary and secondary education in a way that helps to create more sustainable education and learning systems in line with the Digital Agenda 2021–2027 and the European Education Area. For its part, the European Commission supports the implementation of the recommendation by facilitating the exchange of experience between Member States, developing learning materials and supporting the development and training of teachers. The Council on Education, Youth, Culture and Sport is composed of ministers responsible for education, culture, youth, media, communication and sport from all EU Member States. The Council normally meets three times a year. The Inclusive Digital Education (IDE) activity aims to scrutinise new priorities and requirements for inclusive digital education and blended learning. Its key messages relate to four interconnected and interrelated policy areas and their role in the digital transformation of inclusive education: 1) technology; 2) students and teachers; 3) educational institutions; and 4) regional and national education governance (Voronkova, Valentyna, Kyvliuk, Olga, & Nikitenko, Vitalina, 2023).

Knowledge is information, and it is important that knowledge grows into concentrated information. There is a big difference whether we act with knowledge or information. Facebook disseminates a large amount of information that is only valuable to members. However,

the knowledge is largely hidden from the public, even though it has social value. The digital era has brought a large flow of information. It is interesting to observe the discussions that are taking place in the European Union. In the digital magazine Science/Business, science leaders discuss how to work with big data on the topic of big data. In fact, the problem is not the excess of information, which is natural and inevitable in the digital age, but rather the distinction between knowledge and information, and our ability to find, communicate, acquire and use knowledge. Another big challenge is opening up knowledge to society. The European Union has realised that knowledge should be open, but at first everything remained at the level of talk, because knowledge is big business, and opening up knowledge will lead to changes in the global knowledge market. Intellectual businesses are fighting for their profits and winning. Society's pressure to open up knowledge is growing. Many scientists, designers, and creative people are opening their knowledge gates to the public in the virtual world.

Another giant that is emerging in the digital age is the digital health system. Health has not fared as well as education. Our eHealth was launched as a national project at the beginning of the digital era, but the results are modest. Patients, doctors, medical institutions (hospitals, pharmacies, laboratories), and social workers are the creators of the healthy life system of the future. The most important change in the system of life is in patient-physician communication. The goal of digital medicine is to create a real-time network of doctors and patients that would combine and integrate the knowledge of doctors to serve citizens. First, there is the possibility of virtual monitoring of a patient's health. Visits to the family doctor's centre are replaced by regular remote diagnostic procedures. If necessary, monitoring can also take place in real time, so that a patient with poorer health can be p. sperm systems and models for medical diagnostics originate from the 1960s school of artificial intelligence (Voronkova, Valentina, Nikitenko, Vitalina, Andryukaitene, Regina, & Oleksenko, Roman, 2021).

Today, they are not available on the medical device market. The core of a medical diagnostic expert system is a disease knowledge model that contains the generalised experience of specialists.

Creating a model is a knowledge acquisition and modelling technology mastered by knowledge engineers. The expert system model is self-learning, and the expert system knowledge base is formed as a result of developing a self-updating model. Such an expert system can be considered a natural extension of telephone doctor services and telediagnostics. The source of innovations in healthcare is the new traditional medicine, participatory medicine, and a new health paradigm: prognostic, preventive, personalised, and participatory. Traditional medicine is developing spontaneously, without large investments and programmes, so the first diagnostic systems may appear in the near future.

The concept of the knowledge economy emerged in the European Union in 2000, when the Lisbon Strategy was proclaimed the main European development strategy. Further research clarified the real situation in the knowledge economy. Eurostat divided knowledge economy production into four groups: 1) high-tech (e.g., information technology, pharmaceuticals, aerospace engineering); 2) medium-high-tech (e.g., chemicals); 3) medium-low-tech (e.g., plastic products); 4) low-tech (e.g., furniture). Knowledge products and the knowledge-based economy are efficient and highly productive. Intelligent companies rely on the knowledge of their employees and company knowledge, which is usually unique and expensive. The high value of knowledge products leads to high salaries in the company. The Estonian knowledge-based economy is located in the IT and financial sectors.

The open knowledge market has allowed global capital to buy Skype and banks, but the situation is not hopeless: the development of small IT companies creates a secure future for the knowledge economy (Metelenko, Natalya, Vasyl'chuk, Gennadiy, Kaganov, Yuriy, Nikitenko, Vîtalina, & Voronkova, Valentyna, 2023).

The future of knowledge in the digital age promises the development of technological progress. The digital generation, born free, works in a free virtual mental space. As a result of the virtual revolution, the consciousness of society is striving for freedom, and this is an irreversible process. Serious discussions are already underway on how to reconcile intellectual property laws with the future of free knowledge.

In the near future, we can expect a major breakthrough in the digital age in the education system. The European Union has opened the Gateway to an Innovative European Learning Environment portal, which could become a pan-European digital education centre that we all are part of. Hopefully, an Estonian-language portal for digital education will be created, where knowledge covers the entire field of education from pre-school to university and lifelong learning.

Open knowledge repositories are developing rapidly. There are already two digital libraries in Europe: Europeana and the European Library portal, Digira opens up Estonian language knowledge in the national library. The decision of the Council of the European Union gives impetus to the development of the Digital Single Market and better use of intellectual capital. The future model of the Digital Single Market is still unclear. In theory, the European Digital Single Market should provide every company and consumer with direct access to every company in the Single Market. This principle is the first to be implemented in European digital banking, thanks to the tight regulation and power of the European Central Bank. While the knowledge economy is a reality, the knowledge society is still a theory. A knowledge society is a society where knowledge is the dominant force in society and has become the property of every member of society. According to UNESCO, a knowledge society shares global knowledge across geographical, political and ethnic boundaries. Knowledge is a public good available to everyone. The knowledge economy is the foundation of the knowledge society. In a knowledge society, everyone learns, and lifelong learning becomes the norm for every member of society.

The development of and links between the knowledge society and the knowledge economy are becoming increasingly relevant in society. The digital culture of society affects the daily communication and behaviour of people and organisations in the digital environment. The relatively high level of digital culture is a great advantage for Estonia. It has become a prerequisite for quick and painless innovation solutions.

At the same time, a digital divide is emerging between information technology and society. Social networks such as Facebook have contributed to the development of the digital culture of society.

The complex development of digital life systems reflects the focus of digital education on information technology. The creation of new specialities and the digitalisation of traditional ones are the challenges for education in the near future. The knowledge society is characterised by two main features: knowledge is free and accessible to everyone, and knowledge is easy to obtain. The first feature is that the freedom and accessibility of knowledge is currently limited by the underdevelopment of technological tools and intellectual property laws. Acquiring knowledge is the work and social responsibility of digital technologists.

Estonia surpasses most Central and Eastern European countries in terms of the percentage of highly educated people, but is slightly below the OECD average. In Estonia's education development plan for 2021–2035, the goal is to increase the share of people with tertiary education among 25–34 year olds to 45 %. While this goal provides direction, the role of higher education in the future education system needs to be considered. The 20th century university is not suitable for the 21st century. New technologies open up opportunities for both higher education institutions and competitors. Graduates can start working in professions that did not even exist when they started their studies. Technological developments, especially digital technologies, are shaping the entire environment of higher education. The digital revolution covers very different areas, for example, technology used in the classroom, testing and assessment, admissions management, career planning. In all these areas, new business models are being developed that complement and compete with higher education. The university of the future is a platform for educational services where different educational service providers teach under the university brand and based on quality standards; learning analytics, testing and assessment are provided by other service providers, and third parties manage the technologies used in the learning process. The development of digital technologies opens up many opportunities for higher education institutions, for example, increasing the efficiency of higher education processes, improving knowledge transfer through better learning experiences and learning environments that take into account the student's lifestyle (interactive online materials, the ability to view lectures). In addition, digital technology solutions

make it easier to provide feedback and facilitate communication in the learning community (social media groups, etc.) (Michael Michalko, 2019).

Students are diversifying and expecting an individual approach. Expectations of higher education are changing. Even more demanding than diplomas and degrees is lifelong learning, which is focused on keeping knowledge and skills up-to-date rather than on obtaining degrees. Along with the growing importance of lifelong learning, the student population is also diversifying. Students include those who were previously considered non-traditional students: students who have postponed their higher education, students on work placements, students with dependents or those without a general secondary education. The number of students who do not come directly from secondary school is growing – in Estonia, the share of students aged 25+ has increased by more than 10 per cent in 10 years (Figure). All of this leads to the expectation that higher education can be tailored to suit any lifestyle and preferences. It is clear that an individual and flexible approach to the time, place, form and scope of study is expected. This contributes to the diversification of higher education. The rapid proliferation of non-academic certificates, especially in the field of ICT, blurs the boundaries between educational institutions, including between higher education and other types of post-secondary education. Estonian residents are actively using the opportunities offered. For example, Europe is a leader in terms of participation in online courses. A 2021 survey showed that 35 % of Estonian residents aged 25–64 had participated in some kind of online course in the past three months (15 % in 2019). In the European Union, this figure was higher only in the Netherlands, Iceland, and Slovenia. The individual approach has its limits at first. One manifestation of the personalisation of higher education, which is closely linked to the growing need for lifelong learning, is microqualifications or learning opportunities – longer programmes of further education with comprehensive content based on subjects of in-depth study. Although the concept of micro-qualifications is not well defined and its meaning may differ from country to country, micro-steps are considered to be vital. It is believed that micro-degrees have the potential to improve access to higher education, support

self-development and personalised, student-centred learning, while also serving the interests of employers. The design of a well-designed integrated curriculum would require the highest level of student awareness and a great deal of attention from the higher education institution in managing the learning process. Therefore, a complete unpacking in the near future cannot be considered likely. However, there is a clear upward trend in the growth of the individualised part of the curriculum. Providing a personalised approach costs (time) for higher education institutions. But if this is not done, academic performance suffers, students drop out or turn to an alternative provider. Therefore, higher education institutions need to find a good balance (Kostyria, I., Bereziuk, D., Sadovyi, M., Podoprygora, N., & Tryfonova, O., 2023).

In the more distant future, it will be possible to offer personalised learning experiences as well as reduce costs through the use of machine learning and artificial intelligence applications, such as the proliferation of virtual learning assistants. The international dimension is taking on new forms. Despite the setback caused by the coronavirus pandemic, higher education is becoming more and more internationalised. While in 2011, 4 million students studied abroad, in 2019, 6 million students were studying abroad. The internationalisation of higher education is much more multifaceted than the international mobility of students. International forms of cooperation are gaining importance, such as partnerships between national higher education institutions and degree programmes offered in other countries, as well as international massive open access online courses or MOOCs. The international and multicultural dimension is increasingly being integrated into curricula in the domestic learning environment as well – this is known as "internationalisation at home". Thus, those with higher education have a better understanding of different points of view and cultures, and this is useful in the labour market and in promoting entrepreneurship, as well as increasing the cohesion and security of society.

The internationalisation of higher education expands the market for Estonian higher education institutions, but also creates competition. The increased competition is evidenced

by the availability of digital content around the world, and with it, increased opportunities for local students, but competition among international students is also increasing in the same way. Universities are solving societal problems and driving great change. Higher education institutions have always been the first choice for solving global problems. The world's population will grow to almost 10 billion by mid-century, an ageing society is putting pressure on health and social systems, and dangerous climate warming means that greenhouse gas emissions and the burden on natural resources must be reduced. Such interdisciplinary tests require a combination of knowledge from very different fields. Universities are arguably the best and most logical candidates to manage major societal changes and find solutions to problems. In addition to addressing global challenges, there is a growing expectation in many places that higher education institutions aim to and support the development of the local economy and living environment (Metelenko, N. G., & Andriukaitene, R., 2022).

Thus, higher education institutions are expected to be international and local at the same time, so that information and knowledge gained through international cooperation is used for local benefit. 'To outline the future scenarios for higher education, experts in Estonian education were asked to rank the main factors that will determine the future face of the Estonian higher education sector, based on the results of the Development Monitoring Centre's Higher Education Monitor. The role of digital technologies in learning and the role of higher education institutions in lifelong learning emerged as the two most important factors. When thinking about the role of higher education in lifelong learning, two opposing paths can be identified. One option is for higher education institutions to respond quickly and widely to the increasingly rapid pace of skills obsolescence by offering flexible opportunities for continuing education and retraining.

The state can facilitate this by providing higher education institutions with advantages in the continuing education market, as it understands that a large market share of higher education institutions improves the quality of education. Another scenario is also possible, when the market for educational services becomes

significantly diversified as the need for further training grows, and numerous companies providing educational services and educational technologies emerge. The importance of an academic degree in demonstrating knowledge and skills is decreasing. The role of digital technologies in education is also manifesting itself in many ways. With the support of the development of artificial intelligence, the role of the teaching staff in the educational process is changing significantly, and learning is becoming individualised in both content and form. The changes can also be much more modest – learning is more web-based, but digital solutions primarily fulfil the tasks of a learning platform. The role of teachers is changing, but will not be greatly diminished compared to today. Combining these paths of development, three scenarios can be presented.

I. In the national lifelong learning scenario, the state grants higher education institutions advantages to participate in the lifelong learning market, such as the exclusive right to offer micro-degrees. Universities strive to keep up with career expectations and offer flexible learning opportunities – the aim is to make it easier for working students to obtain an education. Micro-degrees can be combined into an academic degree, and this is constantly contributing to the so-called higher education degrees. Edtech companies are growing rapidly, but non-academic certificates remain important only in limited areas, primarily in the technology sector. On the one hand, state funding for higher education is increasing, and on the other hand, tuition fees and paid professional development bring significant additional revenues to the budget of higher education institutions, which allows them to employ staff. Teaching is much more digital, but the workload on teachers is not reduced, as providing feedback, leading seminars and group work takes a lot of time. A virtual assistant cannot yet perform these tasks well, and students also expect the surrounding academic atmosphere to be consistent with studying in a higher education institution. Universities are growing in both students and faculty.

II. In the elite higher education scenario, lifelong learning is purely market-driven and no preference is given to higher education institutions. New entrants to the market, especially education technology companies, are responding flexibly and often offer more

value than higher education institutions. Non-academic certificates are also gaining importance outside the tech sector. Some employers are pleased that there has been a surge in precision training, i.e. providing specific skills when they are needed, rather than offering everyone the same broad range of skills that may be needed at a given time. Other people complain that in the past, young people were more well-rounded, had a broader outlook and a more innovative way of thinking. Universities remain for a select few, and in many areas, their role is being fulfilled by educational technology companies, vocational schools and other providers of more practical education (Voronkova, Valentyna, Nikitenko, Vitalina, Oleksenko, Roman, Andriukaitiene, Regina, Kharchenko, Julia & Kliuienko, Eduard, 2023).

In Scenario III of the virtual university, learning is digitised in both content and form. Students are comparing learning experiences not only in the education sector, but much more broadly – when Amazon, Netflix and Uber offer personalised services, the same expectations are created for higher education. Technology solutions are not just a means of learning, but an integral part of learning, from the technology used in the virtual classroom, to testing and assessment, to admissions and certification, to career planning. Machine learning and artificial intelligence applications provide a personalised learning experience. They provide cost savings while still offering a personalised approach. Everyone can learn at their own pace, and gamification helps to capture learners' attention – at least temporarily (Vergara-Romero, A., 2023).

Digital education is much more global than it is now. Along with internationalisation, the market power of global tech giants is growing, with platforms run by Google and Microsoft dominating the market. In the global market, higher education institutions are finding their niche by offering subject-specific courses on digital platforms, but profitability is limited by the rules of the platform. Higher education institutions are not particularly involved in the growing market for lifelong learning. Public funding for higher education remains at the current level, as it is considered necessary to provide only the necessary and harder-to-digitise education, while market forces are at work in other areas. Digitalisation can save human labour by automating some learning processes, but budgets are limited

and the ivory tower comparison is no longer used when it comes to higher education institutions. The trends faced by higher education institutions and higher education have been described previously in the academic literature and industry reports. The higher education system should not only adapt to these changes, but also actively prepare for them. If traditional higher education institutions are too slow, they may find themselves in a situation where other companies will start to compete successfully with them, both internally and externally, both at home and abroad. The role of digital technologies in learning and the role of higher education institutions in lifelong learning have emerged as the two factors that are shaping the face of higher education in Estonia. In both cases, the paths of development also depend on country choices, for example, whether higher education institutions are given an advantage in the lifelong learning market through regulation. Some of it also depends on other country choices. In the last year, the prospects for financing higher education have rightly received a lot of attention.

Although education is generally generously funded against the background of Estonian social spending, public spending on primary, elementary and secondary education precedes higher education, and private funds are also scarce in the higher education system. In addition to how money flows to higher education, student financing is equally important, i.e. how to ensure access to higher education regardless of income (of parents). Ten years of unchanged need-based student scholarships and low maximum student loan amounts mean that students without family support struggle to cover living expenses. Two-thirds of Estonian students work alongside their studies, and the lack of family support (and studying in another city) correlates with the intensity of work. Since free education is currently only for full-time students, they try to stay in full-time education at all costs.

1.6 The Spanish Model of Online Education During the Epidemic

Due to the new corona epidemic, face-to-face university studies have been completely suspended in most countries and regions of the world, including Spain, leading to major changes in Spanish education. Without a doubt, the COVID-19 pandemic has had a devastating impact on all social, economic and cultural spheres, changing people's lifestyles, especially the gradual shift from offline to online education. Students from approximately 191 countries have been affected, representing 91 % of the total number of students worldwide. This is undoubtedly a huge global challenge for the education sector. As a result, face-to-face university education has been suspended in most countries, including Spain, leading to dramatic changes in Spanish education. In response to the emerging coronavirus epidemic, the Spanish government decided to declare a state of alert around mid-March 2020 and required the immediate closure of schools. At the same time, teachers and students must implement online teaching and learning.

While the digitisation of Spanish higher education has been steadily increasing, the sudden global outbreak of the new crown epidemic has led to an unprecedented situation in education, meaning schools are forced to make radical changes to their educational models to continue to provide education It has become the model for online teaching, even though some teachers did not even have some of the tools, training and materials needed for distance learning. The digital divide in Spain has reduced students' communication skills. More than two years after the outbreak of the novel coronavirus epidemic, online education in Spain has become an important way of learning in Spain. Major platforms and social foundations have published various educational reports, highlighting that the novel coronavirus epidemic has deepened the gap between students from different socioeconomic backgrounds. Given the existing differences between them, the remote model is absolutely unable to fulfil the social function of the school classroom. NGOs such as the Rescue Society and the Cotec Foundation have published the Covid-19 Education Report, which outlines a number of initiatives and recommendations for returning

to the classroom for the 2020/2021 school year, as well as an initial look at the impact of education measures related to the student health crisis. The introduction of online education, the existing digital divide, the closed administration and the economic crisis resulting from the new crown epidemic have widened the education gap and caused serious damage to students' physical and mental health, due to the suddenness of the new crown epidemic and the lack of time to prepare. It threatens both the quality of education and the equity that education systems in Western countries work so hard to achieve. The implementation of new models differs significantly between private and public education systems. In addition, some educational institutions and families do not take online education seriously and may not even be able to provide students with an appropriate learning environment. Adapting to online education requires pedagogical adjustments and constant updating of electronic technologies. Although it was the only option at the time, it did not include all the features and capabilities available in face-to-face education.

Furthermore, despite the Spanish government's efforts to provide universities with materials and technical resources, not all students have access to computers and Internet connections. Aid's report highlights that Spain's education system has been unfairly disadvantaged by the Covid-19 pandemic. Many of the impacts of the health crisis will be exacerbated for education centres and students who are already facing difficulties related to the education system. The Aid Society report also discusses the impact of the COVID-19 crisis on educational equality. Spain closed schools in mid-March, meaning students had to study online for the rest of the school year. The school lockdown lasted until the summer holidays, meaning that most students experienced almost 6 months of online learning without face-to-face interaction with teachers and classmates. Online learning also reduces the amount of formal classroom time for teachers to make necessary changes. This particularly affects students who are excluded from small groups that need special attention, exacerbating educational disparities in Spain. These months of distance education in Spain will widen the gap in academic achievement between better and less socioeconomically advantaged students, and distance education has been less restrictive for those whose families have some financial means to purchase

material and technological resources. The aid describes an "engagement gap" based on how engaged families and students are in distance education. The Cotec Foundation's diagnostic analysis of the current situation in Spain shows that the transition to an online education model is complex and uneven due to its sudden nature and lack of preparation time. This threatens both the quality of education and the equality in education that education systems in Western countries are working so hard to achieve (Vengerska, N. S., Voronkova, V. G., & Bezkorovaina, L. V., 2022).

The introduction and implementation of new models of distance education differ significantly between private and public education systems. Adapting to the development of the new model requires a joint effort by all teachers and students. Prior to the outbreak of the new crown epidemic, the use of ICT in Spanish schools was generally considered to be a supplement to offline teaching. It can be said that the online learning method is a complement, not a replacement, of the offline didactic teaching method. It is a kind of added value. This style of learning is similar to the situation in EU countries. The 2019 Spanish Schools Survey 2019: Report on ICT Education in Spanish Countries (European Commission) mentions digital devices (laptops, cameras, digital whiteboards, etc.) in Spanish countries. Spain ranks highest in Europe in terms of both the number of students and the average broadband speed. There are more digital devices and suitable schools at all levels of ISCED. Students using BYOD for learning are also slightly below the EU average (except for the use of own laptops at ISCED level 2). According to the 2019 Household Equipment and ICT Use Survey (INE), 18 % of single-parent households have at least one student, and 7 % of two-parent households do not have any type of home computer device (laptops, tablets, handheld electronic devices, etc.). The report also showed that 136,486 (7.7 %) single-parent households with one or more children and 142,073 (2.2 %) households with two children did not have access to the Internet. In terms of teacher training, according to the Digital Education in European Schools 2019 Report (Eurydice Report), Spain has published the "Common Framework of Digital Competences for Teachers", which serves as a reference standard for teachers and education managers, focusing mainly

on digital education. The framework includes 21 digital competencies for teachers, divided into five areas: 1) information literacy; 2) data; 3) communication and collaboration; 4) digital content creation; and 5) safety and problem solving). It also includes six progressive levels of competence to provide a comprehensive assessment of teachers' digital competencies. Compared to Europe as a whole, the Spanish ISCED shows high confidence in teachers' digital abilities. And on an individual level, before the COVID-19 crisis put students' health at risk, Spanish society was more comfortable using the internet and ICT in everyday life than while studying at university (Voronkova, V. G., & Kyvlyuk, O. P., 2022).

After the outbreak of the new corona epidemic, teachers have to change the design, plan how to teach courses, and what improvements need to be made to adapt to teaching online courses. The main challenge is that not all teachers and students have the technical media or digital skills needed to create and use virtual classrooms. During the epidemic, students have been forced to disrupt the original teaching method and carry out online learning. The corresponding original education quality inspection method cannot adapt well to online teaching, especially when teachers cannot teach face-to-face. Under these circumstances, feedback and communication are not timely enough, the quality of education of many students has seriously declined, and student satisfaction with online education has also declined.

Another problem with online learning is the "one-size-fits-all" approach, which does not seem to take into account individual differences. Every student is unique and therefore learns differently. If a teacher or instructor uses the same teaching method, it will affect the effectiveness of the students' online learning. Therefore, teachers should use different teaching methods for different students to achieve the greatest learning effect. In online teaching, teachers cannot make timely adjustments to the learning content because they cannot immediately see the reactions of different students as they do in face-to-face teaching. At the same time, with online teaching, students can use the Internet to find answers to questions in many channels. Many students will be lazy and go online to get information while doing teacher assignments and tests. Such test results and tasks cannot be true. It does not accurately reflect

the current learning situation of students, and teachers cannot adjust the curriculum to match the learning situation of students. During the epidemic, Spanish students were forced to study alone, could not conduct face-to-face offline learning with teachers, and there was no communication and exchange between classmates and teachers, which increased the "anxiety" of learning. Some tests and assignments in online learning are convenient and fast because of the large number of channels for obtaining resources, but they cannot really reflect the students' learning situation. When obtaining certificates, the lack of basic knowledge of online learning also makes it difficult for students to cope with many learning "challenges", and some students cannot even obtain academic certificates (Girvan C., 2018).

During the pandemic, the Spanish government must ensure and maintain learning opportunities for all students through an effective and fair system. "The 'digital divide' defines that children from upper and middle class families have greater access to the resources and facilities needed for online learning. There is a gap in the use of and access to learning resources between children from upper-middle class families and children from lower class families, which determines the ability of educational centres and teachers to teach online. In addition, there are gaps in digital learning and teacher training for teaching, and some teachers are not even aware of the new learning software. In response to this situation, some schools are sending learning materials to students by post to ensure equity in learning. In addition, students are required to post their homework to the teacher when they do their homework. At the same time, they often use the telephone to communicate with students during learning and take special care of special students during communication. In addition, schools can get free access to resources when students use online education platforms during the epidemic. Different schools set up their own official learning platforms and learning resource libraries to meet the learning needs of students from different families.

Due to the sudden attack of the epidemic, teachers and students were unprepared and needed to switch to online education in a timely manner. The development and use of new learning platforms and educational software is a top priority for online education. Therefore, with the support of modern technology, many universities

in Spain need to find the easiest way to achieve the widest impact and compensate for the lack of online education. To ensure the continuity of academic work, Spanish universities provide teachers and students with a good learning environment by providing teachers and students with some technological resources such as virtual campuses and professional applications such as Skype, Adobe Connect and so on. By simplifying online teaching, learning ignores the diversity of students. For example, students with low reading skills may find many written courses taught online a challenge, as online learning requires students to do intensive reading and writing, which requires design. An appropriate interactive system that allows students to not only learn but also enjoy the experience.

To cope with the sudden change in the learning situation, the quality of online learning services is very important to meet the learning needs of students. Online learning should keep students motivated and minimise their frustration with this new situation. In order to increase students' satisfaction with online learning, we should first increase the interaction between students, improve students' interpersonal communication skills, gain a sense of belonging and identity, share experiences with each other, and enhance students' learning ability and learning effect; we should pay attention to the variety of assessment tests. Teachers need to use online assessments to expand the range of testing formats and increase student satisfaction with the assessment system; work on top-level design and prioritise the development of digital education.

1.7 EU Digital Education Action Plan "European Digital Literacy"

The Digital Education Action Plan (2021–2027) is a new EU initiative that helps to sustainably and efficiently transition Member States' education systems into the digital age. The Digital Education Action Plan aims to:

– create a long-term strategic vision of what high-quality, inclusive and open digital education looks like in the Europe of the future;

– addressing the digital challenges and opportunities in education that have emerged as schools have switched to distance learning as a result of the COVID-19 pandemic and the use of technology has increased in an unprecedented way;

– opening the way for cooperation at the EU level in digital education and encouraging different sectors to jointly implement education in the digital age;

– digital teaching will be developed and expanded, learning that uses digital tools and materials will be supported, and sustainable network connections, platforms and tools for flexible and participatory distance learning will be offered.

To achieve these goals, the action plan sets two priorities:

1. Developing effective digital learning ecosystems that include:

– sustainable network connections, digital devices and platforms and their interconnection;

– effective planning, development and updating of digital expertise, also at the level of organisations;

– digitally skilled and competent teachers and teaching staff;

– high-quality learning content, user-friendly tools and secure platforms that comply with data protection regulations and ethical standards.

2. Developed digital skills and competences required for digital transformation, including:

– basic digital skills and competences from childhood to old age;

– digital literacy, including the ability to identify fake news;

– training in information technology;

– a good understanding of technologies that use different data sets, such as artificial intelligence;

– digital skills beyond the basic level to train more experts in digital fields;

– encouraging girls and women to study and work in digital fields.

Why do we need measures to improve digital skills?

The digitalisation of society and the economy is always having a deeper impact on people's daily lives. However, in several countries, the digitisation of education was just beginning before the COVID-19 pandemic. The pandemic has made it clear that the education system must also meet the demands of a digitised society. The COVID-19

pandemic has shown that the digital capacity of the education sector needs to be increased. Furthermore, disadvantages and inequalities related to students' digital skills came to the fore and were exacerbated when students who were in a weaker social or skills position were excluded from learning. Furthermore, it was found that the digital capacities of learning organisers and the content of teacher training also need to be updated for the digital age, and that the level of digital skills and competence in general needs to be increased (Voronkova, Valentyna, Nikitenko, Vitalina, Bilohur, Vlada, Oleksenko, Roman, & Butchenko, Taras, 2022).

The numbers speak:

– A 2018 study by the Organisation for Economic Co-operation and Development (OECD) found that less than 40 % of teachers working in EU countries felt ready to use digital technologies in teaching (results varied across EU countries).

– More than a third of 13 to 14-year olds participating in the 2018 International Citizenship and Information Literacy Study (ICILS) lacked basic digital skills.

– A quarter of low-income households are unable to afford computers and broadband (household income affects affordability differently in different parts of the EU) (Eurostat, 2019).

The pandemic has increased online and hybrid learning, where part of the learning takes place online and part of it is face-to-face at an educational institution.

In response to this trend, new teaching and learning methods have been developed, and online learning requires flexibility and more individuality than ever before.

In this state of change, decisive coordinated action is needed at EU level to enable education systems to respond to the challenges caused by and related to the COVID-19 pandemic. In addition, a long-term vision of what digital education entails and how it can be organised in the Europe of the future needs to be created.

In her recommendations in July 2019, European Commission President Ursula von der Leyen stated that a new action plan is needed, building on the first Digital Education Action Plan (2018–2020). The revised Digital Education Action Plan is part of the Commission's European Digital Agenda and receives funding from the EU's Next

Generation Instrument. It also supports the Recovery Goals and the Recovery Support Instrument. The aim of the instrument is to create an even greener, more digital and more resilient Europe (Voronkova, Valentina, Andryukaitene, Regina, & Oleksenko, Roman, 2022).

The Digital Education Action Plan plays an important role. In July-September 2020, the Commission organised an open public consultation to gather information on how EU citizens, public and private institutions have experienced the impact of the COVID-19 pandemic on education and the transition to distance and online education. In addition, respondents were able to give their own vision of the future of digital education in Europe. The following was found:

– almost 60 % of respondents had not taken distance or online learning before the COVID-19 crisis;

– 95 % of respondents believe that the COVID-19 pandemic has brought about permanent changes in the way technology is used in education;

– according to respondents, digital tools and educational content should be modern, interactive and easy to use, and not dependent on the financial resources of the city or municipality;

– more than 60 % of respondents estimated that their own digital skills had improved during the crisis, and more than 50 % wanted to improve their skills in the future.

Activities included in the digital education action plan

The Digital Education Action Plan includes the following actions for 2021–2027:

Focus 1: Developing effective digital education ecosystems.

Step 1: Let's start a strategic dialogue with Member States on the factors that contribute to successful digital education.

Step 2: It is proposed that the Council provide a recommendation on the integration of digital learning environments and classroom learning in primary and secondary education.

Step 3: A European framework for digital education content will be developed.

Step 4: Educational institutions are supported in the acquisition of network connections and equipment.

Step 5: Educational institutions are supported in planning for digital transformation.

Step 6: Development of artificial intelligence and use of data in education.

Focus 2: Developing digital skills and competences needed for digital transformation.

Step 7: Develop guidelines for teachers and educational staff to improve digital literacy and combat disinformation.

Step 8: Update the European Digital Skills Framework to include artificial intelligence and data skills.

Step 9: Develop a European Digital Skills Certificate (EDSC).

Step 10: It is proposed that the Council make a recommendation on how to improve the delivery of digital skills training.

Step 11: Collect data on the digital skills of learners in different countries and set EU-level targets for learners' digital skills.

Step 12: Digital opportunities apprenticeships will be extended to cover those in vocational training and apprenticeships.

Step 13: Let's encourage women to work in STEM fields.

Digital Education Centre

To support the actions of the priorities, the Commission is establishing a digital education centre. The new centre aims to strengthen cooperation and information exchange on digital education in the EU.

First digital education action plan

The Digital Education Action Plan (2021–2027) builds on the first Digital Education Action Plan (2018–2020), which included the following priorities:

- increasing the use of digital technologies in learning;
- digital skills and competences are developed;
- learning is developed through better data analysis and forecasts.

The modern school is becoming digital. Competence in information and communication technologies is a civilian skill, so the digitalisation of schools is inevitable. The programme emphasises the role of teachers, as devices, technology or software are by no means the key to digitalising schools. The learning environment in schools has been updated and expanded because the modern school is becoming digital: information and communication technologies are used in all subjects and in all classes (Voronkova, V. G., & Kivlyuk, O. P., 2023).

As the world changes, so must the school. The challenge for teachers is to inspire learning so that students use technology in the right places and in the right ways. In this regard, learning organisers need to ensure that teachers have good enough skills to use digital technologies in their teaching.

Pedagogy is also number one in digitalisation.

Technology should not be an end in itself: technological tools should not be used only for tools. In the digitalisation of education, the pedagogical competence of teachers is also emphasised above all.

The tools that are used in teaching are not very important, the main thing is what skills are formed with the help of these tools.

Digitalisation is very uneven. The report shows that the digitalisation of education is very uneven across different levels of education, with the best situation in terms of students' skills in information and communication technologies, i.e. early childhood education. Digital learning does not create a single learning pathway across levels of education, although digitalisation can increase equity when all learners have equal opportunities to use technology.

Currently, the digital skills a learner acquires are entirely dependent on where they receive their pre-school education, basic education and further education. Currently, national control over digitalisation is not sufficient to ensure educational equality in this regard.

There are also large differences in teachers' ICT skills. Competence is strongest in higher education, where the use of ICT is also most widespread. A large number of teachers at all levels of education consider their ICT skills to be average or even weak at best. Existing ICT competencies are particularly focused on the technical competence of the devices used and basic software, while competencies related to the pedagogical use of ICT are much less developed (Voronkova, Valentyna, Oleksenko, Roman & Fursìn, Alexander, 2021). Effective digitalisation for the work of teachers and principals. In addition to hardware, digital purchases also include maintenance, software and training materials, as well as user training.

A national minimum level should be defined with mandatory quality criteria for digitisation. The procurement expertise of education providers should be supported by national leadership. Every teacher and school principal should have a portable personal

digital work tool provided by their employer. Technology should evolve with the job and its requirements, not the other way round. The starting point for purchasing should be the relevance and practicality of the tools in terms of pedagogy and the work being done. Purchases of workplace equipment should be consistent and based on research. The use of incomplete digital solutions should be avoided. The use of new working tools and methods should be supported, i.e. with additional education that meets the need and is provided during working hours. In continuing education, for example, the tutor-teacher model should be used The purpose of using digital work tools should be to improve the quality of work performed, simplify work and free up employees' time for core tasks. Staff should play a decisive role in choosing and developing appropriate work tools for them. The teacher should have pedagogical freedom to choose the learning material to be used, and this freedom should not be restricted even as the use of digital materials increases. Copyright should be respected and teachers need to take care of copyright. Teachers have the right to the material they have prepared themselves. All experiences should be collected from the current period of distance learning caused by the corona pandemic. On their basis, Finland should build a national digital school system with artificial intelligence support for all educational levels. The digital artificial intelligence-supported education and training system will be structured on the model of the SOTE-IT system, including various data backups, service objects, and solutions for the operating environment. The architecture of the system will use the architectural solutions and models of the SOTE-IT system.

The education and training system that will be developed consists of the learner's own knowledge and the national platform of digital content and services (MIKAEL), which are connected to the digital learning environment of the next generation digital school (AGRICOLA) and the school's student archive. The pupil connects to this through their user interface and receives help from a digital teacher. When SOTE services are connected to this education and learning environment, Finland will be the first country in the world to build a digital SOTE and school system (Drozich, I., Drobin, A., Skrypka, I., Mamchych, O., Mykhailenko, O., & Kurach, M., 2023).

In the presented concept, the Centre for Educational Materials ensures the quality and reliability of educational materials used by children and youth. The material is already multichannel. The e-book is only one channel, and the new system controls the acceptability and reliability of the material. The system provides an individualised learning environment supported by artificial intelligence and supports the work of the teacher. A key requirement is that the digital learning environment must have adequate information security solutions. The use of artificial intelligence has obvious benefits for both students and teachers. AI-based solutions can adapt, for example, to the level of knowledge and interest of students. The system can help students in areas where they have difficulties. This way, special learning materials can be offered according to the student's needs. For example, a student takes a test before starting to use the programme; the application analyses it and suggests appropriate tasks and courses. The advantages of artificial intelligence for teachers are the ability to anticipate student learning problems, create better interaction and individual approach. The system that will be built in Finland will become an exemplary example for other countries, bringing us to the core of global development. The world's first digital SOTE and school systems to be built in Finland, as well as the corresponding service platforms and services, could become a leading product on the global market.

In the digital economy, digital capabilities are a new type of ability for personal survival and development, and they are at the centre of digital transformation. The EU is seizing the opportunities in the digital age and guiding member states to achieve digital transformation, driven by the development of digital capabilities. In 2013, the European Commission launched the Citizens' Digital Competence Framework, which believes that digital capabilities are an essential survival skill in the digital age, and are the creative use of information and communication technologies (ICTs) by citizens in the course of work, life, learning, leisure and participation in society.) knowledge, skills and attitudes and other integrated capabilities. In 2017, based on the Citizen Digital Competence Framework 1.0, the European Commission updated and released the Citizen Digital Competence Framework 2.0, which quantifies

and divides digital capabilities into 21 competences in five main areas and uses them as a teaching, assessment and certification framework. Based on the definition and classification of digital capabilities, the EU places digital capabilities in the field of education, guides countries in formulating relevant learning standards and curricula, and requires schools at all levels to offer courses such as computer science, programming and artificial intelligence. In addition, the EU is optimising its talent training system. Through the introduction of the EU Digital Competence Framework for Educators, it provides a common reference system for improving the digital competences of educators, and also facilitates the issuance of a corresponding "European Digital Competence Certificate", which indicates the level of digital competence of the holder and his/her skills. has been widely recognised in European countries (Gramchuk, Marina, & Nikitenko, Vitalina, 2023).

At present, the European Union and its member states have initially created an educational ecology that fosters the development of digital talent, taking into account the latest industrial and technological development needs, with government support, enterprise support, school-to-school connectivity, co-building, and sharing. The increasing prevalence of digital solutions in everyday life means that systemic change is needed.

The vision of inclusive(ish) digital education: encompasses all levels of the education system, from individuals (students and teachers) to organisations (schools) and to the regional or national level; considers inclusion, exclusion, digitisation and the digital divide as interrelated, self-contained cross-cutting issues; builds on education system structures to support the creation of flexible education systems that provide equal educational opportunities for all learners; and is based on a digital transition that goes beyond the introduction of digital technologies.

The key features relate to four interrelated policy areas and their role in inclusive education during the digital transition: technology; students and teachers; educational institutions; and regional and national education governance. Technologies such as artificial intelligence (AI), virtual and augmented reality can make inclusive digital education a reality in the future. Policy and practice should

seriously consider the ethical aspects of TI and other new technologies in education, especially in inclusive organisations. Policies should ensure that new technologies are used ethically and protect all students from the digital divide. Vulnerability to digital exclusion in digital education can be linked to strong manifestations related to learning in relation to (societal) systemic mechanisms. In education, both policy and practice should focus on the following aspects for students: raising students' awareness of vulnerability to digital exclusion in the education system in a digital context in general and specifically how individual and environmental conditions (e.g. digital competences, social inequalities) affect students' degree of engagement in learning and their access to digital education; in terms of individual students' access to digital education and social participation in digital education with opportunities and ensuring that they invest in digital solutions for developmental learning (Voronkova, Valentina, Nikitenko, Vitalina, Metelenko, Natalya, 2022).

Conclusions to Chapter 1

In summary, it should be noted that the European Union and its Member States have created an educational ecology that fosters the development of digital talent, taking into account the latest industrial and technological development needs, with government support, enterprise support, school-to-school connectivity, co-building and sharing. The European Commission, under the leadership of Ursula von der Leyen, will coordinate with member state governments to continue to strengthen leadership and increase financial support. In the Sustainable Growth Strategy, published in 2021, the digitalisation of education will be included in the European Union. It is one of the seven main investment areas for recovery and growth, investing more than €249 million in educational digital equipment, teacher training, development of digital skills courses and other areas. At the same time, the EU fully takes into account the different interests and demands of the digital transformation of Member States, builds a multilateral cooperation mechanism, realises resource integration and added value, and jointly develops

digital talent. In 2021, the European Union announced the official launch of the Digital Education Hub, which aims to create a platform for information exchange and cooperation that encompasses member states around four objectives: "connect, oversee, collaborate and innovate". Specific work includes coordinating the development and implementation of digital education policies, overseeing the development and completion of Member States' progress, building a quality assurance mechanism for digital education, and formulating common standards for digital education.

Based on the needs of industries, sectors and businesses, the EU promotes cooperation and integration between industry, academia and research, and fosters the development of digital talent. In December 2016, the European Union launched the Digital Skills and Employment Alliance. Within the alliance, the "European Software Skills Alliance" and the "European Artificial Intelligence Alliance" were established according to different areas of the digital economy, and the structure includes member state education departments, digital enterprise associations, college principals' associations, educational institutions, and European investment A digital education framework for various stakeholders, including foundations, to provide students with relevant digital skills training certificates and employment opportunities. The European Union focuses on promoting the digital transformation of the entire education process, teaching students according to their abilities in line with the characteristics of different stages of individual development, and cultivating digital talent throughout.

At the basic education stage, the EU attaches great importance to strengthening basic digital literacy. As required by the EU Strategy 2020, 21 member states, including Ireland, Germany, Belgium, Portugal and Poland, have made computer programming a compulsory course in primary school, and more than half of EU countries have adopted computer science, IT and other courses as compulsory courses in secondary school. Among them, in 2016, the German Federal Minister of Education and Research Johanna Wanka announced the implementation of the strategy "Educational Offensive for the Digital Knowledge Society" to promote cooperation between 850 German secondary schools and vocational schools and digital

companies and industry associations Provide specialised courses in computer programming, safe Internet use and data protection, detection and prevention of cyberbullying, and teach students to use digital knowledge critically, independently and creatively.

In the field of general higher education, the EU is actively promoting digital transformation by proposing the European University strategy, strengthening cooperation in digital education and enhancing the competitiveness of EU universities in the digital age. Under the European Framework for Social Rights, the EU aims to ensure that at least 60 % of adults attend training each year by 2030. However, in 2021, the proportion of adults reporting participation in education or training was 10.8 %, with the highest rates in Sweden, Finland and the Netherlands. According to a study conducted by the Organisation for Economic Co-operation and Development (OECD), the level of learning remains low in many countries due to the cost of learning, as well as the relevance and quality of learning. Across the EU, we currently spend an average of 0.1 % of GDP on adult learning, and we still expect to get a lot out of it. At the same time, traditional education needs to be adapted to the current needs of the labour market. The development of digital skills is not integrated into our education and training systems, adding that education plays a key role in ensuring that most Europeans develop digital competences.

The European Union believes that the transformation and development of digital education in Europe requires deeper cooperation between EU Member States, regional commissions and local authorities, as well as enhanced inter-agency and inter-policy coordination. In view of the global digital divide revealed by the COVID-19 pandemic, the EU is actively involved in the global digital education governance network.

CHAPTER 2
CONCEPTUAL DIMENSIONS OF DIGITAL EDUCATION TRANSFORMATION IN THE ERA OF THE FOURTH INDUSTRIAL REVOLUTION AND GLOBALISATION

2.1 Development of Digital Technologies as a Global Trend of the Fourth Industrial Revolution

The digital society is undergoing systemic and profound changes that affect all spheres of life and serve as the driving forces that generate new megatrends in the digitalised society caused by a profound transformation – points of fundamental technological breakthroughs and their social impact. The Fourth Industrial Revolution provides people with the value of a longer, healthier and more active life thanks to digitalisation as the most important value for long-term growth and higher living standards. The Fourth Industrial Revolution has the potential to boost economic growth and mitigate global challenges.

Despite the positive impact of digital technologies on economic growth, it is equally important to consider their possible negative effects on the labour market. The spread of technological unemployment is outstripping the pace at which we are finding new applications for it, and the new technology revolution is causing deeper social upheaval than previous industrial revolutions. The new digital technologies are fundamentally changing the nature of work in all industries and professions, as technological change is fundamental. According to Klaus Schwabs, "the impact of the fourth industrial revolution on the economy is perceived as an inevitable stage from a simple transition to digital technologies (a feature of the third industrial revolution) to a much more complex form of innovative solutions based on the combination of numerous technologies in new ways" (Voronkova Valentyna, Vasylchuk Gennadii, Kaganov Yurii, Nikitenko Vitalina, & Metelenko Nataliia, 2023).

New digital technologies have created revolutionary new ways of combining products and services and blurred traditional boundaries between industries. The interconnectedness of the physical, digital and biological worlds, as the central idea of the fourth industrial revolution, offers the world the possibility of huge digital transformations in resource use and productivity. Digital development knows no borders, which inevitably raises the question of the impact of technology on geography – and vice versa. Digital technologies are affecting the markets of emerging economies, and these opportunities should be seized by countries to develop a digitalised society. According to the analysis, no country will be able to prosper if the innovative ecosystems of cities are not constantly nourished. Therefore, in 10 to 20 years, the infrastructure of smart cities will be driven by digital technologies – artificial intelligence, self-driving cars, augmented reality, genetically modified food, new and more efficient energy sources, smart materials, countless gadgets and devices connected to each other and capable of exchanging information. Moreover, many digital technologies are interconnected and push each other forward. Virtual Reality (VR) uses computers to create simulated environments of real and imaginary worlds to which we can add our physical presence and feelings. However complex and multi-layered these virtual spaces are today, in the near future, hardware

and software will improve, and a platform like Hilt Fidelity's will provide us with the next generation of virtual worlds – potentially as large and complex as the real world today. The line between human and machine, online and offline worlds is becoming increasingly blurred. Augmented Reality (AR) provides a direct view of the physical environment through a computer screen or mobile phone and overlays it with additional digital information such as images, sound, video, or GPS data in real time. In particular, manufacturers of prestigious cars such as Mercedes-Benz or Range Rover project data on the speed and direction of the car directly onto the windscreen. Unlike virtual reality, which can create a completely fictional world, augmented reality enhances the perception of reality by placing useful data on top of the image of things we see around us. Augmented reality (AR) can be used on any device with built-in sensors and cameras – a mobile phone, tablet, glasses, or even contact lenses. It is expected that 2.5 billion VR apps will be downloaded and installed on our gadgets in the coming years. The benefits of its use are truly impressive and the most powerful companies are already showing us these opportunities. The development of digital technologies in a digitalised society is linked to robotics. Robots are increasingly being equipped with additional functions such as high-quality video cameras, touch sensors and laser rangefinders, which are connected and controlled by computers. The huge shifts in robotics are largely driven by the "smartphone revolution", as robots are largely dependent on computer chips, batteries and sensors like those found in a powerful mobile phone.

The digital values of a digitalised society in the Fourth Industrial Revolution are developing in an era of convergence, a time when bits from the digital realm merge with the atoms of the physical world. The digital values of the digital society of the Fourth Industrial Revolution must be developed in the context of a true science of sustainable development – perhaps the most important task of the 21st century, without which nothing else will matter. Information technology and digital change bring "revolutionary change" or even "destruction", but the emergence of the digital world is just one manifestation of the trend towards interdependence, where many different things interact and influence each other: trade, travel, censorship, privacy, and much more. The digital technologies of a digitalised society can change false stereotypes and prejudices

and deepen inequalities. Instead of old identity markers based on class, ethnicity, and political opposition, new ones are emerging based on the urban/rural or educated/uneducated divide. If we can take full control of digital technologies and clearly identify their potential consequences and adapt to these consequences, the outcome of their implementation will be quite optimistic. Finding the right path through these complex and confusing factors and building a digital society will ensure the stability and well-being of all humanity, which may be one of the greatest challenges of our time. The development of digital technologies as a global trend of the fourth industrial revolution is a new, undeveloped innovative discipline based on the philosophical foundations of digital technologies (information and computer), which are developing on the verge of sciences – philosophy, computer science, software, high (convergent) technologies, which means the impact of innovative and information technologies on digital development, the development of the Internet economy in the context of the formation of a new digital culture (Voronkova V. G., & Kyvliuk O. P., 2022).

The Internet economy as a global trend in the development of the digital society and globalisation will lead to changes that will contribute to endless transformations in all corners of the globe. The digital technologies of the digitalised society will change all management processes, cryptocurrencies, blockchain, fintech, and megatrends of the Digital Age will appear, changing the outlines of our planet at an incredible speed. Old management processes will be replaced by automation, robotics, and new business process capabilities. Everyone must adapt to the speed of digital change – business leaders, companies and organisations, government officials, and ordinary people. The speed of change means that production is beginning to depend not on tangible assets but on digital technologies, which are intangible assets based on the intellectual component, organisational and human capital. The development of digital technologies as a global trend of the Fourth Industrial Revolution will contribute to the development of sharp, large-scale and irreversible changes, which scientists call “disruptive”, leading to quantum computing. A “disruptive” technology is a technology that displaces established production methods and fundamentally

changes the market, as a breakthrough product creates a new industry. Disruption has already taken place in many areas. For example, quantum computers will allow us to solve problems that we cannot even begin to solve yet – a whole class of problems that would take billions of years for the fastest computers to solve. "We should hope that quantum computers will open up completely new possibilities and change our lives in unexpected ways" [2]. The computing power of conventional computers is steadily increasing every thirty years and doubling about every year and a half. This pattern is called Moore's Law. Progress is being made by miniaturising the transistors that make up the computer process. The picture seems encouraging, but some problems are so complex that even the best computers will take a long time to calculate the correct answer. What are these tasks? For example, forecasting the weather, calculating the most profitable stock investments, calculating the fastest route for a courier with several deliveries, a quantum computer can give you the answer right away. There are many examples of a quantum computer demonstrating superiority over a classical computer, performing many calculations simultaneously, and most of the fundamental obstacles to a quantum computer have been successfully overcome. This technology opens up new opportunities for humanity and proves that the world will change radically in the era of globalisation (Drozich, I., Drobin, A., Skrypka, I., Mamchych, O., Mykhailenko, O., & Kurach, M., 2023).

The development of digital technologies as a global trend of the Fourth Industrial Revolution is related to the fact that we live in the age of "big data". Our phones, various smart devices, sensors, Internet of Things – all of them collect and transmit data. Big data is being used to improve the marketing of goods and services, predict earthquakes, and combined with machine learning (algorithms that make predictions based on data), it is relevant to all areas of the industrial sector, helping to optimise processes and use electricity more efficiently. The last piece of this "digital mosaic" is the emergence of new secure ways to conduct decentralised peer-to-peer transactions. Blockchain technology, which underpins virtual currencies such as bitcoin, is a kind of distributed ledger that records all transactions of participants. Blockchain and similar technologies allow two or more parties to conduct secure financial transactions without the need for

bank intermediation. In the energy sector, this will make it possible to sell electricity generated by solar panels directly to a neighbour without any intermediaries. Studies show that millennials cannot imagine their lives without mobile technology and are much more interested in distributed energy technologies such as solar panels than previous generations, which means they will welcome disruptive energy technologies (European Commission, 2019). Artificial intelligence is already operating in many areas. In the next decade or two, such devices will define our lives and make wealthy industrialised societies dependent on them, all thanks to machine learning based on big data: computers will draw conclusions about trends and patterns in human behaviour from huge amounts of information. This technology is called "deep learning" and has been known in theory for more than a quarter of a century, but it has not been implemented in practice because computers are not yet powerful enough. Recently, however, the computing power of computers and memory capacity have increased to the point where modern machines capable of performing a million billion operations per second can process giant databases with billions of items. At the same time, it is important to identify intertextuality as a systemic textual and discursive category [3]. The development of digital technologies means that in the future, all societies are doomed to use the services of the digital society to some extent in the context of the Internet economy, which is a global trend that will contribute to the creation of wealth in the digital age. Digital society Internet companies are a new form of doing digital business, with the help of the Internet, over the Internet and on the Internet. Without government support, the digital economy cannot be innovative and developed, and today it includes all spheres of society: from demography, the biosphere and climate change to the future of medicine, genomics and genetic engineering, synthetic biology and transhumanism; from cloud technologies and the Internet of Things to artificial intelligence, quantum computing to smart materials, energy, transport, robotics; from interstellar wars and colonisation of the solar system to teleportation and time travel, which in general contributes to the development of the digital economy as a component of the digital economy [4]. However, in order to achieve high standards of the digital economy, technology transfer must be developed. Some

authors warn us that if we do not take action now, the forces of nature or human activity can radically change our planet. In addition to the scientific and engineering dimensions, global problems also have financial, geopolitical and cultural dimensions. Therefore, there is no doubt that we should pay attention to the development of new digital technologies, such as artificial intelligence, robotics, genetic engineering, and nanotechnology, which will help the digital world, digital values, and digital culture to evolve. Thus, to develop digital technologies as a global trend of the Fourth Industrial Revolution, it is necessary to: 1) to create conditions for the formation of a digital society developing in the era of the fourth industrial revolution; 2) to promote the development of digital technologies as a global trend of the fourth industrial revolution, which is formed within a single global information space that unites all of humanity into an information community of people; 3) to pay attention to the development of new technologies (convergent, high), in particular artificial intelligence, robotics, genetic engineering, nanotechnology, which will make the world incomparably different (Dionisio, J. D. N., Burns, W. G., & Richard, G., 2013). Benefits of the Fourth Industrial Revolution. The Fourth Industrial Revolution entails changes in the organisation of business, especially in production processes, as well as in society as a whole. These changes are leading to increased productivity and process automation as internal decisions are data-driven, optimising the entire process from production to delivery to the customer. Companies have more information to explore new business models, improve conditions for workers by reducing jobs in hazardous environments, and are able to develop customised products to meet demand and environmental goals without compromising other business objectives. As for the negative impacts of Industry 4.0, critics point to the possible loss of jobs, especially due to robotisation, where machines take over work previously performed by humans. However, with the emergence of these many new technologies and the emergence of new emerging sectors, many new professions are also emerging. Industry 4.0 is here, like the previous ones, to facilitate our industrial processes, to create a transformation of supply and demand, so it is necessary to keep up, because those who lag behind will not have a place in the new market. Industry 4.0 is considered a top strategic

priority. Seventy per cent said their companies are already piloting or implementing new technologies. The Fourth Industrial Revolution builds on the inventions of the Third Industrial Revolution or Digital Revolution, which unfolded from the 1950s to the early 2000s and brought us computers, other types of electronics, the Internet and much more. Industry 4.0 takes these inventions beyond the previous realm of possibilities through four main types of disruptive technologies that can be applied across the entire value chain: 1) connectivity, data and computing power: cloud, internet, blockchain, sensors; 2) analytics and intelligence: advanced analytics, machine learning, artificial intelligence; 3) human-machine interaction: virtual reality (VR) and augmented reality (AR), robotics and automation, autonomous driving vehicles; 4) advanced technology: additive manufacturing (3-D printing), renewable energy, nanoparticles. However, technology is only half of the Industry 4.0 equation and to thrive in the Fourth Industrial Revolution, companies must ensure that their employees are properly equipped through upskilling and retraining (Hrynevych, L. M., Morse, N. V., & Boyko, M. A., 2020). End-to-end skills transformation has three phases: 1) analysing the skills required to achieve the company's ambitions; 2) identifying the talent gaps that need to be addressed and developing the software infrastructure to address them; 3) developing and implementing content and delivery mechanisms to train employees at scale. It's about making sure all employees are ready for this future, keeping them focused, actively engaged, re-skilling them, and getting them excited about what the future holds. Digital factories serve as "construction sites" for companies to introduce 4IR technologies and test new operations before applying the advances at scale.

2.2 Artificial Intelligence as a Driver of the Digital Transformation of Education

Against the backdrop of the Fourth Industrial Revolution, artificial intelligence is an important variable for future social development, and its impact on the future demand for talent will be the most intuitive and far-reaching; Talent cultivation will affect the future society. Artificial intelligence works through deep learning of machines,

and this learning process is about identifying and memorizing a large amount of existing knowledge. This is a challenge for our current education system, which focuses on knowledge transfer. Of course, while artificial intelligence brings convenience to the development of human society, it can also have some negative consequences. This calls for strengthening moral education and embedding the ethics of scientific and technological talents into artificial intelligence technology so that it can better meet the needs of people. human society progress. In a society equipped with artificial intelligence technology, all citizens should be able to read, understand and communicate with data, and participate in the discussion of artificial intelligence-related policies. Informatics has become a "new basic skill". This requires the integration of artificial intelligence, data science and related fields into the national education system. At the same time, the development of artificial intelligence will make many skills obsolete. If artificial intelligence is widely used in services, manufacturing, transport, healthcare, science and technology, and other areas, a large number of workers will be excluded, which will be a serious challenge for future skills education (European Commission, 2021). During the digital revolution, the nature of small economic enterprises that create knowledge and turn it into profit or contribute to social welfare activities has become more social than individual. More than 80 % of the value of the S&P 500 companies is "dark matter", i.e. intangible factors. Compared to these "intangibles", the share of tangible assets and cash flows attributable to the company is less than 20 %. Among this "dark matter", intangible experiences, including corporate culture, incentive systems and management knowledge, are a significant part of the "dark matter" that is crucial for modern businesses. To be precise, the key to a successful company in the future is to have a set of processes for collecting, processing and responding to information that contribute to the company's development and are difficult to copy. The development of artificial intelligence will transform the way we train talent. Artificial intelligence improves the quality of talent training by facilitating the digitalisation of education.

1. Improving the quality of learning in the classroom. Thanks to big data technology, teachers can accurately understand the level

of knowledge of each student; use image recognition technology to monitor student concentration in learning. Smart classrooms can provide teachers with richer teaching methods and a large number of high-quality teaching resources, full interaction, and learning-based teaching.

2. Enhancing teachers' performance. In the future, every teacher may have an AI teacher assistant to help teachers assess work, plan lessons, create curricula using knowledge graphs, and provide big data-driven decision-making and learning management suggestions.

3. Artificial intelligence technology can reduce the cost of education and provide a large number of educational and learning opportunities outside the classroom. Stanford University is planning to create an "open cycle university" to extend the duration of education and relax age restrictions.

4. Thanks to artificial intelligence technology, knowledge can be transformed into intelligent products for promotion and placed in many scenes of daily life; experimental simulations of scenes can be carried out to strengthen the integration of production, learning, research and application. Artificial intelligence has a profound impact on the social structure, scientific and technological innovation, and scientific and technological talents (Nikitenko, V. O., Voronkova, V. G., & Oleksenko, R. I., 2023).

By the middle of the 21st century, scientific and technological power will have a number of characteristics: science and technology will become more prominent as the main supporting force for national prosperity, and the demand for scientific and technological talent will be greater. Artificial intelligence and machine learning enable manufacturing companies to use vast amounts of information from production floors, business units, and even from partners and third parties. Artificial intelligence and machine learning can provide insights that provide visibility, predictability, and automation of operations and business processes. For example, industrial machines are prone to breakdowns during production. Harnessing the data collected from these assets can help companies perform predictive maintenance based on machine learning algorithms, increasing uptime and improving efficiency. Artificial intelligence (AI) and machine learning refer to the ability of machines to learn and

act intelligently, meaning they can make decisions, perform tasks, and even predict future outcomes based on what they learn from data. Artificial intelligence will change our world and our way of life. Artificial intelligence is already present in our daily lives, from Google searches to Amazon product recommendations, personalised recommendations on Netflix and Spotify, and in the process of securing credit card fraud. Artificial intelligence and machine learning are fundamental to the development of other technology trends. AI enables machines to perform a variety of human tasks, such as seeing (facial recognition), writing (chatbots), and talking (Alexa). As machines become more capable of acting intelligently, artificial intelligence will penetrate all aspects of our lives. For most people, the terms AI (artificial intelligence), ML (machine learning), and DL (deep learning) are interchangeable. Let's provide specific definitions. Artificial intelligence (AI) is a general term in the field of computer science and management that aims to teach machines to imitate human cognition with a focus on complex problem solving. A truly strong AI should be able to do everything a human can do and even more. This is the core essence of this technology. Machine learning is a subset of AI that focuses on how to make machines learn to analyse huge amounts of data on their own, without coded instructions, and apply their knowledge. Deep learning is a subset of machine learning (ML). This technology tries to mimic the activity of neurons in our brain. This complex is known as a neural network (ANN). ANN systems really do learn in the literal sense of the word. The basic idea that computer software cannot replicate a large array of brain neurons in an artificial "neural network" emerged decades ago, but until 2010 it was unfeasible. In 2012, Microsoft's director of research, Rick Rashid, impressed the audience at a lecture in China by demonstrating speech recognition software using deep learning [1]. The software transcribed his speech into text in English with few errors (the error rate was only 7 %), then translated it into Chinese and imitated Rashid's voice so that it seemed as if he was speaking. That's the power of artificial neural networks (ANNs), and by the second half of the decade, these technologies had become very real, and in a few years they would be commonplace. When we encounter certain stimuli (such

as an image, sound, or touch), chemical signals are sent to our brains and some neurons are fired. The functioning of these neurons depends on a minimum threshold. That is, if the signal coming to the neuron is strong enough, the neuron will fire (activate), and if the signal is weak enough, the neuron will not fire. It's like an "on/off" switch). Yes, it is similar to the work of transistors and the binary language of computers (Voronkova, V. & Kivlyuk, O., 2023). In addition, our brains can change and alter the connections between neurons: some can be changed, others can be deleted. When we learn something, the connections between neurons change. The artificial neuron uses this idea to reproduce a simplified process. The nucleus is replaced by a node (it is a mathematical function that determines when to activate). Dendrites are replaced with an input (input data). Synapse is changed to a weighting function that determines the probability of activating an artificial neuron with a value from 0 to 1. An axon is replaced by an output (the data that constitutes the response). The 86 billion neurons in our brain are arranged in a complex three-dimensional structure that provides an almost limitless set of connections. A complex neural network consists of layers, including input, output, and hidden layers. It is in the hidden layers that learning takes place. To appreciate how these systems learn, let's take a closer look at our ability to distinguish between similar things. It was already early in 1957 when psychologist Frank Rosenblatt developed what he called a "perceptron", a digital neural network that mimicked several neurons in the brain. The flood of research and general interest in artificial neural networks (ANNs) changed the world. Image recognition has now become commonplace (e.g., disease detection in medical imaging). Everyone now understands how powerful machine learning is. Artificial intelligence is a key part of the government's "Made in China 2025" plan, which aims to make the country a global leader in high-tech industries, including robotics, by 2025. In addition, it has been found that deep learning of ANNs takes 10,000 times less time than that of radiology [2].

Thus, artificial intelligence is gradually taking over the world, and in the future it will become more powerful than the president of a large country. Indeed, huge superbrains have already been

created that learn on their own, acquire knowledge and are able to make more accurate decisions than any experts. Fat intelligence is better at detecting payment fraud, predicting crime and weather, and more effective at predicting that oil platforms are about to explode. Artificial intelligence will be able to manipulate markets and develop weapons that people do not even understand, combining human brain biometrics, intelligence and robotics into a single whole. According to forecasts, by 2025, 5G coverage will reach between 14 and 65 %, and this will require a completely new infrastructure. Today, cybercrime has been called a potentially more dangerous factor than terrorism. As machines penetrate every aspect of our lives and work, hacking and cybercrime are inevitably becoming an increasingly pressing issue. As the networks of connected devices become more complex, so does the detection of vulnerabilities. Here are some examples of industries where the use of artificial intelligence is growing and becoming potentially productive: 1) intelligent music; 2) intelligent marketing; 3) intelligent construction (building of living forms); 4) intelligent ethics; 5) intelligent toys; 6) intelligent sports. Artificial intelligence has become an integral part of our everyday life, and today it can perform various tasks – play chess, drive a car, treat patients, even "work in the Verkhovna Rada" (Voronkova, V. G., & Kivlyuk, O. P., 2023).

Artificial intelligence and medical big data deep learning can: 1) efficiently obtain more accurate data on diseases; 2) facilitate the combination of artificial intelligence and gene editing, which should develop new treatment solutions and solve some problems in the modern field of medicine; 3) the combination of artificial intelligence and medical imaging can help diagnose diseases and reduce the likelihood of missed diagnosis and misdiagnosis; 4) the combination of artificial intelligence in research and development of new drugs can reduce drug development time, reduce costs and increase the efficiency of research and development. The concept of "artificial intelligence" has gradually become mainstream in data processing, knowledge extraction and discovery using machine learning techniques such as text and images. Big data analysis follows three main principles: 1) the use of intelligent algorithms to discover knowledge from it and

to support decision-making; 2) the principle of machine learning is to create a mathematical model using a training set, test the optimal mathematical model using a test set, and apply it to evaluate new data; 3) data mining intelligent discovery to obtain approximate knowledge through data mining, identify knowledge and generate it.

2.3 Smart Manufacturing as the Dominant Sector of the Fourth Industrial Revolution

The concept of Industry 4.0 is the fourth industrial revolution dominated by intelligent manufacturing, or a revolutionary method of production. The strategy aims to transform the manufacturing industry into an intelligent one by fully utilising a combination of information and communication technologies and a virtual cyberspace system:

The first is "Smart Factory", which focuses on the research of intelligent manufacturing systems and processes, and the realisation of networked distributed manufacturing facilities; The new generation of information technology is developing rapidly, and great breakthroughs have been made in computer chip processing technology, data storage technology, network communication technology, analytical computing technology and quantum computing; new technologies such as artificial intelligence, big data, cloud computing, Internet of Things, mobile Internet and 3D virtual reality

The second is "intelligent manufacturing", which basically involves managing the production and logistics of the entire enterprise, human-computer interaction and the use of 3D technologies in industrial production. The plan will pay special attention to attracting the participation of small and medium-sized enterprises, and will try to make small and medium-sized enterprises become users and beneficiaries of the new generation of intelligent manufacturing technologies, as well as become creators and suppliers of advanced industrial technologies. manufacturing technology;

Third, it is "smart logistics", which integrates logistics resources mainly through the Internet, the Internet of Things and logistics networks, and takes full advantage of the efficiency of existing logistics

resource providers, while the demand side can quickly obtain relevant services and logistics. The name Industry 4.0 refers to the fourth industrial revolution in human history. The first industrial revolution was the mechanisation of factories using water power and steam engines from the 1860s to the mid-19th century; the second industrial revolution was the widespread use of electricity from the second half of the 19th century to the early 20th century; the third industrial revolution was the automation of production processes based on programmable logic controllers (PLCs), which emerged in the second half of the 20th century. Industry 4.0 is positioned as a technological innovation comparable to these industrial revolutions. Industry 4.0 is about moving from diseconomies of scale to economies of scope by automating the flow of data and creating a heterogeneous and customised industry with homogeneous and large-scale costs. This is crucial for the restructuring of industry. Industry 4.0 is ushering in a new round of industrial revolution, and its main feature is interconnectivity. Internet technology reduces the information asymmetry between production and sales, and accelerates the interconnection and feedback between them. As a result, a consumer-oriented business model has emerged, and Industry 4.0 is a key enabler of this model. Industry 4.0 represents Internet + Manufacturing intelligent production, which gives rise to a large number of new business models and can truly realise the C2B2C business model. The future trend of data flow automation is understood differently by the world's leading manufacturing powers. A typical example is the "Industrial Internet" promoted by General Electric (GE), which puts more emphasis on the intelligence of the product itself (Europe 2020 strategy, 2020).

Through the implementation of the Industry 4.0 strategy Germany will become a supplier and leading market for the new generation of industrial production technologies (i.e. cyber-physical systems), enabling Germany to once again increase its global competitiveness while maintaining the development of its domestic manufacturing industry. On a social basis, Germany's perfect democratic legal system and intellectual property protection are a strong support for the healthy development of German industry, as well as a real weapon to reduce the costs of social production and increase efficiency. Industry 4.0 has a key point, i.e. "raw materials" = "information".

In particular, the raw materials purchased at the factory are "labelled": this is product XX, produced for customer A, and raw materials in process XX. To be more precise, "raw materials" containing information are used in smart factories, understanding that "raw materials (substances)" = "information", and the manufacturing industry will eventually become part of the information industry.

Business models are crucial for manufacturing. So, in the era of Industry 4.0, what is the business model of the future manufacturing industry? It is mainly about solving customer problems. Therefore, in the future, manufacturing companies will not only sell hardware, but will also add more value by providing after-sales service and other follow-up services. This is soft manufacturing. The system with the function of "informing" has become the new core of hardware products, which means that personalised demand and small batch customised production will become a trend. Entrepreneurs in the manufacturing industry should increase the added value of products in the production process as much as possible, expand more and richer services, provide better and more complete solutions, meet the individual needs of customers, and soften production + Personalised individual roads. The Sino-German Industry 4.0 Promotion Alliance Qingdao, consisting of German Industry 4.0 research institutes, China-related institutes and Chinese and German companies, has become the first Industry 4.0 alliance in China.

The Sino-German Qingdao Ecological Park is an ecological, smart and open community of interest established jointly by China and Germany, and the establishment of the Sino-German Ecological Park Alliance to promote Industry 4.0 is of great significance here. "Industry 4.0" is the improvement and modernisation of the combination of intelligence and industrialisation of enterprises against the backdrop of the big data revolution, cloud computing and the mobile Internet era. It is an important way for Chinese enterprises to improve and develop. After the establishment of the Sino-German Industry 4.0 alliance, Qingdao West Coast New District is investing 100 million yuan to implement pilot projects for some enterprises in the region and gradually realise the Industry 4.0 upgrades in the future (Nikitenko, Vitalina, Voronkova, Valentyna, Andriukaitiene, Regina, & Oleksenko, Roman, 2021).

Industrial automation is one of the important prerequisites for the start of Industry 4.0 in Germany, mainly in the fields of mechanical and electrical engineering. An "embedded system", which is currently widely used in the German and international manufacturing industry, is a special computer system developed for specific applications that completely embeds mechanical or electrical components into a controlled device. Some experts predict that the ongoing advancement of Industry 4.0 will bring a large number of orders to some German machine and electrical manufacturers, as well as many small and medium-sized enterprises. Industry 4.0 is a concept proposed by the Germans, who believe that the manufacturing industry can only create value through intelligent production in the future, meaning that production itself creates value. The United States proposed the Industrial Internet, introduced by General Electric (GE), focusing on improving production efficiency and creating a future digital industry through machine-to-machine connectivity, software and big data analytics. "Industry 4.0 is the use of intelligence to create more flexible production procedures, support manufacturing innovation and better serve customers. represents a change from the centralised manufacturing model. Intelligent manufacturing and industrial production is not a simple production process, but a connection between product and machine, and the product tells the machine what to do. Intelligent manufacturing is possible in the future. The combination of factories, products and intelligent services will be quite normal in the new manufacturing era in the world.

Industry 4.0 is a gradual process that involves many different businesses, departments and areas and is developing at different speeds. Cross-industry and cross-departmental collaboration is becoming inevitable.

2.4 Big Data as a Strategic Resource for the Digital Transformation of Education

Big data has become an important factor in education as well as in manufacturing. From the advent of Watt's steam engine in the 1860s to around 1850, along with the Industrial Revolution,

machines created the "muscle" as a system for the economy, and now the "nervous" system is tuned to it. The rapid development of a new generation of information technology has more effectively improved the ability to acquire, store and analyse data in the course of economic activity, making large amounts of information about people, things and activities digitised. New mutations of massive data are becoming more and more serious. It is obvious that data has become an important factor of production and an important nerve element of the current economic development, providing a new impetus for the new economy. In the context of the Fourth Industrial Revolution, the new round of the scientific and technological revolution is accompanied by the trend of digitalisation, and technological innovation presents characteristics of multi-subject collaboration and interdisciplinary integration. Changes in speed, scale and scope. The speed of development of the fourth industrial revolution has shown exponential growth, and the speed and breadth of the spread of the latest technologies and innovative achievements in various fields far exceed the three previous industrial revolutions. Disruption and innovation are becoming even more intense as the pace of development and diffusion is faster than ever before. The steam engine is a symbol of the first industrial revolution. It took 120 years for it to come into existence, but it took less than 10 years for the Internet to spread around the world. As networking and informatisation are the main characteristics of the fourth industrial revolution, information and data will become the most valuable resource in the future. All people and countries will have a "data addiction" and if data is in the hands of a few people, it can lead to a data dictatorship. The issue of regulating data ownership will be linked to the future of people and future lives. Electronic tools and social media can monitor people, and data privacy faces major challenges. At the same time, data can be used to measure people's thoughts, manipulate emotions, and even influence individual decisions. Governments and companies share responsibility for data security (Innovative technologies in the modern educational space, 2020).

Digital governance has unprecedented complexity. In the digital age, rules and standards need to be formulated to ensure the responsible use of artificial intelligence and to prevent data

information from being used for illegal activities. The government and businesses should jointly formulate rules to create an environment of network security and data trust. It is necessary to clarify the purpose of the technology and ensure transparency, adhere to data security rules and data use principles, and clearly define that data always belongs to users or consumers. A prerequisite for data freedom is the protection of security and privacy. Big data technology is designed to quickly extract valuable information from various types of data using new processing modes to achieve deep insights, sharp discoveries and accurate decision-making. At the moment, the big data industry has gradually matured and needs to be used in all walks of life. The development of the big data industry in my country still faces the problem of "information islands". The inter-agency and inter-industry data exchange is still not smooth, and valuable public information resources and commercial data are not open to the public, are basically at a standstill, and cannot operate smoothly. The deep integration of the new generation of information technology and various spheres of the economy and society has caused an explosive growth in data volume, making data resources an important strategic resource and a major innovation element of the country (Kivliuk, O. P., Voronkova, V. G., & Nikitenko, V. O., 2023).

Klaus Schwab, founder and executive chairman of the World Economic Forum, highlights 23 technological changes that will affect the development of the whole person in the future, including the use of big data for decision-making. Big data can predict the future. Today, informatisation has evolved from a tool for increasing efficiency to a basis and support for social development. New generation information technologies, such as cloud computing, big data and mobile internet, have overcome initial technical barriers and shaped a new model of industrial Lowering the threshold for innovation can create a fairer, more open and transparent market environment while promoting data as an important means of production. The use of big data analytics can summarise experiences, identify patterns, predict trends, aid decision-making and fully unleash and utilise the enormous potential contained in massive data resources. The development of big data will have a revolutionary impact on economic and social

development, and even on people's thinking and conceptions, and can create strategic opportunities for national development. As my country's economic development gets back on track, big data will play an increasingly important role in stabilising growth, promoting reforms, adjusting structure and improving livelihoods. It will play a fundamental, strategic and leading role in economic and social development. will also become more visible. At the same time, big data will also reconstruct the information technology system and industrial structure, and provide great opportunities for the development of the information technology industry (Kindratets O., 2019).

In fact, the competition around the development of big data will not only determine the structure of the international information industry, but also profoundly affect national security and comprehensive competitiveness. Promoting the development of big data and enhancing my country's overall strength and comprehensive competitiveness in big data technology research and development, field application, industrial development, security, legal standards and personnel training are key to promoting my country's economic growth, transformation and upgrading, as well as facilitating government management and cooperation. The concept of "big data" is closely related to everyday life. Whether it is government agencies, business operations or shop floor production, logistics and transport, large amounts of data are generated every day. When data from all walks of life accumulates to a certain scale, new technologies such as data storage, management, mining and application can help us "understand the present and predict the future". Telecommunications operators are relying on big data technology to open up new avenues for traditional businesses, such as intelligent transport, opinion analysis, precision e-commerce marketing and accurate advertising. We will get a better understanding of what is happening, the city we are in, and make predictive maintenance or improvements. The so-called big data technology is designed to rapidly extract valuable information from various types of data through new processing modes to achieve deep insights, sharp discovery and accurate decision-making. According to Accenture, the big data industry has gradually matured and is now being used in all spheres of life (Kohli R, & Melville N., 2019).

The big data industry includes three parts: hardware, software and services. From the point of view of Internet companies, which are leading the way at the forefront of big data technology, the level of big data innovation also consists of three steps. The first tier is represented by Google, which occupies the absolute leading position in big data technology; the second tier is a large number of Internet companies such as Yahoo, Facebook and Twitter; on the basis of improvements, it is closely integrated with industry-specific system applications to rapidly form commercial products that can be directly used by general enterprises. The overall development of the global big data industry is still in its infancy. However, there may be gaps in the development of different industries and regions. At present, governments are leading the development of the big data and application industry in Beijing, Shanghai, Guizhou, Guangzhou, Shaanxi and other places. These places were the first to try and actively explore and achieve initial results. For example, we support and approve Guiyang Guian big data. The establishment of industrial agglomeration zones has achieved significant results in the implementation of industrial support policies, data exchange transactions, laws and regulations, etc. In addition, thanks to the joint efforts of all parties, big data in China is developing rapidly. The scale of the industry continues to expand, breakthroughs have been made in some key technologies, and a number of backbone enterprises have emerged. Cloud computing and big data itself are also contributing to the creation of large amounts of data that provide important resources for innovation. Data is an important means of production in the future society, and transactions must exist. For this reason, Zhuoshu, a platform for big data trading, was created in China. The platform currently has 19 categories of data, has gathered nearly 8,000 transaction users, and more than 20,000 users are using the data online. In terms of using cloud computing and big data to promote business model innovation, many governments have taken the lead in demonstration and made fruitful research attempts (Kucherak, I., 2020). The Shandong provincial government has combined the credit data of 46 units to build a provincial-level public credit information system. So far, nearly 10 million data items have been collected, providing open services to government departments and third-party credit agencies, and connecting the data to Credit China.

Local governments have very rich data resources, and they also need to use big data to improve management efficiency. By opening up data to the public, strengthening cooperation with social enterprises and data processing organisations, and purchasing services from the public, we will promote the integration and comprehensive application of big data in key areas such as environmental protection, healthcare, education and transport, and improve the efficiency of public affairs and public services. Society has not yet formed an objective and scientific understanding of the laws of big data development, some people mistakenly view the construction of data centres as the centre of big data development, blindly pursue hardware investment, and underestimate the ability to collect, accumulate, process and apply data resources. Big data requires the support of the entire information industry chain, from basic chips to basic software and application analysis software. If a manufacturing enterprise can establish a big data platform in an industrial environment, it can improve the enterprise's ability to sort the massive information collected by various devices, improve the computing power and data digestion ability of the enterprise information system, and realise the enterprise's product and operational data, sales data, real-time customer data, and targeted analysis, and use them to guide the next stage of research and development, production, sales and service This is true sustainability. Simply put, big data refers to the exponential growth in the amount of data created in the digital age. Our world is more data-heavy than ever before. The more data we have, the easier it is to gain new insights and even predict what will happen in the future. By analysing large amounts of data using intelligent algorithms, you can discover previously unknown patterns and relationships. When you understand the relationships between data points, you can better predict future outcomes, make more informed decisions, and deliver value to your business. The digital economy brings various new development trends. In recent years, the digital economy has been developing at an unprecedented speed and with an unprecedented degree of impact. It is becoming a key force in reorganising global factor resources, changing the global economic structure and reshaping the global competitiveness landscape. The development of the digital economy is setting the direction of progress and giving a powerful impetus

to big data, which is opening up a new stage of informatisation and facilitating the digital economy. In the era of the digital economy, data is gradually becoming a new factor of economic and social development. Big data as a concept and a stream of thought originated in the field of computing and then gradually spread to the fields of science and business. Over the past 10 years, technologies, products, applications and standards related to big data have developed rapidly, gradually forming a big data industry structure that covers data infrastructure, data analysis, data applications, data resources, open source platforms and tools, etc. infrastructure, analysis methods and technologies, industry applications, big data management, and changes in data ecosystems. Big data provides people with new ways of thinking and new tools for understanding complex systems (Maksymeniuk M., Nikitenko V., 2016).

Theoretically speaking, digitisation of the real world on a small enough time and space scale can build a digital virtual image of the real world that carries the laws of the real world. Given sufficient computing power and efficient data analysis methods, in-depth analysis of this digital image will allow us to understand and discover the working behaviour, state and laws of real complex systems. Big data provides people with a new way of thinking and new means of exploring objective laws and transforming nature and society. This is also the most important reason why it is driving economic and social change. Big data is an inevitable product of the development of information technology. Informatisation has gone through two waves of rapid development. The first started in the 1980s with digitalisation (Informatisation 1.0), which was mainly characterised by standalone applications driven by the widespread popularisation and use of personal computers. The second time is networked creation (Informatisation 2.0), which began in the mid-1990s and was caused by the large-scale commercialisation of the Internet, the main feature of which was networked applications (Marienko, V. Y., 2022). We are now entering the stage of intelligence (informatisation 3.0), which is characterised by deep data analysis and synthesis applications. In the context of the three-component integration of “man, machine and object” with the goal of “everything should be interconnected and everything can be programmed”, digitalisation, networking and

intelligence are a new trend in integrated development. Another important sign of the opening of a new stage of informatisation is that information technology has begun to transform from an auxiliary tool that helps social and economic development to the main engine that leads to social and economic development, thereby giving rise to a new economic paradigm – the "digital economy". After decades of accumulation and storage, data resources have been collected on a large scale, laying a solid foundation for the development of the digital economy and digital education.

2.5 The Influence of Digital Education on the Formation and Development of the Digital Economy in the Highly Developed Countries of the World

The relevance of the study is that the modern world has comprehensively entered the era of the digital economy. The widespread use of digital technologies has had a profound impact on the transformation and modernisation of traditional industries and has given rise to many new industries, formats and models. Faced with the interconnected impact of significant global changes unseen in a century and the COVID-19 pandemic, countries still have shortcomings in building a digital economy, especially in data management, key technology projects and social services to ensure people's lives. After the 18th National Congress of the Communist Party of China, the digital economy has made world-famous achievements: big data, artificial intelligence, cloud computing and other new technologies have accelerated innovation and are increasingly integrated into various fields and the entire process of economic and social development.

The history of the country's digital economy and the status of China's digital economy summarise the advantages and challenges of digital economy development, ranging from open data protection, development of key technologies, training of big data talents, livelihood services, and social collection. In its documents, China puts forward proposals on how to make the digital economy bigger, better and stronger, and advocates the introduction of the concept of "digital"

into Chinese culture, the creative cultivation of a Chinese-style big data culture, the better realisation of "digital China" and the speedy creation of a world-leading digital economy (Matviienko, O., Vytrykhovska, O., Veremijenko, V., Zabiiaka, I., & Tyulpa, T., 2023)

There is no consensus on the specific definition of the digital economy at home and abroad. The digital economy is a new economic form that is based on three main elements: big data, intelligent algorithms, and computing power platforms. Data is stored, processed, analysed and knowledge is discovered, and then serves to optimise resource allocation, transform and upgrade various industries and promote high-quality economic development. Without intelligent algorithms, the digital economy cannot "create value", without computing powerful platforms, the digital economy "will no longer exist". The digital economy can be divided into two aspects: 1) "digital industrialisation"; 2) "industrial digitalisation". Digital industrialisation refers to the process of digital technologies forming an industry that provides basic technologies, products and services for overall development, such as artificial intelligence and cloud computing. Industrial digitalisation refers to the process of digital modernisation of traditional industries, mainly because the use of digital technologies has led to an increase in the number of products and production efficiency.

Big data as a component of the digital economy is a set of data from many sources, of different types, large and complex, potentially valuable, but difficult to process and analyse within the expected time. It is a new strategic resource in the digital age, an important factor that drives innovation, changes human production and lifestyles. The types of big data are very diverse, covering almost all aspects of social life, such as health, genetics, communication, weather, credit, social big data, etc. In terms of source, big data mainly includes government, corporate, and open sources. The emergence and popularisation of big data has profoundly influenced and changed all walks of life: the use of big data for scientific analysis can not only provide effective decision support, but also innovate production and people's lifestyles (Michio Kaiku, 2017).

The concept of "artificial intelligence" has gradually become the mainstream for data processing, knowledge extraction and

discovery using machine learning techniques such as text and images. Big data analysis follows three main principles: 1) the use of intelligent algorithms to discover knowledge from it and to support decision-making; 2) the principle of machine learning is to create a mathematical model through a training set, verify the optimal mathematical model through a test set, apply it to evaluate new data; 3) intelligent data mining discovery, to obtain approximate knowledge through data mining, identify knowledge and generate it.

However, the development of big data analytics still faces three major challenges: 1) to transform unstructured data such as text and images into structured data through data fusion; 2) data complexity and uncertainty, that is, to reflect the overall complexity and uncertainty of big data from different scenarios; 3) data heterogeneity and decision heterogeneity lead to decision heterogeneity to find effective decision support. Big data must seek precision and understand causality through correlations and predict the future.

Intelligent algorithms are mathematical tools for analyzing big data that are widely used in various industries. For example, the intelligent Go program AlphaGo repeatedly defeated professional players, demonstrating the super-ability of intelligent algorithms to learn. Intelligent algorithms can be conditionally divided into two categories by studying and researching patterns of groups: 1) created by logical learning; 2) created by modeling consciousness. Intelligent algorithms include statistical analysis, association rules, clustering methods, deep learning, mathematical programming.

Computing power is the computing resource for storing and analyzing big data. There are two specific forms:

1) centralized computing power, such as supercomputers and cloud computing;

2) distributed computing power such as computers and mobile phones. Computing power platforms consist of four parts: a complete machine, a chip, an operating system, and application software. Carbon emissions caused by high energy consumption must be considered when deploying computing power platforms such as new Internet data centers (Michio Kaiku, 2020).

The term “digital economy” appeared at the beginning of the 21st century, but economic activity supported by digital

technologies emerged in the 1950s, and its historical evolution roughly went through three stages: 1) from the 1950s to 2000, the "period technical training: the emergence of innovative products such as IBM personal computers and Microsoft operating systems provided the technical training for the flourishing of the digital economy, since then the beginnings of the Internet were created; 2) the "boom period" from 2000 to 2012: the rapid development of new business models such as e-commerce, search engines and social media gave birth to Internet technology giants such as Amazon, Google, Facebook and PayPal, which provide the rich resources for the digital economy; 3) the era of big data and artificial intelligence from 2012 to the present: the world accelerates digital industrialization and the development of artificial intelligence", which it raised to the national strategic level. As a result of the development of the digital economy, the three priority goals of the digital economy in each country are: 1) building a digital government; 2) development of basic means of telecommunication; 3) promotion of innovations in digital technologies.

The developed countries of Europe, the USA and China have built a powerful digital economy. Since 2019, the United States has successively issued more than 30 laws clarifying the rights and responsibilities of various actors in the digital economy and regulating their development. The General Data Protection Regulation, promulgated by the European Union in 2018, is the most stringent data protection law in history, which effectively guarantees the security of personal data in the era of the digital economy. Five companies in the United States – Facebook, Amazon, Apple (Apple), Netflix (Netflix) and Google – have technological advantages in social media, online retail, mobile communications, streaming video and search engines. The United States took the lead in creating a relatively complete system of social credit. Rating agencies provide comprehensive market advisory services for transactional and circulation relationships in the digital economy. The creation of the US social credit system not only relies on the development of digital technologies, but also further contributes to the process of digitalization of industry (O'Connor Joseph, & McDermott Ian, 2018).

In the first 10 years of the 21st century, e-commerce on the Internet and social media began to develop rapidly, and the digital economy became a key driver of high-quality economic development in advanced countries. Its main achievements can be summarized in six aspects: 1) the scale of digital industrialization, which continues to grow; 2) the pace of industrial digital transformation, which is accelerating; 3) new models and formats that are constantly growing; 4) innovation and development of the regional digital economy, focusing on the development of key areas of the digital economy, such as big data, artificial intelligence, computing and high-end chips; 5) integration and joint use of state information systems, which contributed to the creation of a national data exchange platform, which mainly implemented "network communication", "data transmission" and "business communication"; 6) digital services that improve people's lives, accelerate the process of digital transformation of life services. The emergence of online education, online offices, online stores and contactless distribution has radically changed people's basic life needs. In recent years, advanced countries have made many achievements in the digitization of industry, especially in the application of digital technologies in such sensitive industries as finance and insurance. The rapid development of the digital economy in recent years is due to the long-term accumulation and formation of various digital services. In summary, a market advantage can be identified. The huge consumer demand, which is the driving force of the digital economy, has a full range of industries, a network-based industry, and the ability to provide a full range of digital economy products with service (Altrade Dagogo, 2021).

Although the development of China's digital economy has reached a relatively advanced level, there are still shortcomings in many areas, especially many problems in key technical engineering. In general, three main points can be distinguished. The digital economy is not strong. Although the country's digital economy is growing rapidly, the rate of growth is cultivating new models and new formats. In general, the development of the digital economy mainly depends on the demographic and market dividend and the Internet. The "consumer side" is relatively mature, while the "tech side" and "innovation side" are relatively weak. Although China leads the world

in the number of supercomputers, overall computing power needs improvement. It can be noted that supercomputers can be used not only for large-scale engineering calculations, but also serve the development of the national economy and develop more innovative programs.

The key technology project is a "stumbling block" that prevents the digital economy from moving towards high quality, especially in the creation of powerful computing platforms. Whether it is a personal computer, a supercomputer, cloud computing, or other forms of computing power, it consists of four main parts: a machine, a chip, an operating system, and application software. Taking the operating system as an example, it can be divided into server, desktop, mobile and international market. OS has long held a monopoly position compared to chips, application software, etc., the international strength of the digital economy still needs to be improved. The digital economy is becoming China's new driving force to achieve the long-term goal of 2035. To this end, the country needs to use "digital" to open up more fields and industry application scenarios, create obvious advantages in the digital economy, and embark on a digital path with Chinese characteristics. to realize the goal of a national integrated data processing center, a joint innovation system, a computing power center, that is, to coordinate around the national large-scale regional development strategy, according to the energy structure, industrial location, market development, climate environment (O'Neil Keith, 2020).

It is necessary to develop the appropriate regional location of a large data processing center, national hub nodes, establish a high-speed data transmission network between nodes, support the deployment of national computing power resources, and form a national computing power concentrator system. The goal is that by the end of the "14th Five-Year Plan", the data center will form a rational location, green and intensive infrastructure integration model across the country, achieving a structural balance between east and west, ensuring that large and super-large data centers data operated with high energy efficiency. In order to make the country's digital economy stronger and more efficient, data openness and protection should continue to be strengthened based on the Data

Security Law of the People's Republic of China to further coordinate the development and use of data, privacy protection; proactively open up data and strengthen data management and oversight, accelerate the marketing of data elements, and build a market-oriented data "trinity" for government, enterprises, and society. There is a need to get the relationship between government and private enterprises right about the use of data, to direct the private economy to the right use of data in a way that is oriented towards social values, so that data can be derived from people; use them for people to better develop a safe, healthy and responsible digital economy; continue to promote vocational skills training such as big data. There is a serious talent shortage in building the digital economy, especially in building computing power platforms. According to the forecast of the China Research Institute of Electronic Information Industry Development (CCID Research Institute), by 2025 there will be a talent shortage in the data processing field of 2.3 million. In the future, we should continue to support the training of professional skills such as big data, create an effective incentive mechanism, lay a solid talent foundation for the high-quality development of the digital economy. The formation and development of the digital economy in the highly developed countries of the world requires strengthening political support for key technological projects. In response to the key technical challenges China is currently facing, relevant departments are actively deploying and implementing a number of support policies. In the future, China still needs to strengthen its independent innovation capacity, formulate careful plans and purposefully develop key technology projects: Compared with hard technologies such as microcircuits, China has more advantages and a better foundation for innovation in soft areas such as Operating Systems. The government should actively help companies related to key technology projects, open up markets, encourage leading companies to invest in key technology projects in a market-oriented way to create a smarter, more competitive business ecosystem (Nambisan, S., Zahra, S. A., & Luo, Y., 2019).

Accelerate the establishment of a public service system: After the outbreak of new coronary pneumonia in China, regional health

codes were implemented, which contributed to effective epidemic prevention and control management. However, numerous health codes have brought a lot of inconvenience to people when traveling. In order to enable the public to truly enjoy the conveniences that the digital economy brings, data barriers between government departments must be broken down as soon as possible in the future. Relevant information such as education, social security, taxation and medical care for citizens should be integrated and collected according to the law of "one card" (ID card) and "one code" (communication route code) as a basis for creating a single organizations providing information services to citizens and big data platforms for citizen services. China's digital economy cannot develop without the support and cooperation of the international community. In this regard, it is necessary to actively participate in various international organizations of the digital economy and actively participate in the formation of the rules of the international digital economy. In international organizations such as the Open Government Alliance (OGP), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Group of Twenty (G20), a more decisive influence is needed. China is now experiencing a historic moment of great change unseen in centuries, and China is closer than ever to a great revival of the Chinese nation. The future should assess the situation, use technology to innovate and develop, use technology to change lives; steadily embed "digital" into deep Chinese culture and creatively cultivate the Chinese language to create the world's leading digital economy, build a digital China. Right now, human society is rapidly entering the era of the digital economy. Disrupting many traditional industries, the digital economy has opened up new channels for high-quality economic development. The digital economy is not only the fastest growing and most dynamic new economic form in the national economy, but also represents the future direction of industrial development, which can effectively improve economic stability and risk-fighting capabilities. In a certain sense, the speed and level of development of the digital economy will directly affect the economic structure and dominance of the industrial development of the countries of the world in the future. For this reason, the world's largest developed countries and countries with

developing economies consider the development of the digital economy as one of the important strategies for increasing national competitiveness, promoting economic growth and social development, actively implementing big data, the Internet of Things, and artificial intelligence. The way to accelerate the development of the digital economy, use digitization to create new advantages in development and embrace the era of the digital economy is in the center of global attention.

The digital economy has important characteristics such as technological innovation, industrial integration, green development and information sharing. The elements of technological innovation represented by the digital economy are becoming the main driving force of the new momentum of digital development. Adaptation to legislation is an important starting point for a nation to promote high quality development. Against the background of slow growth and even recession of the world economy, digital transformation becomes necessary. In recent years, China's digital economy has been developing rapidly: in the fields of 5G communications, the Internet of Things, and artificial intelligence, many Chinese companies have achieved global innovation capabilities. The digital economy is in a period of historic opportunity for vigorous digital development. The next 5–10 years will be a period of significant development of China's digital economy, as well as a period of expanding digital capabilities in more areas and changing traditional industries. Therefore, this opportunity should be used to accelerate the development of a new impulse for the digital economy (Nikitenko Vitalina, Voronkova Valentyna, Oleksenko Roman, Andriukaitiene Regina, Holovii, Liudmyla, (2022).

In general, China has an advantage in the development of the digital economy. First, it has the obvious advantage of having a large number of network users. China is currently the world's largest manufacturing country and the world's largest online retail market for eight consecutive years. China attaches great importance to the integration and open sharing of data resources. Now and in the future, we should continue to deeply study the value of data elements, constantly strengthen relationships and actively promote data-based technology innovation and model innovation, activate

the potential of data elements to improve their support. Fourth, implement policies and regulations to strengthen supervision and create a standardized and orderly business environment. The digital economy, as a new economic form, does not have ready management experience to rely on. It is necessary to adhere to the principle of equal emphasis on development and regulation, to accelerate the formulation and improvement of the system of rules that are compatible with the development of the digital economy, that strengthen the economic supervision of Internet platforms in accordance with laws and regulations in order to effectively curb them (Nikitenko V. O., 2020a).

It should also be noted that the importance of network security has become more prominent with digital transformation and the rapid development of the digital economy. It is necessary to strengthen the protection of key information infrastructure, formulate national standards, such as rules for the security of network data processing, promote the implementation of laws on the protection of personal information, build a strong line of defense of network security, and provide an important guarantee for the development of the digital economy.

The development of the digital economy is of great importance, it is necessary to develop new opportunities for the new round of the technological revolution and industrial transformation. China must stand at the height of coordination of the overall strategy of the great rejuvenation of the Chinese nation and the great changes in the world unseen in centuries, coordinate security, provide full access to massive data and various application scenarios. The advantages that promote the deep integration of digital technology and the real economy, promote the transformation and modernization of traditional industries, give rise to new industries, new formats and new models to continue to develop China's digital economy.

The digital economy is an economic form with data as a key factor of production, a modern information network as an important medium, and the application of digital technologies as the main feature. The healthy development of the digital economy contributes to the acceleration of the transformation of old and new kinetic energy. New industries, new formats and new models generated by digital technologies have significantly enriched the connotation of national economic and social

development, expanded the scope of economic and social life, and formed a new scale based on individual needs. The digital economy not only plays a huge role in expanding domestic demand, modernizing consumption and directing production on the demand side, but also creates a wide range of efficient supply, structural optimization and high-quality development impact on the supply side. It is necessary to clearly recognize changes and new trends in the development of the digital economy, respond scientifically, identifying new opportunities for the development of the digital economy, actively seek changes in order to open new prospects for the development of the digital economy and create new advantages in the digital economy (Nikitenko V. O., 2022). The healthy development of the digital economy contributes to the construction of a new development model. An important task of building a new development model is to increase the pace of economic development. Digital technologies and the digital economy can facilitate the rapid flow of various resources, accelerate the integration of various market actors, help market actors reconstruct organizational models, overcome time and space limitations, expand industrial chains, supply chains – service chains and credit chains, capital chain, value chain.

The highly developed countries of the world should take advantage of the development of the digital economy to create the most open and optimized business environment in the world, to form the best scenarios for the application of industrial technologies. The healthy development of the digital economy contributes to the construction of a modern economic system. The digital economy has a high level of innovation, strong penetration and wide reach. High innovativeness means that the digital economy can stimulate the innovative vitality of the modern economic system, create new products and services, and form a double effect of production (Olexenko R. I., Voronkova V. G., 2020).

The digital economy can permeate all aspects of production, distribution, exchange and consumption. The deep integration of the digital economy and the real economy can continuously expand the opportunities and expand the space for the growth of the modern economic system. Broad coverage means that digital technologies can facilitate socialized large-scale production to realize network cooperation and stimulate the network synergy effect of the modern economic system.

Thanks to the accelerated development of innovative technologies such as the Internet, big data, cloud computing, artificial intelligence and blockchain, digital technologies are fully integrated into the economy, politics, culture, society and the construction of ecological civilization with new ideas, new formats. This process will inevitably have a major impact on economic development, national and social management systems, changes in industrial relations and people's lives.

The healthy development of the digital economy contributes to the construction of a modern economic system, the construction of an innovative and coordinated industrial system; contributes to the construction of a single, open, competitive and orderly market system; building a system of income distribution that reflects efficiency and promotes fairness; contributes to the construction of a system of regional development of the city and village; building a multi-balanced, safe and effective complex open system, an economic system that implements an effective market mechanism, the viability of micro-entities.

The healthy development of the digital economy contributes to the creation of new advantages in national competition. The accelerated integration of next-generation digital technologies such as big data, cloud computing, artificial intelligence, blockchain, and the Internet of Things with the real economy has created limitless opportunities for new industries and new models. The digital economy is not only a driving force for high-quality economic development, but also a center for increasing long-term competitiveness. In the modern era, digital technologies and the digital economy are opportunities for the global scientific and technological revolution and industrial transformation, as well as key areas of a new round of international competition. Countries must seize the opportunities and seize the commanding heights of future development. The digital economy is about whether we can seize the opportunity of a new round of technological revolution and industrial transformation, whether we can win the initiative in future development and international competition.

Nowadays, centuries of change and centuries of epidemics are intertwined and overlapped, and a new round of technological

revolution and industrial transformation is accelerating. The world's largest economies are taking the lead in implementing digital technologies and the digital economy. Competition in key areas of core technologies is becoming increasingly fierce, and global competition is also undergoing profound evolution. Governments must not only see the local advantages that the country has achieved in the areas of digitization, networks and intelligence, but also clearly understand the shortcomings and weaknesses of key basic technologies, and the balance in the development of different regions. We must not only take full advantage of the huge market, massive data and digital application scenarios, but also actively participate in international cooperation in the digital economy, actively learn from international best practices, and make the best use of the global factor. Increasing and strengthening the digital economy and promoting the deep integration of the digital economy is an urgent need to create new competitive advantages in the future and an important way to promote high-quality industrial development and support the construction of a new development model (Otych, O., Ordina, L., Ordin, Y., Ivasenko, B., & Velyka, K., 2023).

2.6 The Influence of Digital Education and Digital Technologies on the Development of Medicine

The philosophy of medicine of the 21st century is based on the exponential growth and convergence of technologies, based on genomes, stem cells, 3D printers, electric transport, etc. When it comes to medicine, it turns out that the system is sicker than the patients. Even the terminology is confusing. Today, going to the doctor is more associated with illness than with health. This is already a reaction to the event, and not work in anticipation. Doctors act after the fact, often fighting ineffective, expensive and absurd battles. For example, in the USA, due to fear of liability, doctors spend 210 billion on unnecessary procedures for patients every year [1, p. 160]. In the field of medical research, the situation is not better, out of 5,000 new drugs, only 5 reach human testing and only 1 receives a license. Because of this, new drugs need an average of 12 years and

2.5 billion dollars to reach a patient. At the same time, the average American spends $10,739 on medical care every year. This is more than in any other country. If nothing changes by 2027, this industry will absorb almost 2 % of the US GDP [1, p. 161].

The philosophy of medicine of the 21st century concerns technologies and shifts in the paradigms of human thinking. The medical service train is being rebuilt on the technological rails. The locomotive is the convergence of sensors, networks and artificial intelligence, which is transforming the principles of diagnostics, based on disease diagnosis and 3D printers, which are changing the nature of medical procedures, and artificial intelligence, genomics and quantum computing are changing medicines themselves. At the same time, as a result of this technological merger, two paradigms are changing. The first is a strengthening of the emphasis from illness to health, the transition from a system that reacts to consequences to a system that acts in advance and seeks a personal approach to each patient. The next one is in changing the management system, using the potential of augmented reality, namely artificial intelligence and exponential growth of information (using big data, BIG DATA). Alphaber's medical division, Verirty Life, develops a wide range of internal and external sensors that monitor everything from blood sugar levels to its full chemistry. Exo Imaging's affordable AI-powered portable 3D ultrasound machine will soon be able to monitor everything from wound healing to baby growth in the womb from the comfort of your home. Using red laser holography, Openwater's device is creating a portable equivalent of an MRI machine, turning a multimillion-dollar machine into a small electronic device and giving three-quarters of the planet's population access to scans they've never had before. In less than 20 years, wearable wrist devices have gone from simply counting steps to Apple's fourth-generation iWatch, which has an EKG scanner that tracks your heart in real time.

Attention should also be paid to the combination of easy-to-use medical sensors and diagnostic artificial intelligence, accessed through an app that detects more than 50 common diseases. All these developments represent the future of medicine, in which we will have constant monitoring of our body using simple diagnostic methods. The working name of this new industry is mobile health services,

the market share of which will be $102 billion by 2022. The medical portal will have to give way, since it is about the possibility of having a personal virtual doctor in the pocket for everyone. Currently, the market is filled with medical chatbots based on artificial intelligence, which have spawned a wave of fusion of networks, sensors and computing technologies.

These applications diagnose hundreds of diseases, including our psychological health. Through Facebook, he conducts therapy for patients suffering from depression. Already today, the service is offered, which is based on an annual three-hour examination, which includes genome sequencing, whole-body MRI, heart and lung CT, electrocardiogram, echocardiogram and a series of clinical blood tests, which gives a complete picture of the state of the human body. This picture is important from the point of view of diagnosing diseases in the early stages. In total, 14.4 % of clients were diagnosed with serious diseases requiring immediate intervention, and another 40 % had diseases requiring constant supervision. Thanks to special sensors, our smartphone can become a personal doctor. Experts call personalized genomics a medical revolution. If we understand the genome, then we can optimize our "self": we can choose the perfect food, the perfect medicine, the perfect training regimen, which nutritional supplements are best for your physiology. Thus, 20 % of patients who underwent DNA analysis were found to have rare diseases that are life-threatening and require immediate treatment [1, p. 165]. In 2018, the National Institutes of Health at Harvard and similar organizations launched the All of Us project, awarding $27 million in grants to decode millions of genomes. If they manage to do this, then work on growing organs for transplantation will be established, weapons to fight viruses and cancer, cheap drugs and vaccines will be obtained. Another goal is to learn how to edit the genome using CRISPR technology, which is also called "molecular scissors" (Nikitenko V. O. 2020b).

It is too early to talk about anything, but the progress in this direction is impressive. Recently, scientists engineered a gene to resist cocaine addiction and injected it into mice, "turned off the gene responsible for muscular dystrophy in dogs" and began developing personalized cancer treatments in humans. They even work with

insects. Researchers at Imperial College London have used CRISPR to breed a new breed of mosquitoes that do not produce offspring and, in addition, should displace their malarial relatives. It will be a real medical revolution by editing the genetic code of various biological species. Actually, it is already happening. At the end of 2018, field trials were conducted in Brooklyn Faso, which is particularly affected by malaria. Dozens of robotic surgeons specializing in spinal problems are now on the market; collaborative works that assist surgeons, not replace them; robotic surgeons working in the operating room; autonomous robots such as STAR are promising.

Thanks to an army of cheap new robots, robots that "democratize surgery" are set to hit the market in 2020. A microscopic robot has already been created that moves through tissues at a speed of about 60 cm/h, and very clearly and accurately, directing its weak magnetic fields. In just a few years, they will reach the peak of their development and will be actively used for diagnostics, local use of medicines and minimally invasive surgery. 3D printers have also entered operating rooms to help create prostheses and organs, specialists are creating organs, ears, heart shunts, spinal cords, cranial plates, hip joints and special surgical instruments, and the ability to print electronics makes it possible to make bionic body parts.

Cellular medicine is successfully developing in the fight against diseases. The patient is impressed by living cells, which to one degree or another affect various functions of the body: they grow hair, rejuvenate tissues, kill cancer, restore damaged areas of the heart, treat autoimmune diseases, turning human stem cells, which contain a significant supply of stem cells, into real medicines. This is far from a complete list of the discoveries that modern medicine created with the help of modern breakthrough technologies, and philosophy helps a person to be healthy, happy, in demand.

Conclusions to Chapter 2

The exploration of digital technologies signifies a prevailing global trend in the landscape of the Fourth Industrial Revolution. The ubiquitous integration of technologies such as the Internet of Things (IoT) and cloud computing is reshaping educational paradigms worldwide. Embracing these innovations becomes imperative for educational institutions seeking relevance and adaptability in the dynamically evolving digital era.

Artificial Intelligence (AI) emerges as a pivotal force propelling the digital transformation of education. The infusion of AI-driven applications, such as personalized learning platforms and intelligent tutoring systems, revolutionizes the educational experience. This section emphasizes the transformative potential of AI in fostering adaptive and customized learning environments, catering to diverse student needs.

The dominance of intelligent manufacturing in the Fourth Industrial Revolution has far-reaching implications for digital education. As smart technologies redefine industrial processes, the demand for a digitally literate and skilled workforce intensifies. Exploring the symbiotic relationship between intelligent manufacturing and digital education becomes paramount for aligning educational curricula with industry requirements.

Big Data emerges as a strategic resource driving the digital transformation of education. The ability to harness vast datasets offers unprecedented insights into student learning patterns, enabling institutions to tailor educational content and methodologies. This section underscores the pivotal role of Big Data analytics in optimizing educational outcomes and institutional efficiency.

Digital education plays a seminal role in shaping and advancing the digital economy, particularly in highly developed nations. The interconnectedness between educational advancements and economic prosperity becomes apparent as digital skills become a currency for workforce participation. This segment examines how digital education acts as a catalyst for economic growth in technologically advanced societies.

The convergence of digital education and healthcare technologies has transformative effects on the field of medicine. From virtual medical simulations to data-driven diagnostics, this section explores the symbiotic relationship between digital education and advancements in medical practice. The integration of technology-enhanced learning in medical education contributes to a paradigm shift in healthcare delivery and professional training.

CHAPTER 3
THE CONCEPT OF "KNOWLEDGE MANAGEMENT" AND ITS CONNECTION WITH THE "KNOWLEDGE ECONOMY"

3.1 "Knowledge Economy" as an Expression of Digital Education in the Age of Digital Revolution and Globalization

"Knowledge economy" is an economy based on the entire process of knowledge production, transactions, circulation and consumption. The reason why knowledge can become an independent factor is the result of the development of industrial and agricultural economies, which are becoming more and more specialized, as well as the development of technology. With the development of industrialization, the value of knowledge itself is becoming higher and more important for the real economy. There is no clear distinction between the knowledge economy and the new digital economy and the information economy, the boundaries are rather vague, they overlap conceptually. The digital economy and the information economy reflect the characteristics of the development of modern processing methods of computer technology, while the expansion of the knowledge economy is broader, more abstract and systematic. The "knowledge economy" permeates various industries and creates new industrial classifications: 1) new industries generated by the knowledge economy, such as information technology, electronic

technology, and communication industries; 2) the capabilities of traditional industries, which comprehensively transform traditional industries with the help of technological innovations, and also contribute to transformation and modernization. The changes brought about by the knowledge economy will be comprehensive. The development of the "knowledge economy" confirms the truth that the factor that really drives an economy to achieve sustainable growth comes from knowledge innovation, while economic growth that depends only on the factors of labor and capital is often unsustainable. The development of the "knowledge economy" brings great changes to a person's life. The United Nations Organization for Economic Cooperation and Development defines the knowledge economy as an economy based on the production, distribution and use of knowledge and information (Olexenko, R. I. 2017).

After the middle of the last century, the knowledge economy began to develop gradually, which was manifested in the development of information technologies after the industrialized society. Compared with developed countries, on the one hand, the process of industrialization is not yet complete, and it is necessary to catch up on the lessons of the development of industrialization; on the other hand, Ueorain is facing the challenges of the knowledge revolution and the information revolution. Currently, the advanced countries of the world (USA, China) have achieved rapid development in some related fields, especially in the application of artificial intelligence, relying on a huge market that has formed a relatively obvious advantage. There is still a big gap between Ukraine and developed countries in some key technologies and processes, and it is necessary to accelerate to compensate for the shortcomings and catch up.

In 1982, Naisbitt put forward the concept of "information economy" in "Megatrends". The knowledge economy is a concept that corresponds to the agricultural and industrial economy and includes knowledge created by human society, including: knowledge about science and technology, management and behavioral science. Traditional economic growth theory focuses on labor, capital, raw materials, and energy, and views knowledge and technology as external factors affecting production. Knowledge increases the return on investment, which in turn improves the accumulation

of knowledge, which can be achieved by creating more efficient ways of organizing production and creating new and improved products and services. Romer suggested that when calculating economic growth, knowledge should be included in the function of factors of production. Therefore, the OECD definition of a knowledge-based economy is a knowledge-based economy that reveals the fundamental role of knowledge in modern economic growth and accurately reflects the reality of a knowledge-based economy. Therefore, when we understand the knowledge economy from the perspective of the economic era, what we call the knowledge economy must have a corresponding economic theoretical basis. This requires a starting point, which should be a theoretical framework for demonstrating how a knowledge economy is possible. The theory of the knowledge economy was formed in the early 1980s. In 1983, University of California Professor Romer put forward the "New Theory of Economic Growth", arguing that knowledge is an important factor of production that can increase the return on investment. The emergence of the "knowledge economy" as a form of economic industry is a new phenomenon, and its main symbol is the rise of the software knowledge industry, initiated by Bill Gates, the president of Microsoft Corporation in the United States. Gates' main products are diskettes and the knowledge contained on the diskettes, it is the application of this knowledge that opens the door to computer programs. "Knowledge economy" is an economy that promotes the coordination and sustainable development of man and nature, in which intangible assets dominate, and knowledge and intelligence play a decisive role. "Knowledge economy" is an economy subject to global economic integration, in the context of which a large world market is the main force of its constant growth. "Knowledge economy" is an economy focused on knowledge-based decision-making, the macro-control function of scientific decision-making has a growing trend in the knowledge economy. The "knowledge economy" has overcome the various shortcomings of the industrial economy, it relies on the intelligence of everyone to create wealth, it does not need to exploit surplus value. The products of the knowledge economy do not have the exclusivity of industrial products, people become the owners

of material goods. The ecological environment can be truly protected, the circular economy can be truly implemented, and the problem of resource scarcity can be fundamentally solved. The era of the knowledge economy is different from the era of the agrarian economy and the era of the industrial economy, which pays more attention to the development of industries with high added value. The growth of the "knowledge economy" in the world had an increasing influence on the development of the economy and the strengthening of the national power of various countries. The process of development of the "knowledge economy" is a process of convergence from a material-oriented economy to a human-oriented economy. In the era of the knowledge economy, the speed of dissemination, processing and feedback of information is significantly accelerated, the speed of responding to market demand must be faster and faster in the conditions of intense market competition. Hence, the knowledge created by innovation has become the engine of economic growth, which coincides with the theory of human capital created in the 1960s. The theory of human capital is the first theoretical focus of the "economics of people", especially the use of their economic opportunities. While no economic theory can compete with human capital theory in terms of direct concern for people themselves, affirming and stimulating people's economic capabilities becomes crucial in theories of the "knowledge economy." As for human capital, its continuous accumulation and explosion contributed to the development of society, which introduced a knowledge economy characterized by knowledge innovation. At the same time, the modernization or adjustment of the industrial structure also means the modernization or adjustment of human capital, since the new economy and the knowledge economy require human capital (Nikitenko, Vitalina, Voronkova, Valentyna, Oleksenko, Roman, Matviienko, & Halyna, Butkevych, Oksana, 2023). "The Knowledge Economy" is "the Knowledge-based Economy". Although the modern industrial economy and agrarian economy are inseparable from knowledge, in general, economic growth depends on energy, raw materials and labor, that is, it is based on materials. The knowledge economy is a historical product of human knowledge, especially knowledge in the field of science

and technology. The knowledge economy and the information economy are closely related, but there are also certain differences. The key to the knowledge economy is the ability to innovate. Only when information is transmitted and combined with human cognitive abilities-intelligence-can new knowledge be effectively generated. Therefore, the concept of the knowledge economy focuses on intelligence, which can effectively generate new knowledge only under the condition of information exchange. The information revolution – digitization, creation of networks and informatization – laid a reliable basis for the exchange of information and the effective generation of new knowledge, that is, the information revolution, informatization, are inextricably linked with the knowledge economy. "Knowledge" in the knowledge economy as a factor in the information revolution and informatization includes: 1) knowledge about facts; 2) knowledge of principles and laws; 3) knowledge (know-how), including technologies, skills, know-how; 4) knowledge and management skills. From the point of view of resource allocation, the development of human society and economy can be divided into the economy of labor resources, the economy of natural resources, and the economy of intellectual resources (Pinker Stephen, 2019).

A knowledge economy is an economy in which intellectual resources, such as knowledge and human resources, are used as elements of resource allocation, conservation and more rational use of existing natural resources that have been developed, and development of abundant natural resources that are yet to be exploited. through intellectual resources. A "knowledge economy" is an economy in which intangible assets are primarily invested in intellectual achievements such as knowledge and information. Intangible assets have become the main capital of economic development, and the share of intangible assets in the company's assets exceeds 50 %. The core of intangible assets is intellectual property. Science-intensive soft products, that is, the wealth of knowledge contained in knowledge products developed using knowledge, information and intelligence, will greatly exceed the material wealth created by traditional technologies and become the main form of social material wealth creation. The "knowledge economy" attaches great importance to the environmental

and ecological benefits of economic development, so it adopts a sustainable development strategy that benefits people in the long term. The development of high technologies shortens the space-time distance and creates material conditions for the globalization of the world economy.

In the "knowledge economy" era, the development of enterprises mainly relies on key technologies and brands, entrusts production to subsidiaries or cooperative enterprises through licensing and transfer methods, and makes full use of existing factories, equipment and workers. When people emphasize the concept of the "knowledge economy", they distinguish it from the material economy and the capital economy, in which material and capital play a leading role in production. Unlike economic growth, which depends on production factors such as materials and capital, the growth of the modern economy depends in part on the growth of knowledge content. However, it cannot be assumed that the knowledge economy differs only from the so-called material economy or capital economy. First, the division of the human economic era includes a natural economy and an industrial economy, but there is no mention of a material economy or a capital economy. Secondly, in the division of the economic era, what is important is not what is produced, but what is used for production. Here there is an important difference, that is, the leading means of production of a certain society and the industries formed from them are obviously outside the boundaries of the material economy or capital economy. The "knowledge economy" not only shows its existence through the key role of knowledge in production, but more importantly, a knowledge industry has emerged that dominates economic growth, represented by the information industry. "Knowledge economy" provides greater vitality and creates better opportunities for economic and social development, and how vigorous development of "knowledge economy" contributes to the optimization of the economic structure, rational use of resources, environmental protection, promotion of coordinated development, improvement of the quality of the population, elimination of poverty, development of the national innovation system. Innovation, technological innovation and system innovation improve the innovation awareness of the whole society

and the national innovation ability to realize the path of economic development. Scientific and technological strength formed on the basis of knowledge has become an important competitiveness. The prosperity of the country, the prosperity of the nation, the development of enterprises and the development of individuals – all this depends on the acquisition of knowledge, creative development and application of knowledge. The production, learning and innovation of knowledge have become the most important, it has become the mainstream of the development of the knowledge economy system with high-tech information as the main part. "Knowledge economy" is known as the intellectual economy, which refers to the economy based on the production, distribution and use of intelligence, mind, knowledge and information (Olexenko R. I, & Garbar G. A., 2021).

3.2 Digital Economy as a Difficult Path to the Knowledge Economy

One of the key characteristics of digital business models is the desire to systematically manage the information and knowledge generated and extracted from users of digital goods and services. There is a trend towards innovation processes that are almost entirely based on user input: obtaining information from consumers to better adapt offers to their preferences and recognizing the central role of user feedback in the innovation process. In addition to reducing the costs of collecting, sorting, storing and retrieving information, digital technologies provide producers and users of information products with a high degree of customization, the ability to implement rules for the use of shared information, which leads to the possibility of using incentives for information production and achieving efficiency in managing access and distributions that have self-executing contracts or statutes. These capabilities are all the more important because digital technologies also use the ability to accumulate knowledge, making it useful for users.

Tracking and storage capabilities combined with the Internet and common coding languages created a vast and ubiquitous knowledge

base “embedded” in software, resulting in a cumulative process. From the perspective of knowledge management, the capabilities of digital networks and technologies apply not only to problems related to knowledge, but also to all types of information generated by daily individual and collective activities. The Internet and related collective activities provide new ways to communicate and share a variety of information about product quality, past behavior of potential traders, tastes, preferences or opinions. Referring to the analytical framework of digital business models, digital networks enable the accumulation of knowledge and information at three levels: compliance level, as the combination of system tracking and transaction information reduces the risk of transactions or ensures more effective coordination between supply. and demand; an assembly level, benefiting from user feedback, which allows you to adjust the assembled module sets to better meet the needs of users, or to improve the quality of the modules themselves; cognition itself benefits from tools that enable collaboration and knowledge management more effectively (Plakhotnik, O., Zlatnikov, V., Strazhnikova, I., Bidyuk, N., Shkodyn, A., & Kuchai, O., 2023). The first step (Step 1) is to build the foundation of a guided learning capability, focusing on the value of pan-data and the value of knowledge model. With data, supervised learning is a good way to develop skills, and attention to simulated learning can also be considered. Some scholars believe that this is a typical way to create value for important data elements in the digital economy.

At the second stage (step 2), comparative data is collected, which is the basis for creating reliable opportunities, which, in fact, is a type of value model of the knowledge economy. At first glance, this part differs from many traditional language models as a preference-based model.

The third step (Step 3) is to strengthen the learning architecture to achieve a solid foundation and a solid foundation of solid performance opportunities. This includes a type of knowledge value model. In fact, it is somewhat different from traditional reinforcement learning. In essence, the environment is the carrier of rewards in reinforcement learning.

When deep learning was just nascent, a learning method represented by supervised learning contributed to the birth of the "labeling" industry. A large number of data tagging companies hit the first pot of gold in technology before AI companies; in a process called infrastructure, the AIGC-based learning method introduced by ChatGPT has the characteristics of "pan-data, unsupervised, reliable targets and general capabilities", and its essence is gradually transformed from the original triple meaning of data elements to a new one. knowledge economy, on the path of strong artificial intelligence, the economic model is also transformed from a digital economy to a knowledge economy. We are entering the era of the digital economy, and the digital economy is the only way to the knowledge economy. In 1996, the World Organization for Economic Co-operation and Development published a report, The Knowledge-Based Economy, which proposed for the first time that a knowledge economy is an economy based on the production, storage, use and consumption of knowledge and information. At that time, the knowledge economy accounted for more than half of the GDP of the main OECD member countries. At the 2016 G20 Hangzhou Summit, the G20 Digital Economy Development and Cooperation Initiative proposed that the digital economy means the use of digital knowledge and information as key factors of production, modern information network as an important medium, and effective information and communication technology. types of economic activity, which are important drivers of increasing efficiency and optimizing the economic structure (Punchenko, Oleg, Voronkova, Valentina, 2019).

The knowledge economy is a product of a highly developed industrial economy, which brings the industrial economy to the stage of qualitative development. With the development of information and digital technology, more and more human knowledge was digitized, and then quickly entered and became the main engine of economic development. With the development of artificial intelligence technology, it is possible to excavate on a large scale tacit knowledge, represented know-how, that is, the internal knowledge and skills of the industry (enterprise), as well as to digitize and automate. an important direction. The importance of domestic knowledge and skills to economic development is self-evident. Major OECD member

countries have taken the lead in acquiring highly developed domestic knowledge and skills, thus enabling the creation of a knowledge-based economy.

Therefore, digital transformation is an inevitable trend in the long-term development of enterprises. How to return the digital transformation of enterprises? An important path is the reconstruction and renewal of human capital with knowledge and skills as key elements through digital and intelligent platforms to constantly adapt to the rapidly changing market environment, increase productivity and production efficiency, and move towards post-industrial knowledge. economic times. Founded in 2015, UMU is committed to helping knowledge-intensive and high-tech companies create effective digital learning processes and digital platforms, helping companies to effectively extract, disseminate and exploit tacit knowledge. UMU uses mobile Internet and artificial intelligence technology to rapidly build human capital that adapts to the digital and knowledge economy in an ever-changing environment.

3.3 From Digitization to Digital Intelligence and Artificial Intelligence in the Educational Process

Using artificial intelligence to reconstruct the educational process, education has opened a new way of digital transformation of the educational process in the era of digital knowledge and learning. Just as Microsoft Office helps create efficient office processes and document processing capabilities, UMU creates an efficient silent platform for acquiring and sharing knowledge for enterprises – a digital learning platform. According to the OECD's 1996 report "The Knowledge-Based Economy", "knowledge" is divided into four types: 1) "knowing what"; 2) "knowing why," that is, knowledge of facts and natural principles and laws, that is, information that is currently known; 3) know-how; 4) skills and abilities to do certain things and information about who knows how to do them. The first and second types of knowledge are called codified knowledge, i.e. information, and the third and fourth are called tacit knowledge or industry/enterprise internal knowledge. Digitization is about

how to use knowledge that can be codified, while digital intelligence is about how to use tacit knowledge. The effective development and use of tacit knowledge is the key to the transition from digitization to digital intelligence and then to the knowledge economy. Knowledge formation mainly comes from practical experience, such as sales, technical and financial management knowledge and skills. It exists within the enterprise and cannot be efficiently extracted and effectively disseminated like codified knowledge. The World Economic and Development Organization's OECD report, The Knowledge-Based Economy, states that the digital revolution has made it easier to capture and share codified knowledge, while tacit knowledge is more important in the industrial and knowledge economies, but tacit knowledge is more difficult to extract and share – even only through "learning". For a knowledge-based economy, the learning process cannot completely depend on formal education, it is more important to learn in practice and "teach and teach" through practice at work (Punchenko O., Voronkova V., Punchenko N., 2019).

At present, with the development of information and digital technology, the digitization of coded knowledge represented by big data technology has passed 15 years and entered a mature stage, while the digitization of complex silence represented by artificial intelligence technology Digital intelligence of cognition has only just begun. In order to model processes and digitize corporate "learning", as well as how to effectively acquire, disseminate and replicate tacit knowledge, a completely new digital intelligence platform is required. Edward D. Hess, Professor of Business Management at the Darden School of Business in the United States, in his book The Science of Learning, believes that the right process is crucial to building an effective learning organisation. In a more volatile environment, businesses, institutions and organisations that have established learning processes are more likely to adapt to environmental changes. With the right corporate learning process in place, a digital platform combined with artificial intelligence will provide an efficient, seamless knowledge acquisition and dissemination experience for enterprises. The digital learning platform, like Microsoft Office, helps enterprises create efficient office processes and document processing capabilities, which is one of the key ways to move from digitalisation to digital intelligence.

Since its founding in 2015, UMU has focused on creating an effective corporate learning platform focused on learning. Based on learning science and artificial intelligence, UMU creates a new type of intelligent learning scene, breaks the "learning, practice and use" links, bridges the gap from "knowing" to "doing", and uses effective learning to improve employee productivity, thereby driving organisational development and revenue growth. Unlike other domestic SaaS startups, UMU has established customer relationships with many Fortune 500 companies since its inception. Today, UMU has users in more than 200 countries and regions around the world, and its corporate clients include leading high-performance companies in industries such as healthcare, education, retail, manufacturing, and finance. In 2020, 60 % of UMU's revenue will come from major international markets such as the US and Japan, and the renewal rate of corporate clients will reach 150 %. UMU has now established global teams in China, the US and Japan and has developed multilingual versions in Chinese, English, Japanese, Thai and Spanish. UMU has gained unanimous optimism from venture capital organisations: UMU received an investment early on (O' Riley Tim, 2018).

To do this, it is necessary to help businesses and schools increase the effectiveness of learning. The first function of UMU's product is to help teachers and educators make teaching more interactive in traditional face-to-face classrooms, help better deliver learning information, and achieve better results. Based on the interconnectedness of the mobile Internet, UMU launched a code scanning tool to participate in classroom performances and achieved better learning effects through "information transmission + interactive tools". After the launch, UMU was welcomed by teachers and teachers. The user group covered more than 100 countries in the first year and 208 countries and regions in the third year. UMU has entered the deep sea of corporate training, and it has to decide: can the effect of online learning be comparable to or even surpass that of offline learning? In fact, with the advent of the Internet, various forms of online learning have emerged, but with limited effectiveness. The fundamental reason is that it is not possible to simply copy a certain part of the offline learning experience to the smartphone, relying on the smartphone, screen interconnectivity and the mobile

Internet ecology to completely reconstruct the online learning experience from scratch. In addition, it is necessary to integrate and deeply apply artificial intelligence technology, which has begun to develop massively since 2015. On the digital intelligence platform, consisting of artificial intelligence, smartphones, screen-to-screen connectivity and mobile internet, etc., the online learning industry will be completely destroyed. This requires deconstructing the essence of the 'corporate learning' business from the very beginning and finding how to use it on a digital intelligence platform. It aims to reconstruct the path of "enterprise learning" and continuously realise and create business value for enterprises in the process.

However, the "science of learning" is still evolving. It is an empirical science based on brain science and cognition, it is a scientific concept of learning on which UMU products are based today, which can be summarised in four areas: 1) teaching; 2) learning; 3) practice; 4) use, based on high quality content and teaching, targeted practice, tutoring exercises and assessment with work scenarios designed for impact-oriented learning. Key elements also include the composition of the UMU product system – learning tools and on-site interaction, the enterprise learning platform, homework and interactive live streaming. For corporate digital intelligence, the science of learning is a huge goldmine, with many important principles of natural science learning being commercialised through UMU one by one so that the principles and methodologies of natural science learning can be incorporated into online products accessible to everyone (Ramaswamy, V, & Ozcan, K., 2018).

In the knowledge economy, it is not easy to incorporate knowledge, especially tacit knowledge, into a standardised economic production function, and a suitable standardised tool platform is especially needed. This is like Microsoft Office on PCs and Windows operating systems, which standardises the digitisation of corporate documents. Markets in different countries and regions of the world are checking Microsoft Office documents. Office can be used not only to generate standardised documents, but also on the basis of globalisation on the Office platform. Today, UMU is trying to use smartphones and artificial intelligence technology to create a global standardised software platform in the field of corporate knowledge and learning.

From 2015 to 2020, thanks to the continuous commercialisation and maturity of AI technology, UMU gradually reconstructed the key links of the enterprise learning process with AI. By 2020, the global commercialisation system of artificial intelligence technology will be fully mature. In this regard, UMU has also begun to reconstruct the entire UMU platform with AI technology with new capabilities.

The latest UMU uShow can help enterprises develop gold medal sales in series. With AI deep learning technology, uShow summarises and analyses the cases of excellent sales in an enterprise and extracts a gold medal sales speech model from them as the evaluation basis for sales training. uShow can not only extract the speech expressions and speech pattern of gold medal sales, but also incorporate emotional expressions and actions, such as using image recognition to analyse facial expressions and posture changes of gold medal salespeople during speeches, as well as using speech recognition to analyse gold medal salespeople's speech Expression and emotional expression combined with product terminology and industry knowledge of the customer's industry to build a knowledge graph so that artificial intelligence can understand the real semantics and knowledge expressed by salespeople. In terms of using artificial intelligence to train sales staff, UMU analyses trainee salespeople's practice videos and compares them to a gold medal sales model calculated by artificial intelligence, and gives multidimensional automated evaluation and feedback guidance. For example, UMU AI analyses students' practice sales videos, can capture students' expressions, automatically match the smile curve, and measure whether students have intimacy; it can also capture students' gaze to ensure that students look directly at the object of communication when practicing a sales scene; in addition, UMU AI can also measure whether the student's voice is clear, speech is fluent, etc. If a student performs poorly in a certain aspect of the assessment, such as unclear logical explanations, uShow will also recommend relevant videos with high scores, i.e., it will analyse the weak links using AI analysis and then recommend good examples (Ryzhova, I. S., 2018).

Now, all salespeople in an enterprise can use the same set of models for self-learning on the UMU platform without additional human support, and the cost of speech and portrait recognition technology

during training is significantly lower than the cost of manual guidance. UMU AI is widely used in sales, manager authorisation, training, feedback, customer service, and many other key scenarios that indicate an increase in productivity and a change in efficiency. Many of the world's leading pharmaceutical companies use UMU as a learning and training tool for medical experts and pharmaceutical representatives. From the perspective of extracting the tacit knowledge of enterprises and generating learning content, UMU enables enterprises to realise course design, course delivery and process management through learning tools and platforms, helping enterprises to create a learning platform that anyone can teach and anyone can learn, so that the real flow of knowledge has changed the dilemma that knowledge is dispersed in the heads of each employee and cannot be transformed into the knowledge and abilities of others on a large scale. After using uShow to implement the artificial intelligence reconstruction of the "practice" link, in 2021, UMU will implement artificial intelligence in knowledge content extraction and production, use artificial intelligence to reconstruct the "teaching" link, and launch an intelligent artificial intelligence sparring robot "link reconstructed. Li Dongshuo said that UMU will use AI to restructure "teaching, learning, practice and use" over the next five years.

In 2021, UMU will also hold a conference for developers for the first time. The UMU SaaS cloud platform is similar to the Microsoft Office 365 cloud platform, enabling teachers, instructors, educational institutions, enterprise internal trainers, etc. to design, create, interact and manage courses on the UMU platform, accelerate knowledge sharing and flow, and create a network that connects enterprises and an enterprise-level SaaS learning platform with network effects for knowledge owners, large enterprises and small enterprises, small enterprises and small enterprises, enterprises and employees.

In summary: as the global economy enters a post-industrial knowledge-based economy based on digital and intelligent platforms and capabilities, an enterprise learning platform that extracts, disseminates, reproduces and promotes corporate tacit knowledge is not only the focus of the next. digital transformation is also the driving force behind the comprehensive digital intelligence of enterprises, as well as a key platform for the development

of the knowledge economy in the future. The pioneering work done by UMU, especially the reconstruction of corporate learning with artificial intelligence, combined with user groups in more than 200 countries, will jointly lead the development of the global knowledge economy (Safonov, Y., Usyk, V., & Bazhenkov, I., 2022).

Disclaimer: This article is reprinted on our website to provide readers with more news and information. This content does not constitute investment or consumption advice and is for readers' information only. In 2022, ChatGPT and Stable diffusion mark the outbreak of AIGC technology. In general, the development of a technology-driven economic model goes through five stages: nascent, flare-up (capital/resource-driven development), stable, mature and factor-like stages. In the stability and mature stage, we can identify value and see the trend by relying on macro analysis of economic laws without considering technical details; but in the generation and outbreak stage, we cannot ignore understanding technical details, and we need to combine technical characteristics and economic laws to understand Change, seize opportunities, find a way into the future is like understanding the cause of a fire at the beginning so that you can make an accurate plan. This article combines ChatGPT's learning principle and the new theory of the knowledge economy to explain why ChatGPT and even AIGC have broken through the digital economy and moved to the new knowledge economy. Please refer to the author's published publications for relevant knowledge economy theories.

The first step (step 1) is to build the foundation of a guided learning capability by focusing on the value of pan-data and the type one knowledge value model. We know that data-driven supervised learning is a good way to develop capabilities, and a focus on simulated learning can also be considered. Some scholars believe that this is a typical way to create value for important data elements in the digital economy. While there is no problem with this understanding, it comes from ignorance of technical details that ignore more important things: first, quality data is costly, the method of realising data value of traditional thinking has a limit that forms a new stage of data value, from over-supervised to unsupervised, from professional data to general data, which is the inevitable

outcome of knowledge economy theory, ChatGPT and big language model Even the inevitable path of AIGC, the technical details here are that ChatGPT and even the Q&A mode is actually a "solitaire", which is to enter a series of input tokens and predict the next tokens, so it is derived by deriving conditional probabilities with supervised learning, similar to the Pan-data input method, which actually solves the labelling problem (the ability problem), but be careful not to solve the valid problem, since the tokens answered (note that they are predicted one after the other, you need to know a little bit about natural language processing here) are drawn from a probability distribution, i.e. there is a randomness, a person who does things randomly, you are sure that is not easy to believe; the second point is actually not easy to find in the existing structure of the digital economy, it needs to be extended to the knowledge economy, that is, the first type of knowledge value model, P in ChatGPT originally contains the value of pre-learning, Finetune's pre-learning technology is the fuse of the deep learning explosion (think of Mr Hinton's pioneering paper in 2006), which is obviously the first type of value model, namely direct knowledge transfer and single-level combination (SLC). What we need to see is that similar ways of building capabilities will generate more methods and create new applications in new scenarios in the future. In this step, you get Xiaobai to let himself go.

In the second stage (step 2), comparative data is collected and a reward model is trained, which is the basis for building robust capabilities, which is essentially the third type of value model of the knowledge economy. At first glance, this part is different from many traditional language models, but it is actually in the publicly available 2017 document (i.e., the benefits-based model). According to the principle presented in InstructGPT, for the same problem as before, there are 4 answers in ABCD (you can generate as many as you want, why?), participants (experts) give a rating of the four ABCD answers, and ChatGPT itself draws two construction points each time (large – 1, small – 0), so that 6 results can be constructed (C(4, 2)). The reward model built in this way can actually be seen as a trusted supervisor, or we will call it a supervisor or supervisor (one line and three, forgive me).

The third step (step 3) is to strengthen the learning architecture to achieve a solid foundation and a solid foundation of robust capabilities to drive performance. This involves the second type of knowledge value model. In fact, this is somewhat different from traditional reinforcement learning. Essentially, the environment is the carrier of rewards in reinforcement learning. Here, the reward model in the second step does not need to take the environment into account. You can see that it is actually between reinforcement learning and imitation learning. This idea was also proposed in the 17-year-old paper. In fact, you need to read the guidance document to see the more important details, i.e. the reward here is not only a second-step reward model, but also includes KL divergence to avoid an excessive break with GPT3.5, which can be understood as in addition to regulators, there is also a criterion of law, so the results are trustworthy. Because it has a "trustworthy" value orientation and a resource screening mechanism, it is a typical embodiment of the second type of knowledge economy value model (Swaab Dick, 2019).

When deep learning was in its infancy, the learning method represented by supervised learning contributed to the birth of the "labelling" industry. A large number of data labelling companies got the first golden pot in technology before artificial intelligence companies; in a process called infrastructure, the learning method relied on by AIGC, represented by ChatGPT, has the characteristics of "pan-data, unsupervised, robust targets, and general capabilities", and its essence is gradually transforming from the original triple meaning of data elements to a new one. knowledge economy, on the way of strong artificial intelligence, the economic model is also transforming from a digital economy to a

Experts say that the development of artificial intelligence contributes greatly to the formation of a knowledge economy, which provides great opportunities for further productivity liberation, and opportunities for the development of artificial intelligence should be seized. The development of artificial intelligence has given rise to a number of new industries, created a large number of new jobs, improved employment conditions and expanded the employment space. But at the same time, it has also led to an adjustment in the employment structure. To address the challenges posed

by AI for employment, governments in the countries should put stable employment in a more important place, focus on higher quality and fuller employment, seize the opportunities of AI development, and interact with AI. Supporting and coordinating the development of artificial intelligence will contribute to economic improvement and improve people's livelihoods (Skinner Chris, 2020).

While scientific and technological progress replaces jobs, artificial intelligence creates new jobs. The development of artificial intelligence contributes to the ability to think ahead and act forward. Only by combining knowledge and action will education be able to better adapt to the rapid development of artificial intelligence. The development of artificial intelligence contributes significantly to the formation of a knowledge economy, which offers great opportunities for further productivity liberation, which will bring profound challenges at the economic and social levels. The AI-driven knowledge economy differs from the traditional economy in terms of the basic resource structure, cost structure, market structure, economic structure, employment structure, distribution structure, and trade structure. The development of artificial intelligence at this time will help to resolve bottlenecks in some industries, especially in mid- and high-level services, and will be key to overcoming labour shortages in the future.

The knowledge economy is an economy based on the production, dissemination and use of knowledge and information. It improves economic and social benefits through the continuous innovation, acquisition, transformation, dissemination and effective application of knowledge. According to statistics from the Organisation for Economic Co-operation and Development (OECD), more than 50 % of the gross domestic product of major member countries comes from the knowledge-based economy. These countries have developed knowledge industries and knowledge capital with strong knowledge capital, as well as talents that can master and skilfully apply new knowledge. In today's world, education, science and technology have become the main productive force among many factors of production, rapidly driving the progress of the new era of the Fourth Industrial Revolution. The growth of the global economy no longer depends on economic resources, but on knowledge resources (Nikitenko V. O., 2013).

Adapting to the changes of the economic era, the structure of organisation and management of human economic activity is also undergoing revolutionary changes. Some old industrial giants in the world have lost their glory. Faced with the challenges of the new economy, they have no choice but to continuously increase investments in technological upgrades and continue to innovate in strategies and management models. In the context of digitalisation and globalisation, "knowledge management" as a completely new concept of education management is emerging as the times demand. Generally speaking, knowledge refers to the sum of knowledge about the material world and the spiritual world that people have acquired so far through thinking, research and practice. In the era of the knowledge economy, the stock of knowledge is increasing, the innovation of knowledge is accelerating, and the depreciation of knowledge is accelerating. People need to learn new knowledge, update outdated knowledge, and regularly replenish knowledge to keep up with the pace of change. To gain useful knowledge, it is necessary to identify what knowledge is useful and then establish a systematic method for collecting and improving it. To become a force, knowledge must be transformed to influence behaviour and improve performance. The emergence and growth of knowledge management signifies that the business environment driven by the knowledge economy has entered a new phase of global digital development. Its emergence is the inevitable result of enterprises' adaptation to changes in the resource environment, as well as the result of scientific and technological progress. The development of science and technology contributes to the integration of knowledge and the economy, making the competitive advantage of enterprises more knowledge-based. In a fiercely competitive market, enterprises can only win the market by relying on continuous enterprise innovation and enterprise knowledge resources.

The development of the knowledge economy has brought endless opportunities and challenges for the development of modern enterprises. Learning and mastering advanced management concepts, exploring the strengths of innovation, and exploring management ideas and methods suitable for enterprises and operating environments in the knowledge economy era are urgent tasks for the business

community and relevant government departments. Many thought-provoking examples are provided in The Intelligent Enterprise, as well as concrete suggestions on how to implement people-centred management, create a new type of knowledge group and implement effective knowledge management in the knowledge economy.

3.4 Formation of Digital Competences of Specialists in the Context of European Experience

The most important feature of modern education is the formation and improvement of the basic and special competences of a modern student and future specialist in the digital economy in the educational space. Education is the key to strengthening the country's innovation potential, central to the development, dissemination and evaluation of knowledge and innovation, building innovative pedagogy, nurturing talents and qualities such as professionalism, digital and reflective thinking, flexible adaptation and stress resistance. The most important feature of modern education is the improvement of the basic and special competencies of a modern student and future specialist in the educational space, which are formed in the educational space and actively influence the educational and organisational processes, which determines their efficiency and productivity.

After the outbreak of the COVID-19 pandemic, digital education has become a key priority in the European Union, which demonstrates the EU's commitment to promoting a people-centred digital transformation in education. The key is the implementation of digital education – in terms of policy and practice – at European, national and regional levels, which will provide a platform for the implementation of the new Digital Education Action Plan. Higher education institutions are uniquely positioned at the crossroads of education, research and innovation. They serve society and the economy and play a crucial role in creating the European Education Area and the European Research Area in synergy with the European Higher Education Area. It is important for us to analyse the role of higher education institutions as drivers of innovation that foster creativity, stimulate professionalism and develop entrepreneurial

skills at all levels of education and require concrete steps to strengthen innovation in teaching and learning in higher education (Social, economic and educational transformations in the digital era: monograph, 2022).

The concept of digital education states that digital competence should be developed in every professional who develops digital competence to promote confident, critical, responsible and creative use of, and engagement with, digital technologies for learning, work and participation in society. Digital competence is one of the core competences, a set of cross-curricular responsibilities for lifelong learning. The competence areas are "cross-cutting" as they apply to any activity carried out with the help of digital means. The acceleration of technological progress in the digital sphere has made the use of devices and applications that use cloud computing, big data analysis, blockchain or artificial intelligence commonplace.

The technological revolution, coupled with the changing strategies of companies at the forefront of digital technology, has significantly increased the role of global platforms, leaving excessive economic and political power to no more than twenty or so corporations based in two or three global powers, a very small group of firms with market capitalisations close to a trillion dollars or more.

Technological advances have been accompanied by socially negative consequences, such as the exclusion of a large proportion of the world's people from the benefits of digitalisation, mainly because their incomes are too low to afford meaningful connectivity (i.e. high quality access), access to devices, fixed home connections and the ability to use them on a daily basis.

Digital competence is a set of skills and knowledge that are essential for learning, professional integration and civic life in a society with a constantly changing technological environment, contributing to responsible active citizenship. The incredible increase in the volume of information, the course of social processes in society, the state of the economy increases the requirements for specialists in the disciplines of the management and economic cycle, which model competencies as a source of innovation, dictating the need for self-development, self-realisation, readiness for life in a globalising world.

The purpose of the study is to form a digital competence-based approach to education, to identify the main trends and requirements for a specialist in the digital economy and digital management. A specialised competency model that focuses on organisation-specific digital competencies that can be measured based on the digital skills that are most important, allowing you to embark on a targeted digital transformation.

Therefore, you should integrate your own training materials into the platform, which will create a direct link between results and resources; you will get a database that can be used for strategic development, performance reviews, and recruitment.

The conceptual reference model of DigComp includes the following competences:

1) information literacy;
2) communication and collaboration;
3) digital content creation;
4) safety;
5) problem-solving (Stoika, O., Butenko, N., Miziuk, V., Zinchenko, O., & Snikhovska, I., 2023).

Information and data literacy: to formulate information needs, find and retrieve digital data, information and content, including storing, managing and organising digital data.

Communication and collaboration includes interacting, communicating and collaborating through digital technologies, while being aware of cultural and generational diversity. Participate in society through public and private digital services and civic engagement to manage digital presence, identity and reputation.

Digital content creation – to improve and integrate information and content into the existing body of knowledge, understanding how copyright and licences are used.

Safety – to protect devices, content, personal data and privacy in the digital environment; to protect physical and psychological health and be aware of digital technologies for social well-being and social inclusion; to be aware of the environmental impact of digital technologies and their use.

Problem solving – identifying needs and problems, solving conceptual problems and problem situations in the digital environment, using digital tools for innovative processes and products.

Consider the competences required by a specialist in management and economic profile:

1. Information literacy. Competences:

1.1 Viewing, searching and filtering data, information and digital content to formulate information needs, to search for data, information and content in the digital environment, to access and navigate between them; to create and update personal search strategies.

1.2 Evaluation of data, information and digital content, for which you should be able to analyse, compare and critically evaluate the accuracy and reliability of data sources, information and digital content; analyse, interpret and critically evaluate data, information and digital content.

1.3 Manage data, information and digital content – to organise, store and retrieve data, information and content in digital environments; organise and process them in a structured environment (Nikitenko V. O., 2015).

2. Communication and collaboration. Competences:

2.1 Interaction through digital technologies – interact using a variety of digital technologies and understand the appropriate digital communication tools for a given context.

2.2 Sharing through digital technologies – share data, information and digital content with others using appropriate digital technologies; act as a facilitator, be aware of referencing and attribution practices.

2.3 Engage in citizenship through digital technologies – participate in society through the use of public and private digital services; seek opportunities for self-improvement and civic engagement through appropriate digital technologies.

2.4 Collaboration through digital technologies – use digital tools and technologies for collaborative processes, as well as for co-designing and co-creating resources and knowledge.

2.5 Networking etiquette – know the norms of behaviour and know-how when using digital technologies and interacting in the digital environment; adapt communication strategies to specific audiences and be aware of cultural and generational diversity in the digital environment.

2.6 Manage digital identities – create and manage one or more digital identities, be able to protect your own reputation, deal

with the data you create using multiple digital tools, environments and services.

3. Create digital content. Competences:

3.1 Digital content development – create and edit digital content in various formats, express yourself digitally.

3.2 Integration and processing of digital content – to change, clarify, improve and integrate information and content into the existing body of knowledge to create new, original and relevant content and knowledge.

3.3 Copyright and licences – to understand how copyright and licences apply to data, information and digital content.

3.4 Programming – to plan and develop a sequence of understandable instructions for a computer system to solve a given problem or perform a specific task.

4. Security. Competences:

4.1 Security – to protect devices and digital content and to understand the risks and threats in the digital environment; to be aware of security measures and due regard for reliability and confidentiality.

4.2 Protection of personal data and privacy – to protect personal data and privacy in the digital environment, to understand how to use and share personal information, being able to protect themselves and others from harm; to understand that digital services use a "privacy policy" to communicate how personal data is used.

4.3 Protecting health and well-being – avoid risks to health and physical and psychological well-being when using digital technologies; be able to protect themselves and others from possible dangers in the digital environment (e.g. cyberbullying); be aware of digital technologies for social well-being and social inclusion.

4.4 Environmental protection – to be aware of the impact of digital technologies on the environment and their use (Sukhonos, V. V., Garust, Y. V., Shevtsov, Y. A., 2019).

5. Solving problems. Competences:

5.1 Solving technical problems during the operation of devices and the use of digital environments to solve more complex problems.

5.2 Identify needs and technological responses to assess needs and identify, evaluate, select and use digital tools and possible

technological responses to address them; to customise digital environments to meet personal needs.

5.3 Creative use of digital technologies – to use digital tools and technologies to create knowledge and innovate processes and products, engaging individually and collectively in cognitive processing to understand and solve conceptual problems and problem situations in the digital environment.

5.4 Identify digital competence gaps to understand where one's own digital competence needs to be improved or updated; to be able to support others in developing their digital competence; to seek opportunities for self-development and to keep abreast of digital evolution.

Today, an update of the digital competence framework (DigComp 2.2) has been published. DigComp and its updated version, DigComp 2.2, can continue to play a central role in achieving our ambitious EU targets for digital upskilling of the whole population. 80 % of the population will have basic digital skills by 2030, as set out in the European Pillar of Social Rights Action Plan. The update takes into account new technologies such as artificial intelligence, the Internet of Things and data, or new phenomena such as new remote working conditions, which have led to new and increased demands on digital competence from citizens. There is also a growing need to address the environmental and sustainability aspects of interacting with digital technologies. Therefore, the current update takes into account the knowledge and skills that citizens need in the face of these developments. Recent events also show that citizens need to be able to verify online content and its sources (information literacy). Competencies are needed when interacting with artificial intelligence systems so that they can take advantage of the new opportunities offered by technology while dealing with the risks associated with the latest developments in social media and digital technologies.

The DigComp 2.2 update will help to keep DigComp relevant for learning, working and participating in society, as well as for EU policy-making. For more than a decade, the Digital Competence Framework for Citizens (DigComp) has provided a common understanding in the EU and beyond of what digital competence is and thus provided

a basis for digital skills policy-making, curriculum development and assessment of digital skills, both in education and for the labour market.

There is already a high awareness of DigComp as a pan-European framework for the development and measurement of digital competences. With this update, we aim to keep DigComp relevant for learning, working and participating in society. It will also help to strengthen DigComp's role in EU policy-making and the European Digital Strategy, including initiatives such as: the skills agenda; the digital education action plan; the digital decade and compass; and the European Pillar of Social Rights and its action plan.

As such, a large demand gap has emerged, as coverage is adequate but not reflected in connectivity and usage. Other challenges have also become more acute, such as the spread of fake news and cyber attacks, the growing risk to privacy and personal data security, and the large-scale production of e-waste. The global situation with regard to the unresolved balance between the benefits and costs of digitalisation is more unfavourable than expected 15 years ago. Geopolitical struggles, often centred on digital patents, standards and manufacturing, have significantly weakened multilateral decision-making and action. The environmental crisis has escalated into an environmental emergency or, according to some analysts, an environmental catastrophe. Rising inequality in many countries and the exclusion of vulnerable groups make it even more difficult to build social and political systems that can adequately manage digital development (Tolochko, S. V., 2021).

The COVID-19 pandemic has exacerbated all these problems and plunged the world into the worst economic crisis since World War II, with all the attendant negative consequences for jobs, wages, and the fight against poverty and inequality.

Digital technologies have played a key role in overcoming the effects of the pandemic. However, the benefits of their use are limited by structural factors such as connectivity constraints (access, usage and speed), social inequality, productivity heterogeneity and low competitiveness, and limited access to data and information management, among other factors. To overcome these challenges, it will have to embark on a major push towards economic, social and

environmental sustainability, leading to progressive structural change based on the vigorous creation and deployment of technologies to diversify the production system.

Digitalisation affects productivity and agricultural production chains. Digitalisation is necessary for a new future and progress towards a digital welfare state. The main directions of development of digital education allow us to identify the main ways to improve the process of forming professional competences of specialists in the digital educational environment of the university. Therefore, the model we present takes into account the specifics of setting goals and selecting content, organising students' learning activities and assessing learning outcomes. This model is designed for the gradual formation of professional competences in bachelors and takes into account the unity of the goal and result, as well as the dynamics of the process under study (Nikitenko Vitalina, Andriukaitiene Regina, Punchenko Oleg, 2019).

To implement this model, the organisational and pedagogical conditions for the formation of professional competences of specialists in the specialities of the management and economic cycle have been developed.

The practical significance of the process of forming bachelors' professional competences is confirmed by the results of the implementation of diagnostic tools for determining the level of professional competences, which allows to stimulate various types of student's learning activities; increase their motivation to learn professional activities; organise continuous monitoring of the quality of knowledge savings in detail in specific missions that are at the centre of the roadmap.

Rebuilding safe, healthy and efficient work and social environments is a challenge that requires collective efforts. The lack of digital skills and access to digital networks is an obstacle that slows down this joint effort, but already exacerbates the existing and sharp digital divide. In this period of uncertainty, a global collective effort is needed to ensure that everyone has the digital skills and access to digital networks needed to adapt to the "new normal". Technology has revolutionised every aspect of our society and our economy, including how we deliver our public services, helping to make people's lives easier and safer [5].

EU countries have presented the government's Digital and Data Roadmap 2022–2025 Transformation for a Digital Future to transform digital public services, deliver world-class digital technologies and systems, and attract and retain the best digital talent. This roadmap is an ambitious statement of intent, represents a new era of cooperation in digital transformation and marks a step in the digital and data agenda. The barriers facing the government in achieving digital transformation are significant, but the opportunities it presents are enormous and will ensure that society benefits for decades to come. Technology has revolutionised every aspect of our society, transforming our digital capabilities as well as realising our ambition to deliver world-class digital services to the public.

Digital data is key to building this more efficient government, effective digital education, digital personality and digital society. Ukraine has joined the European Union's programmes to develop digital education and digital competences.

The main objectives of the Framework Programme are:

1) present the types of basic skills needed to adapt to future work;

2) to provide a basis for lifelong employment, decent work and well-being for all women and men in different age groups;

3) to offer a reliable, concise taxonomy and definition of essential skills for policy makers, teachers, trainers and experts;

4) contribute to curriculum development in a variety of educational institutions;

5) inform the professional development of teachers, trainers and managers;

6) to promote awareness of the importance of basic skills among government, social partners, academia and the community.

Conclusions to Chapter 3

Developing a knowledge economy means not only focusing on the high-tech industry itself, but also combining knowledge innovation with the development of traditional industries. At present, the traditional economy still accounts for a relatively large proportion, so it is necessary to accelerate the improvement of the technological

innovation capabilities of traditional enterprises and promote the optimisation and upgrading of traditional industries with the knowledge economy.

The knowledge economy is a knowledge-based economy based on the entire process of knowledge production, transaction, circulation and consumption. The development of the knowledge economy has a comprehensive impact on economic development, including investment patterns, industrial structures, and even people's thinking patterns. A key element of the knowledge economy is the promotion of innovation, and the return on investment and the added value of products depend on the role of innovation in increasing productivity. The changes brought about by the knowledge economy must be comprehensive. The development of the knowledge economy confirms the truth that the factor that really drives an economy to achieve sustainable growth comes from knowledge innovation. It is also the centre of future global economic growth, which will bring great changes to human life. After the middle of the last century, the knowledge economy began to develop gradually, which was manifested in the development of information technology through the innovations of industrialised society.

The knowledge economy is defined as an economy based on the production, distribution and use (consumption) of knowledge and includes all knowledge created by people so far, knowledge of science and technology, management and behavioural science. The development of the knowledge economy has a profound impact on the investment model, industrial structure, and the function and form of education. In terms of investment patterns, there will be an increase in employment prospects in knowledge-intensive industries such as information, education and communications, leading to large-scale investment in intangible assets.

In terms of industrial structure, emerging industries such as e-commerce, the networked economy and the online economy are growing on a large scale; on the other hand, traditional industries such as agriculture will become more digital. Knowledge accumulation and innovation are a prerequisite for the development of digital production, and the speed and scope of change are rapid. Economic activity is accompanied by learning, and education is embedded

in all levels of economic activity, while the acceleration of knowledge renewal will make lifelong learning essential. Digital transformation IT is a means of implementing the digital transformation of enterprises and will include digital transformation technologies: 5G and terminal development, enterprise blockchain, chatbots and voice NLP agents, Internet of Things and wearable devices, Big Data and analytics, machine learning and artificial intelligence, cloud, network security, augmented reality.

CHAPTER 4
SUPPLY AND DEMAND FOR KNOWLEDGE WORKERS AND THE GROWTH OF INFORMATION WORKERS: FROM EDUCATION TO THE NEW ECONOMY

4.1 History of the Evolution of Distance Learning: from the Beginning to the Present

Online distance learning is also accessible to people who can study anywhere and anytime, which is suitable for busy people. Distance education dates back to 1728, when a teacher named Philip Crabb placed an advert in the Boston Gazette in an attempt to attract students to his weekly class to learn about a new shorthand he was teaching. The University of London was founded in 1858 as an off-campus course, and was the first school to offer degrees taught remotely. The Society for the Advancement of Home Education was founded in Boston, Massachusetts in 1873. In Australia, the University of Queensland established a Department of Communication in 1911. The University of South Africa also offered communication courses as early as 1946. Massey University in New Zealand launched distance education and off-campus courses at the university level in 1960. In 1969, the University of British Columbia introduced the largest distance learning programme. Some of the systems formulated by the Correspondence University of Hagen in Germany in 1974 were

later widely used internationally, and most of them were called Open University, using English or the local language, and many of them have developed into giant universities. Charles Wedemeyer of the University of Wisconsin-Madison is known as the father of distance education in the United States. From 1964 to 1968, with the support of the Carnegie Foundation, he led the Articulated Instructional Media Project (AIM), using various communication technologies to provide relevant courses to outsiders in need. According to Moore's story, the British who introduced AIM were deeply influenced by it, so they founded the first open university, now called the Open University, to distinguish it from other open universities. The British Open University was founded in the late 1960s and used television and radio as its original means of communication, thus elevating the status of the British Open University to a pioneer in the use of technology to promote education. Since then, it can be said that all open universities use distance learning technology as a method of communication. Many public and private, non-profit and for-profit institutions offer courses and educational programmes through distance education. But accreditation standards vary, and distance education provided by some institutions in the United States is rarely approved. In many other jurisdictions in the United States, the term "university" is not allowed to be used by institutions that are not recognised and authorised by the national government (Philosophy of the Main Spheres and Areas of Human Life, 2022).

In the United States, online learning has rapidly increased the exchange between universities, and online doctoral courses have even become a robust research system. In the 20th century, radio, television, and the Internet began to be used for distance education. Computers and the Internet have also made the spread of distance learning easier and faster. The for-profit, private University of Phoenix is a primarily online university. It currently has 200,000 students, and has grown to 500,000 since 2010. According to a 2006 report by Sloan Associates, nearly 3.2 million U. S. students at more than 96 % of colleges and universities took at least one online course in the autumn 2005 semester. Thompson Rivers University is a pioneer in providing distance education in Canada and its educational goal is to be accessible to anyone, anytime, anywhere.

It features over 400 individual courses and over 57 distance learning completion programs, such as Air University, where you can earn bachelor's degrees, associate degrees, college diplomas, a variety of undergraduate certificates, and diplomas of completion. There are two types of existing distance education technologies: synchronous and asynchronous. Synchronous technology is a delivery mode that transmits information to all online participants simultaneously. Asynchronous technology means that all participants can choose their own time to use the learning materials. Learners do not have to gather at the same time. A learning management system (LMS) or learning content management system (LCMS) can also be used for synchronous and asynchronous learning. (A learning management system is not so much a learning tool as a platform that makes it easier for instructors to control courses.) Distance learning has encompassed several technological changes in history, such as print, broadcasting, audio and video conferencing, computer-assisted learning, e-learning or online teaching and webcasting, etc. In cases where broadcasting is immature due to its scalability, such as in developing countries. FM frequency modulation in India is very popular and is widely used by universities to broadcast a variety of educational channels of school-like learning, such as rural development channels, farmers' training in agricultural knowledge; academic channels, creative writing training, mass communication, in addition to traditional liberal arts, there are scientific and administrative courses. The widespread use of MP3 players, PDAs and smartphones has also become an alternative means of disseminating information remotely. For example, some professors even allow students to watch music or videos related to courses through podcasts. In mainland China, universities that offer distance education courses used to be called "Radio and Television Universities" or "TV Universities" for short. On 31 July 2012, the official opening of the Open University of China, established on the basis of the Central University of Radio and Television, took place in the People's Congress. Since then, the Beijing Open University, Shanghai Open University, Jiangsu Open University, Yunnan Open University, Guangdong Open University and other open universities have been established successively (as of 2014), building on the original radio and television universities in various

provinces. A total of 68 colleges and universities have established online education colleges and offer academic courses. Students can use the Internet to study. In Canada, the University of Athabasca is a well-known distance education university in Canada, located in Athabasca, Alberta, Canada, 140 kilometres north of the provincial capital Edmond, and has a branch campus in Edmond and Canada's Calgary, the fourth largest city; AU is a well-known public university in Canada and a Canadian university recognised by the Chinese Ministry of Education. In the UK, the most famous distance education institution is the Open University of England (Innovative technologies in the modern educational space: a collective monograph, 2020).

In the United States, schools such as the Honolulu University of Arts, Sciences and Humanities and the Massachusetts Institute of Technology offer distance education courses. In Taiwan, schools such as National Air University and Kaohsiung City Air University offer distance education courses. In Hong Kong, the Hong Kong Metropolitan University offers distance education courses. In Japan, schools such as Broadcasting University offer distance education courses. In Malaysia, schools such as Visionary Open University and Open University of Malaysia offer distance education courses.

Michael G. Moore is a pioneer in the study of distance education in the world, one of the pioneers of distance education research and practice in the United States, and one of the founders of the development of international distance education. education have made outstanding contributions. From 1959 to 1960, Moore studied at Goldsmiths College in London, received a Postgraduate Certificate in Education (PGCE) and began to enter the field of education; from 1970 to 1973, he studied at the University of Wisconsin-Madison in the United States, under the guidance of Charles Wedemeyer), received a doctorate in adult education; Since 1986, he has been the Director and Professor of Education at the American Research Centre for Distance Education (NCSDE) at the University of Pennsylvania, and Editor-in-Chief of the American Journal of Distance Education (AJDE). In the development of distance education, Moore created many "firsts": in 1972, he published the first scientific article on the theoretical foundations of distance education in the field of distance education, and also proposed

and precisely defined “distance education”. an important term; in the mid-1970s, he taught the first graduate course in distance education at the University of Wisconsin; joined the Pennsylvania State University in 1986, founded the American Distance Education Research Center, and established the first American journal on distance education, The American Journal of Distance Education, etc. In his academic career, Moore has published many research papers on distance education and has published almost a hundred academic articles. His representative works include Learner Autonomy: The Second Dimension of Independent Learning (1972), Independent Learning (1980), Theory of Distance Interaction (1993), Three Types of Interaction (2000), A Systems View of Distance Education (2005), and Handbook of Distance Education (2007), among others. At the same time, Moore has delivered many important academic lectures around the world, making an important contribution to the promotion of distance education internationally. He has visited China three times. The first time was in 1991 at Beijing Normal University to give a public lecture entitled “Distance Education in the United States and the World”, and in 2006 he gave lectures on “The Distance Education Keynote Speech Brought New Vitality” to China’s distance education. In this interview, Professor Moore shared with us his life journey and views on distance education. He believes that the challenge of distance education is mainly about “resource allocation reform”, but that a successful change in resource allocation depends on a quality and effective transfer of the process of “knowledge innovation” (Bilohur, Vlada, Andriukaitiene, Regina & Makieshyna, Yuliia, 2021).

Moore outlined his efforts to work in the field of distance education in different countries and his work with the Global Distance Education Network. He suggested an ideal research area for future scholars engaged in distance education research and especially reminded us that the reform of educational methods and principles offers us great prospects for the development of distance education in the future. Distance education (distance education in Hong Kong, distance education in Taiwan) refers to a mode of learning that uses communication tools such as television and the Internet. Students who use this mode of learning are usually amateur learners.

Since they do not have to travel to a specific location to attend classes, classes can be held anytime and anywhere. Students can also help each other learn through various channels, such as television broadcasting, the Internet, counselling hotlines, classroom research clubs, and face-to-face (distance) learning. Institutions offering distance education mostly offer courses at the university or college level, including master's and doctoral levels. A few institutions also offer distance education courses at the secondary level. Many other terms (e.g. distributed learning, e-learning, mobile learning, online learning, virtual classroom, etc.) are roughly synonymous with distance education. In Malaysia, schools such as Visionary Open University and Open University of Malaysia offer distance education courses. Introduction to Distance Education Strategies for School Suspensions Due to the COVID-19 Pandemic The large-scale suspension of schooling as a public health control measure to combat the spread of the novel coronavirus has left education systems around the world facing unprecedented challenges (Fursin O. O., Muts L., Voronkova V. G., 2019).

Government agencies are collaborating with international organisations, private sector partners and civil society organisations to deliver education remotely, using a combination of technologies to ensure that lessons are kept for all, regardless of school closures. The development and strengthening of distance learning strategies is a response in the education sector to the sudden closure of schools due to the COVID-19 pandemic. These strategies are guided by concerns about equity and inclusion, and the need to ensure that distance learning is designed and implemented without exacerbating existing educational and social inequalities. However, planning for a more comprehensive distance education strategy should be guided by addressing immediate educational deficits and developing long-term educational goals. In addition to responding to the current COVID-19 crisis, working towards the large-scale deployment of distance education at all levels of the education system offers valuable lessons and can inform efforts to create more open, inclusive and flexible education systems post-COVID-19. Distance education refers to a mode of learning that uses communication media such as television and the Internet. It breaks through the boundaries

of time and space and differs from the traditional mode of learning where you have to go to a school building and sit in a classroom. Students who use this mode of learning are usually amateur learners. As there is no need to travel to a specific location to attend classes, classes can be held anytime and anywhere. Students can also help each other learn through various channels, such as television broadcasting, the Internet, advice hotlines, classroom research clubs, and face-to-face (distance) learning. It refers to the collection, design, development and use of various educational resources, the construction of the educational environment by a particular educational organisation, the integrated application of technology of a particular social period and the provision of technology-based education for students, educational resources and the educational environment of a particular social period Service, as well as the organisation of group meetings and communication activities for students (traditional face-to-face or modern electronic means) for the purpose of learning and socialisation, and all practical activities aimed at In all activities, teachers maintain an almost constant separation from students in the form of educational resources or as learning facilitators; while students and educational organisations (teachers) or learners establish mechanisms for two-way or multi-way communication, supporting instantaneous conversations. In China, modern distance education is sometimes referred to as network education. Most of the current distance education classrooms and modern distance education institutions engaged in higher education are network education colleges or modern distance education colleges in regular colleges and universities. Networked education is a new concept created after the application of modern information technologies in education, i.e. education delivered through networked distance technologies and environments. In some documents issued by the Ministry of Education, modern distance education is also called network education (Volkov O. G., Zemlyansky A. M., Oleksenko R. I., Ryabenko E. M., 2017).

It is a form of learning in which students and teachers, students and educational organisations mainly use various media methods for systematic learning and communication. It is education that delivers courses to students in one or more off-campus locations. Modern

distance education refers to education that transmits courses off campus through the use of audio, video (live or video) and computer technology, including real-time and nonreal-time modes. Modern distance education is a new type of education with the development of modern information technologies. The development of computer technologies, multimedia technologies, communication technologies, especially the rapid development of the Internet, have made a qualitative leap in the means of distance education and have become distance education in the context of high technology. Modern distance education is based on modern methods of distance education compatible with traditional forms of education, such as full-time, part-time and independent education, as well as on a teaching method that optimises the combination of different media. Modern distance education can effectively reproduce the characteristics of distance education. It is a type of learning activity in relation to face-to-face learning, separation of teachers and students, and part-time organisation. It is an inter-school and inter-regional education system and teaching mode. Its characteristics are: separation of students and teachers; use of special transmission systems and media for learning; transmission of information in different ways; places and forms of learning are flexible and changeable. Compared to face-to-face education, the advantages of distance education are that it can overcome time and space constraints; provide more learning opportunities; expand the scope of teaching; improve the quality of teaching; and reduce the cost of education. Based on the features and advantages of distance education, many insightful people have realised the importance and broad prospects of distance education. A good reminder: if your order includes books that are not available/ pre-sold in Simplified Chinese or are available from foreign manufacturers, we recommend that you place your order separately from other products to avoid long waits

1. Develop students' ability to learn independently. In distance education, the instructor and the student are not in the same area. During the learning process, the learner can move independently without unnecessary pressure and learn easily. However, the learner must also have the ability to self-discipline in order to achieve the learning goal. Thus, this type of learning is undoubtedly a test

of independent learning. There are also many people who believe that online learning is not necessary for learning and cannot gain knowledge. This is actually true of people who do not have the ability to learn independently. In fact, as long as learners take the time to listen to lectures carefully, it is still useful. For example, some schools are now opening online education platforms, and students can communicate with teachers online if they have any questions during their studies.

2. Break the boundaries of spatial communication. The big difference between distance education and traditional education is that the traditional method of learning will have the limitation of inconvenient communication across geographical regions, but distance education breaks this boundary. As long as there is a network, it is not limited by location. You can use your mobile phone or computer to access the platform for teaching and learning. Most importantly, learning is no longer limited by time and place. It is suitable for people who are already working and they can use their free time to study independently.

3. Admission is easy and the pass rate is high. Credit for exams in distance education is different from traditional education. Students are enrolled twice in autumn and spring. Students can enrol smoothly after passing the exam without an exam or self-completion. Compared to traditional exam-based enrolment, it has a higher pass rate This is more attractive to practitioners who have a long history of books. It only takes a little effort to study and mostly pass. In addition, the specialities studied in online distance learning are not limited to the specialities for which you need to apply. For some non-specialist majors, if you are interested or have to apply, you can apply for an exam.

4. Distance education diplomas are equivalent. Many people think that distance education diplomas do not cost much and believe that diplomas obtained through self-examination and adult college entrance exams are better than distance education. In fact, there is no difference between a diploma obtained through distance education and a part-time diploma obtained by other means. They are all nationally recognised academic qualifications and have the same validity for further study without special requirements. Compared to the other three, distance education is relatively easy to obtain

diplomas and degrees (European Guidelines for the Development of Ukraine in the Context of War and Global Challenges of the XXI Century: Synergy of Scientific, Educational and Technological Solutions: in 2 volumes, 2023).

5. Break through the age limit. Distance education not only overcomes the limitations of time and space, but also overcomes the age limitations of students. It meets the needs of society. Many adults still need to learn from time to time to enrich themselves. Modern distance education provides these people with great opportunities. As long as you have the interest and purpose to learn, combined with your own conditions, the realisation of the "live and learn" principle has become a reality (Designing Environments, 2018).

6. The cost is relatively low. Distance education schools do not occupy educational resources, and courses recorded by teachers can be studied in several specialities, which ensures relatively low fees for distance education.

7. Effective integration of educational resources. For colleges and universities that host online learning, a variety of educational resources can be distributed and shared through the Internet, and good teacher resources and teaching achievements can be shared without wasting resources.

8. Quality of distance education. Compared to distance education, the entry requirements are low and it is easy to pass the exam, so there is a so-called "wide entry". However, to ensure the quality of online education and teaching, the state and host universities will implement strict rules and regulations, and undergraduate education must pass English and computer exams organised by the state to obtain a certificate of completion. In this way, the rigour of distance education is guaranteed, and only by passing the exam can a diploma be obtained, which is called a "rigorous exit".

9. The form of education is interactive. Teachers and students can discuss and exchange ideas online, thereby reducing the distance between them and making communication between teachers and students barrier-free. Using computers, teachers can judge the types of questions students ask, the number of people in the class, and the level of attendance to help students solve complex problems and organise learning activities more effectively.

10. Learning management is humanised. The distance education learning management platform has automatic management control and remote interactive processing functions. It helps students to consult, register, pay fees, select courses, make inquiries, process files, etc.

4.2 Advantages and Disadvantages of Modern Distance Education

1. Unbalanced development. Distance education, which can only be accessed via the Internet, is still under the relative influence of the regions of China. Due to the backwardness of the basis of economic construction, the developed eastern regions have a higher priority in the development of distance education than the developed western regions, so it is difficult for the country to unify the formation of relevant policies, which also leads to objectively poor standardisation of distance education. In addition, a recent report investigating the status quo of distance education found that there was a situation of unqualified enrolment and that some students were unaware of the conditions of online learning.

2. Duplication of learning resources. To keep pace with developmental needs, many schools attach great importance to classroom work combined with online learning. Some qualified schools have started to develop online distance learning. However, there are many challenges in the development of distance learning. in different schools One aspect is the duplication of learning resources. When many schools introduce distance learning, in addition to the learning management system, each course is completely redesigned, which requires not only a lot of money but also a lot of manpower. Today, many schools organise online distance learning in cooperation with enterprises. Businesses provide the capital and technology, while schools provide the teaching staff and supervision. This type of work in schools is basically a kind of marketing behaviour, blindly making profits and paying attention to large -benefits of scale. In this case, the pilot schools are independent, and it is not easy to cooperate, which will easily lead to duplication of teaching resources between schools (Digital Transformation of Education and Science, 2023).

3. Lack of professional talent. The main reason why distance education is very different from traditional full-time education is that teachers and students are not synchronised in time and space. How to transfer the benefits of traditional face-to-face pedagogy to distance education in this new system of online education is a challenge that needs to be addressed. There are not many people who know how to work with network technologies and have good teaching abilities, so the evolution of the traditional model of education to online learning has not been able to progress.

4. There is a lack of diversity in teaching. There are few teachers who are proficient in networking and have good teaching abilities, which indirectly affects the quality of the learning material, which is crucial for networked teaching, resulting in a lack of diversity in networked learning models. Such learning has a negative impact on students later in their studies, it will weaken students' active mobilisation in learning, and students will not have a deep understanding of the learning content and a thorough understanding of it, which will directly affect the quality of learning.

5. Online distance learning has hidden disadvantages. Nowadays, people do not understand multimedia networked distance education sufficiently, only superficial knowledge, and blindly accept this new model of education, while distance education also ignores the continuous progress of society. The development of information technology and electronic information products is changing the way we work and study, and gradually new models are replacing the old ones. They do not pay attention to this distance education, do not combine social phenomena for innovative learning, and copy the practice of traditional schools. For example, in terms of teaching materials, most online education teaching materials still use the teaching materials of traditional schools, and some do not even have the necessary teaching materials. It seems that online education still uses multimedia to copy and paste the old school education, and has not found its own unified logical structure. In the long run, the weaknesses of online distance education will not be effectively addressed, which will put online distance education at a disadvantage.

6. Online distance education lacks a real feeling. The object of distance education is very broad, and there is no specific teaching

group. Compared with traditional learning, distance education lacks situationality. The so-called situational nature refers to learning according to the actual learning scene combined with students in learning activities, and there is no point in leaving the scene. This is also a big disadvantage of current distance education: without emotion, the learning mode will be patterned, and repetitive and mechanised tasks will be performed without additional emotion. It is true that although distance education can communicate online, it is always separated by a screen, and human emotions are difficult to understand. That is why it takes a long time to observe and understand a person because we are facing a cold world. With a screen, we cannot observe students closely. With this limitation, the teacher's impression of the students is only approximate. Thus, the teaching method cannot be developed and modified to suit each individual. More importantly, emotions themselves are an important part of education, which is impossible or difficult to achieve in online education.

By examining the advantages and disadvantages of distance education, we have a preliminary understanding of modern distance education. Compared to staff with different needs, distance education has more advantages. Based on the characteristics and advantages of distance education, although current distance education has its disadvantages, distance education also has its progress and potential. The creation of a learning society system, modern distance education as an important part, must be constantly improved and refined. First of all, some of the disadvantages of online distance education mentioned in this article are solved and strengthened to make the creation of resources more standardised; on the other hand, online distance education schools should have qualified teachers to help improve the system of learning functions and reduce the gap between teachers and students The unusualness of communication. At the same time, as a group of educators, we must strengthen our beliefs, confront the emergence of contradictions and problems, and take effective measures to solve problems reasonably. Only in continuous improvement and progress can the business of modern distance education develop steadily (Digital Economy: Textbook, 2022).

4.3 Supply and Demand for Knowledge Workers and the Rise of the Information Worker in the New Economy

As a result of the globalisation that is taking place before our eyes today and the increase in technological development, one of the most debated issues in working life is the concept of the 'worker'. Increasingly demanding skills and flexible working conditions are creating new work environments. In addition, from the perspective of product development and innovation, the new economic environment is putting competitive pressure on businesses. Post-Fordist flexible forms of production, which are gradually replacing Fordist mass production, create different conditions for the workforce. The computer era, which began with ENIAC in 1944, together with the development of the Internet and computer networks with ARPANET in 1969, has led to an environment in which the use of computers, individual decision-making and teamwork are becoming important in the business environment, and the concept of the intelligent worker has been put on the agenda. In an environment created by new technologies, where knowledge has become an important factor of production, there are differences in the qualification requirements for employees. A new definition of an intellectual worker has emerged. It is based on a hierarchy of data, information and knowledge. The definition of an intellectual worker has been criticised as it lacks a methodological and theoretical basis. Intellectual workers are not a professional group, but those who work in professional services such as R&D, product development, advertising, education, and law are defined as intellectual workers. The definition of an intellectual worker is based on industrial change. After Daniel Bell's research in 1980 and 1987, information research and discussions about the information age began. Kumar (1981) focused on various aspects of the post-industrial era. Bell's work takes a more sociological view of events. The class that sociologists such as Mallet, Touraine, and Bell call the "new worker" has developed in parallel with the development of the information society. In 1991, Robert Reich symbolically defined "the worker whose fingers are on the mouse (computer mouse) and whose thoughts are in space is a knowledge worker". Intellectual work has emerged with such

developments as Drucker's information society, Castells' network society, and the new networked economy, which has given rise to a new type of "intellectual worker". Based on the fact that capital expenditures on modern technological equipment also increase the demand for an educated workforce, the definition of a knowledge worker is also shaped by technological progress. Some authors define knowledge workers according to their characteristics. Employees who have the ability to analyse and synthesise, who can transform information according to job requirements and solve problems with different variables are defined as knowledge workers (Cherep, A., Voronkova, V., & Cherep, O., 2022).

Another way to define the group is to consider the skills and abilities of information technology workers. Employees who are highly educated, creative, proficient with computers, can easily adapt to any environment due to their intelligence, and can use their knowledge are defined as knowledge workers. These types of workers make up the fastest growing area of the workforce. New technologies are creating jobs that require complex thinking rather than routine work. Intellectual workers put their intelligence and ideas into a product; they are workers who turn themselves into goods and services, who can give their knowledge by selling or trading, who are constantly learning, who have a desire to learn, who are committed to learning and improving. In general, those who work on the use and development of knowledge are defined as knowledge workers. The definition of a knowledge worker has now come to encompass those who work with intelligence. Today, the definition of an intellectual worker is widely spread: information producers (scientists, researchers, specialists, software engineers, biotechnology engineers), information carriers (teachers, librarians, professional communication workers), information processors (administrative and secretarial services), infrastructure personnel (machine operators, maintenance staff). It can be seen that the importance of ICT information work has also increased when viewed from the perspective of an occupational group such as technicians or the service class as a base class. Knowledge workers in the globalisation era therefore have many important applications. They have less equipment, but the specialist's specialised knowledge provides monopoly power. Any power

in a liberal market structure has to reveal its position in the labour market as different from its professional position. With ICT, routine work is performed by computers, while work requiring creativity is performed by information technology workers. The concept of knowledge work is considered as an appropriate expression for the concept of the information age. UNESCO's definition of research and development is a useful benchmark for defining R&D. It is defined as the increase of human knowledge in systematic creative activities, its use in social and cultural fields, applied research, development of new tools, products and processes. Knowledge work is also defined as the development of knowledge and data science. Knowledge workers are those who can quickly organise symbols and concepts and bring long-term success to their companies. The share of knowledge-based work is fundamentally different from what was previously known. Supply and demand for knowledge workers. In knowledge-based industries, it is the job of knowledge workers to collect, analyse and create value. Blue-collar workers are being replaced by knowledge workers. Labourers will not be able to become knowledge workers overnight, just as farmers will not be able to become workers overnight with the shift from agriculture to industry. Education and infrastructure is an important issue (Cherep, Alla, Voronkova, Valentyna, Cherep, Oleksandr, & Kaliuzhna, Iuliia, 2023).

With the development of events, the number of jobs requiring special professional skills (training, discussion, computer...) is growing. The share of services is growing, and automation is eliminating many manufacturing jobs. At this point, the problems increase. Along with the shortage of brain workers/skilled labour, the skills requirements for industrial and white-collar workers are growing. Since the 1980s, the US labour market has seen a decline in demand for semi-skilled or unskilled labour. The main explanation for this is skill-oriented technological change. Research in this area is also linked to the rapid spread of computers. With the development of the modern knowledge-based economy, the demand for information technology workers has also increased. For example, over the past 25 years, the number of intellectual workers in Canada has grown rapidly. The annual increase in total employment of scientists (basic and applied sciences), engineers and social scientists was 5.2 %. In this context, cooperation

between the government, university and industry is an important issue. The production of a mental worker can be unlimited at the same level of demand. These results arise because information can be used by many people at the same time and is not exhausted when it is used, but when new information is replaced, the use of the old information decreases. The supply of skilled workers is a concept related to having enough workers to supply the labour force. The main driving factor is the loss of jobs in agriculture and industry. The main attractive factor is that information work has features such as high individual responsibility and high income opportunities compared to jobs. There is a correlation between the productivity of an intellectual worker and the supply of intellectual workers. The number of new jobs created in the new economy is unsatisfactory in terms of absorptive capacity. This is not to say that the same potential has not yet been fully realised in the new economy. At the very least, the new jobs that are being created in the new economy are not satisfactory, especially in developing countries. The question is what happens if the supply of efficient knowledge workers grows faster than the demand for knowledge products. As productivity in agriculture increases, many farmers become unemployed and move into manufacturing and services, while these sectors absorb this labour from the agricultural sector. If the productivity of production workers increases more than the demand for the product they produce, production workers should also decrease. There are 2 important differences here. When employment in agriculture declined, employment in manufacturing increased, and both agriculture and manufacturing expanded the service sector to absorb this labour. A shrinking sector absorbs a new, growing one. The service sector will have to expand and be divided into different, different sub-sectors, and with the development of new technologies, it will have to maintain this state of absorption (Shparyk, O., 2022)

The pace of technological change is now too fast. ICT industries are changing especially fast. The information sector cannot absorb the decline in other sectors. Intellectual workers will be involved in many new creative jobs, knowledge does not exist without mental activity. An intelligent worker can work like a typist and can produce reports etc. in less time. can prepare, but the main work is; combining,

organising, communicating, accessing data related to knowledge production and creating original and creative work. It can be defined as the process of scanning pre-existing and creating a new product that did not exist before, with the true work of an intellectual worker. Working with original knowledge is when you can create something that did not exist before. Historically, most innovations have been the result of original knowledge work, and they have also had a positive impact on people's living standards. The Internet and other information technologies play an important role in the work of an intellectual worker. It is believed that ICT will have an impact on knowledge work in the near future. Within knowledge work, the distinction between genuine creative work and routine work will become increasingly clear. There will be changes in the issues of collection, regulation, and socialisation. e-mail, chat rooms, and electronic media prevent us from travelling more. Electronic relationships are replacing face-to-face communication because it is easier and more comfortable to use technology. The data needed to create new knowledge can be easily accessed via the Internet. Today, the Internet is an important part of working life, taking the place of libraries and beginning to make changes in medical diagnostics, journalism, engineering and other professional activities. In addition to supply and demand in labour markets, structural changes such as the evolutionary process, the knowledge economy and the heterogeneity of labour supply are taking place. In recent years, the main change in labour demand has been associated with the information economy, information and knowledge. In this process, information functions are growing with the increase in communication and creative activities, and even the meaning of knowledge itself is changing. There are differences based on the types of information.

1. Traditional knowledge, economic capital: the way knowledge is used, partly through investments in research and development, is called economic capital.

2. Social and organisational capital: This is extremely important, especially in terms of communication skills. It is also referred to as social relational capital.

3. Cultural capital: used to explain the growth of economic success.

With the emergence of new sources of knowledge in the information economy, there is a transition to a knowledge economy. Knowledge economy practices are important for economic growth. Investments in software, marketing, design, consumer solutions, and the quality of related relationships are increasing. Companies, regions and countries are competing, and advantages are gained through human resources. European companies invest 3.3 % of their revenues in knowledge management. Jobs/professions are changing in the knowledge economy. Employees do not produce "products", they participate in the process of creating and transforming knowledge. This hidden (= tacit) information, similar to unwritten rules, is used in the business environment, partly important, including social and regional networks. In the knowledge economy, in addition to these new sources of knowledge, economic capital is extremely important in terms of creating the infrastructure and the right environment for the production of high-tech products. Investments in software, marketing, and the quality of relationships are also crucial. Knowledge plays a multidimensional role in economic growth. High technologies are not only ICT-intensive, but also knowledge-intensive (in the form of a balanced combination of economic, social and cultural capital) (Shparyk, O., 2021).

The importance of innovation and research and development also plays a major role in the application of economic capital. The globalisation of the economy and rapid technological innovation are bringing about constant changes in the current structure of the workforce. The work environment is evolving in response to technological innovation, and existing technical skills are being lost. International competitiveness is changing. Workers should always develop their problem-solving abilities and technical skills through lifelong learning. In the knowledge sector, intellectual workers are educated and intelligent. A large number of intellectual professions are emerging, resulting in a growing demand for intellectual workers. In addition, the productivity of workers is increasing as a result of the use of ICT as a tool. Knowledge and skill requirements among young people tend to increase rapidly. The concept of lifelong learning is extremely important, especially for intellectual workers. The environment created by the brain workers shows that formal

education needs to be reconsidered. It should be aimed at educating people who are able to keep up with accelerating structural changes and a changing work environment. New educational opportunities need to be created, and education needs to be revised to ensure both economic growth and a higher standard of living. There is an important link between the element of trust and economic growth. Where people's trust in each other and in institutions is high, growth is also high. This kind of knowledge is also considered cultural capital. Thus, the new economy has seen significant changes in labour supply and demand. With the knowledge economy, the heterogeneity of labour supply has increased due to the need for skilled labour. Capital and knowledge, including these concepts, are important for economic success. The role of labour as a factor of production has decreased, while the role of skilled (intellectual) labour and knowledge has increased (Dovgal, O. A., & Dovgal, G. V., 2021).

4.4 China's New Economy as an Important Driver of Economic Growth and a Condition for the Emergence of New Professions

The new economy has become an important engine of economic growth. With the development of the new economy, new professions are constantly emerging, and the continuous development of people and innovative employment opportunities are only the true embodiment of the development of the times. New career opportunities are expanding from the consumer side to the production side. There are more and more people returning from the city to their hometowns to start businesses and become new farmers and a new driving force for rural revitalisation. Science and technology require "high-tech and first-class" talent, and smart healthcare is worth trillions of dollars. The blue ocean, the development of the new economy, and people's livelihood needs in elderly care have given rise to new professions; niche hobbies have gradually become mass industries, opening up broad prospects and opportunities; environmental and low-carbon reforms and changing professions into new fashions. As China fully implements the rural revitalisation

strategy and carries out measures to promote the revival of rural industries and talent revival, more and more young people have begun to return to their hometowns to start businesses and become new farmers. These new farmers brought new ideas for development, digital services represented by e-commerce were extended to rural areas, and two-way consumer exchange and interaction between urban and rural areas gained popularity, and gave new impetus to the rural development economy. New formats such as live sales and mobile food baskets are flourishing. New farmers in the new rural areas are embracing high technology. With China's 1.8 billion hectares of prime farmland, protection from UAV flights has become an incentive to modernise agriculture. According to the Ministry of Human Resources and Social Security, the demand for drone pilots will reach about 1 million in the next five years. A group of "new farmers" such as farm live streaming sellers, drone pilots, professional agricultural managers, family managers, and rural guides continue to grow. According to the report, there are nearly 1.322 million rural e-commerce enterprises in China. Policy support and platform traffic tilt are driving the development of rural live e-commerce, with strong science and technology demanding talent in "high tech". The Government Work Report 2022 states that one of the government's tasks this year is to strengthen technological innovation capabilities and promote the development of the digital economy. The digitisation, networking, intelligence and service industries of the new round of the industrial revolution have not only given rise to new forms of employment and entrepreneurship, but also to new professions such as digital managers and modelling engineers. These new economies and new professions allow technology to truly lead the future (Zhiliang, G., SolianykA., & Karpenko, O., 2023).

The rapid development of the digital economy has a profound impact on job choice and employment. According to the Future Employment Report 2020, the development of technologies such as big data, artificial intelligence and robotics will lead to a net increase in employment in China by about 12 % over the next 20 years. According to the report "One Hundred Scenes of New Jobs in 2022 in the New Economy", there are 1.044 million digital economy-related enterprises in China, and the number of registered enterprises

grew rapidly in 2021. The broad application scenarios of technology require the urgent use of diplomas, and skilled technologists possess advanced scientific knowledge. New digital job openings continue to emerge, such as artificial intelligence algorithm engineer and artificial intelligence services solution architect. At the same time, digital demand for traditional positions such as digital warehousemen and supply chain managers is also accelerating. The accelerated integration of the manufacturing industry and the new generation of information technology have brought new opportunities for the development of medicine and healthcare. The process of training highly skilled medical talent in the "doctor + X" is accelerating, with new professions such as artificial intelligence medical image algorithm annotators and pathology algorithm engineers mushrooming. The report shows that there are now 440,000 healthcare-related smart companies in China, with an average five-year growth rate of 23.7 %. According to the Healthy China 2030 Planning Plan, the total market scale of China's healthcare industry will reach 16 trillion yuan by 2030, and this prospect is promising. The development of the new economy is full of vitality, and people's livelihood needs have given rise to new professions.

New professions are emerging, such as healthcare companion, and demand for related positions is growing rapidly, such as online learning teacher, etc. The emergence of these new professions is helping 300 million older people to live. The report shows that in 2021, the number of economy-related businesses will reach 50,000, with a compound annual growth rate of 21 % over three years. According to another report, there are more than 13,000 vocational education-related enterprises in China, with a growth rate of around 15 % over the past five years. New professions such as course planners, online learning service providers, online teachers, career planners, and beauty instructors are cultivating new strengths. Niche hobbies are gradually becoming mass industries, and new activities continue to emerge. Young people are no longer limited to the usual "system" and "internet" cameras, but are more committed to a high-quality life and embarking on an innovative career path. According to the report, the number of companies associated with the "lazy economy" will reach 1.883 million in 2021, with an average growth rate

of 112.7 % over the past three years. With a market size of 100 billion, the lazy economy is also nourishing society, opening up broad prospects and opportunities. New professions continue to emerge, such as online contract workers for garbage collection and errand delivery workers. The pet industry chain is constantly evolving (Cherep A. V., Voronkova V. G., Cherep O. G., Nikitenko V. O., 2022).

Among them are direct trade in the livestock sector at the top of the chain and pet care, foster care, interesting professions such as pet detective, pet dieters, pet bakers, and pet healthcare professionals. People's niche hobbies are gradually becoming a mass industry. There are a total of 27,000 fashion-related companies in China, and the average three-year growth rate from 2019 to 2021 reached 23.4 %. A fashion game designer, doll restorer, graffiti artist, costume designer, BJD (make-up artist), Lolita skirt handle designer, and other niche professions have emerged. Guangdong has become the "home" of 90 % of fashion games in China. In the past three years, there have been 18 financial events on the fashion gaming track with a total funding of 1.7 billion yuan. Green and low-carbon are leading economic reforms and changing the new employment fashion. The 2022 Government Work Report states that it is necessary to promote carbon neutrality work in an orderly manner. The two-carbon economy is growing rapidly, industrial transformation and modernisation are accelerating, and strategic emerging industries are opening up rapid growth space. New relevant professions such as carbon emissions administrators, energy savings assessors, waste sorting engineers, etc. have also been developed. These new economies and new professions directly contribute to sustainable economic and social development. Among the 18 new professions announced by the Ministry of Human Resources and Social Security in March 2021 are carbon emissions administrators. According to the report, in 2021, professional demand for energy conservation assessors grew by 214.8 % compared to the same period in 2018. "New green jobs" such as circular economy managers, energy auditors, waste sorting engineers, environmental inspectors for electrical and electronic products will benefit from the momentum. The average three-year growth rate of the number of related enterprises reached 45.8 %. It is believed that the development of a double-carbon economy

will lead to China painting a beautiful new picture. New professions are developing along with the development of the new economy and are becoming an important driving force for the development of new economic formats; the rapid emergence of new professions gives practitioners more opportunities. The development of the new economy and new professions is not only a footnote to the economic boom, but also a microcosm of people in the new era exploring a wider space for development and striving for a better life. The two form a benign ecological system that fosters each other. By providing and meeting the needs of people and society, they contribute to sustainable economic and social development. Recently, a total of 18 new professions in three categories were announced to the public, including digital professions, environmental professions, and new professions created according to people's needs for a better life. The development of new business formats has given rise to new professions, including exploratory tourism instructors, family housekeepers and digital solution designers. The new profession will open more employment windows, which plays a positive role in promoting the transformation and modernisation of the industrial structure and high-quality economic and social development (Cherep A., Voronkova V., Nikitenko V., Ažaja M., Muts L., 2019).

The educational tourist instructor has also become a new profession. Study tour instructor is one of the new professions recently announced by the Ministry of Human Resources and Social Protection. On 14 June, 18 new professions were announced to the public, which are to be included in the new edition of the classification of professions. Digital occupations, environmental occupations, and new occupations driven by people's needs are the three main categories of new occupations, reflecting new trends in economic development. Experts believe that new business forms give rise to new occupations, new occupations will bring new jobs, new jobs can promote economic development, and play a positive role in promoting the transformation and upgrading of industrial structure and high-quality economic and social development. Educational travel instructors have also become a new profession, reflecting the new trend of integrated development of culture, tourism and education, helping to attract more professionals to the industry. According to the Ministry of Human

Resources and Social Security, housekeeper is a new profession that has achieved a massive leap from "0" to "one million" in just a few years, and this is inseparable from the development of the industry. Some industry representatives pointed out that the recognition of housekeepers in the family and a series of supporting projects such as prescriptive vocational training and qualification certification can largely solve the problem of talent shortage in the industry and promote the industry's healthy growth. The development of the digital economy has given rise to digital careers. Among the 18 new vacancies, 9 digital vacancies were generated by the development of the digital economy. The digital economy is driving profound changes in production methods, lifestyles, and management practices. During the revision of the occupation classification ceremony, a special study was conducted on the classification of occupations against the background of industrial digitalisation and digital industrialisation, and occupations with obvious digital characteristics were noted. Judging by the new professions announced this year, the integration of the digital economy and traditional business forms has become an important driving force for the birth of new professions. The reason for the platform for the cultivation of new professions is the integration of traditional forms of business with digital technologies, which in turn facilitates the emergence and growth of new models and new forms of business (National Report on the State and Prospects of Education in Ukraine: Monograph, 2021).

Conclusions to Chapter 4

Digital technologies can significantly improve learning efficiency and training outcomes. They offer a good opportunity to grow interdisciplinary talent, which is much needed nowadays. Digital education should be more equitable, inclusive and of higher quality. It is our shared value to promote inclusive education and to realise learning and teaching without discrimination. Digital technologies are characterised by interconnectedness, instantaneous efficiency and dynamic exchange. They can quickly and efficiently gather scattered, high-quality resources, overcome time and space

constraints, and distribute and share them across schools, regions and countries so that people in different environments can have equal opportunities and channels to educational resources. Quality is the lifeline of education, and digital technologies are a ladder to improve the quality of education. The development of digital education can enrich the application of scenarios such as smart classrooms, adaptive learning, intelligent diagnosis of learning conditions, smart classroom assessment, and the promotion of online and e-learning. Today, global education is facing serious challenges and a learning crisis, so education reform is an urgent need. This also requires the international community to fully harness the power of digital transformation, strengthen dialogue and exchanges, and deepen pragmatic cooperation. In this context, the World Conference on Digital Education has launched the Global Digital Education Initiative. The content of the initiative includes strengthening policy dialogue and communication, promoting infrastructure connectivity, and facilitating the sharing of digital resources, etc. The development of digital education and the promotion of digital transformation of education is a general trend, a development need and a direction of reform. Education is an important strategic support for my country's modernisation, and the digitisation of education is the only way to build a strong educational country. However, for a long time, many people have been accustomed to viewing the digitalisation of education as a practical or even technical proposal, leaving aside many prerequisites and even fundamental issues. In the digital era, in the face of the technological acceleration of human society, we need to give a theoretical answer to the value and possibility of digitalisation in education and to realise the future of education in our minds in order to better serve the digitalisation of education. Continue to move forward on the path to becoming a powerful educational country. To integrate and interact, improve teaching methods, enhance creativity, experience and inspiration in the teaching process to undergo profound changes, develop innovative educational learning and models to improve education management, enhance human learning and cognitive performance, and provide a powerful impetus to achieve better education. Technology continues to create and reconstruct

human society, and people in every era have enjoyed the dividends of technology. Today, digital technologies are driving profound social change. Technologies such as quantum computing, gene editing and artificial intelligence are having a large-scale and far-reaching impact on human society. at the same time, problems such as “digital poverty” and the “digital divide” have re-emerged. Education also faces many risks in taking advantage of technology. Where modern technology will take education has become an important issue for us and the topic of the hour. Education must meet the demands of the diversity of human existence in the digital age, as this means diversity of education. Modern technology has had a profound impact on the physical and even psychological structure of today’s children. Traditional ideas about children are ineffective in understanding children in the digital age and need to be updated. Likewise, in the face of the rapid evolution of the technological system, especially the exponential development of artificial intelligence, the professional orientation of traditional teachers is also under serious threat. “What a teacher should be in the age of intelligence” concerns every educator. We understand that only by increasing the advantage of the “human” as such can we win in the future “human-machine” competition.

CHAPTER 5
DIRECTIONS OF EDUCATIONAL PARADIGM IMPROVEMENT FOCUSED ON THE NEEDS AND LIFELONG LEARNING

5.1 Creative Education as a Global Trend in Digital Transformation

Creative education has become a global trend that is developmentally oriented, emphasises that knowledge is the basis of creativity, and teachers play a leading role in learning. It is characterised by encouraging students to engage in active research, emphasising divergent thinking and learning with unique characteristics. The goal of creative education is to foster curiosity, creative awareness, creative perseverance, creative thinking and technique, etc. Developing students' creativity is one of the main goals of education, and the future society needs more creative talents. Creativity can be enhanced through education and training. The results of a large number of learning experiments show that specialised creativity training can increase learners' creativity by 10–40 %. Creativity and intelligence are different categories, and intellectual education cannot replace creative education. Compared to traditional teaching methods, creative teaching methods can achieve better learning outcomes. Creative teaching should mobilise students'

enthusiasm and initiative, emphasising that self-directed learning is the principle of creative education. A person's intrinsic motivation to strive for success is the main driving force behind creative activity, and strong creative motivation will stimulate people's creative abilities. The level of creativity is directly proportional to the achievement of any profession, and the development of creativity is very important for every educated person in various professions and industries. According to Osborne's theory of the creative process, the American creative scientist Parnes developed the Creative Problem Solving (CPS) model, which has been used in a large number of educational programmes and is considered one of the most effective learning models. The five stages of CPS are to first exercise divergent thinking and then convergent thinking. The five stages of the model are: 1) fact discovery; 2) problem discovery; 3) assumption discovery; 4) solution discovery; 5) acceptance discovery, among which assumption discovery is the key. Only by breaking the habitual way of thinking can creative ideas be generated. This model is very workable and easy to teach, especially in terms of penetrating the subject and creating education that can play an important role (Nikitenko Vitalina, Metelenko Natalia, Voronkova Valentyna, & Vasylchuk Gennadiy, 2023).

Torrance, the former Director of the Department of Educational Psychology at the University of Minnesota in the United States, has conducted in-depth research on the developmental possibilities and measurability of creative thinking and proposed a number of theories of creative thinking testing. He believes that creative thinking can be measured mainly from the aspects of fluency, flexibility, uniqueness, and subtlety, and demonstrates the scientificity and feasibility of measuring creative thinking, which is a guide for future generations to implement creative education. The "Creative Thinking Test", compiled by Zheng Richan and Xiao Beilin from Beijing Normal University, is based on Torrance's theory of creative thinking measurement. According to the research, the idea of creative education has existed since ancient times, but it has not been really clearly put forward and implemented in a concrete and systematic way. Creative education has a broad and narrow meaning. Primary and secondary schools should implement creative education

in a broad sense, referring to the basic principles of creativity, in order to cultivate people's innovative consciousness, pioneering spirit, creative personality, and innovative abilities, organically combining philosophy, pedagogy, psychology, and talent education. This is a new type of education that comprehensively and deeply develops the creative potential of students and nurtures creative abilities. Its main features are: emphasising creative thinking, focusing on nurturing students' creative abilities; focusing on personal development, allowing students to fully develop their abilities, preferences and specialities to stimulate their creativity; paying attention to inspiration and induction, encouraging students to think actively and analyse problems; and paying attention to non-intellectual factors. Education is an activity that creates people, and people are the main factor in education. Our education in the past has been focused on classrooms, teachers, textbooks, exams as a means, and a lifetime of test scores. Students (people) had no status or sufficient status. First of all, we have to discover the value of people. This is the affirmation and maintenance of the proper status, role and dignity of the person (students). Understand that students are not machines, but living people with their own thoughts and concepts. A creative person is a great force that transforms nature and advances society, has his/her own dignity, strives to be respected and understood by others, to gain proper status and fulfil the role he/she is supposed to play. Secondly, we should pay attention to the human personality, which is the expression or reflection of life on an individual, a synthesis of a number of stable characteristics of physiological, psychological and social aspects of people. Personality is a prerequisite for the function of subjective active reflection of people to be fully launched, the person with the greatest personality is often the most innovative. Creative education should pay attention to the personality of a person, respect the spiritual freedom of students, the uniqueness of their spiritual world (Nikitenko V. O., 2022).

The goal of creative education is to foster creative quality. to play the role of a "detonator" aimed at releasing human potential and emphasising that the development of potential should be the same as cultivation. Combining the great qualities of people with a positive attitude to life. In short, creative education is centred on creative

quality, which is the dominant and most time-sensitive quality among the various qualities of current and future talent. Creative quality includes creative quality, creative thinking and creative skills. Creative quality belongs to non-intellectual factors and is the memory power mechanism of creative activity. Including personality creation, personality creation, innovative consciousness, innovative spirit, etc. The key to the success of creative activity is creative quality, which is embodied in strong creative motivation, persistent creative will and healthy creative emotion, reflecting a good outlook and mental state of the subject of creativity. The moral education courses of schools of all levels and types in our country, especially primary and secondary schools, should adapt to the requirements of the development of the times and take the education of creative qualities or personality as an important content.

Creative thinking can overcome routine and tradition, and has keen insight, intuition, rich imagination, the ability to foresee and be able to seize opportunities, etc., so that thinking has a certain progress and flexibility. Creative thinking is the core of creativity. It has two main characteristics: out-of-the-box and proactive. This is the most valuable quality of thinking that creative education should focus on. Creative skill is the ability to act, which reflects the behavioural skills of the subject of creativity, is formed under the control and constraints of creative intelligence and belongs to the working mechanism of creative activity. Possess broad and reliable basic knowledge, a broad vision and the ability to comprehensively explore new areas. Good creative skills, including general efficiency and practical ability, the ability to master and skilfully use creative methods, the ability to achieve creative results (dissertation writing), expressive ability (artistic creativity) and the ability to materialise (creating ideas and translating them into models and products). Creative skills, like other skills, are only truly acquired through learning and practice. In short, a creative character and attitude to life, the ability to think creatively, and the ability to engage in creative activities are the three goals that creative education should strive to achieve. Psychological research shows that there is a strong correlation between knowledge and ability. The more knowledge you have, the more likely you are to generate important ideas. As Taylor said: “A person with a wealth of knowledge

and experience is more likely to create new associations and unique ideas than a person who has only one kind of knowledge experience". Based on the requirements of modern science and social development to the structure of human intelligence, creative education should cover not only natural science but also humanities, it is necessary to move from providing subject knowledge to general cognitive education, focus on the first view, try to expand the field of thinking and cultivate comprehensive abilities. It is necessary to pay attention to the education of basic knowledge, and to follow the new trend of science development, emphasising that students master the latest scientific knowledge and marginal subjects. In addition, it is also necessary to highlight the content of the methodology, promote knowledge of creativity, and develop students' ability to use knowledge in an integrated way to analyse and solve problems (Ukraine 2030E – a country with a developed digital economy, 2022).

We need to apply different methods in different periods according to the growth and development of the human brain. In the creative education period (3–9 years), the focus is on inquiry-based education, with attention to stimulating students' curiosity about natural and social phenomena and learning to identify problems. During the creative learning period (9 to 22 years), attention should be paid to strengthening brain function, and teachers and students should be encouraged to explore and think about problems together to develop the habit of asking more questions and thinking. In the fruitful period of creativity (22–28 years), students should delve into problems, become widely acquainted with social practice, and truly apply the knowledge they have acquired in social production and life practice. In short, on the one hand, teachers should "teach" with inspiration, not only to let students "learn" but, more importantly, to guide students to "know how to learn". This is not only to impart knowledge to students, but more importantly to stimulate thinking, to inspire students to study well, think hard, and create boldly. On the other hand, students need to "learn" creatively, build critical awareness, increase flexibility and depth of thinking, and then overcome the limitations of fixed thinking, laying the foundation for improving creativity.

Creating educational pathways. The first is classroom learning. Classroom teaching is the main frontline for the implementation

of creative education. In the classroom, create a good learning situation in the classroom, give full freedom to students' initiative, and develop the maximum value of the advantages of classroom learning, while cultivating students' love and joy of learning. Change the learning process from "absorb-store-reproduce" to "explore-discuss-create". Not only to teach students knowledge of different courses, but also to develop students' ability to "identify problems – ask questions – analyse problems – solve problems – discover new problems". Therefore, to stimulate students' potential, teachers should retire as "directors" and give students the initiative to be active on the stage. The second is extracurricular activities. Extracurricular activities are usually an important place for creative education. Their advantages are that they can apply what they have learnt in the classroom to practice, they can develop students' interests and hobbies, and they can develop students' independent thinking and practical abilities. Therefore, many of the achievements of creative education are made in the second grade. Therefore, for the implementation of creative education, an important question that our teachers face is how to provide a wider space for activities to nurture students' creativity, so that students can easily unload their heavy school bags and put them in the classroom. Variety of extracurricular activities. Schools should create extracurricular interest groups for various forms of public speaking competitions and debates, and make reading extracurricular literature, making reading cards, calligraphy, piano, drawing, and housework compulsory for students. This not only enriches students' free time, but also develops their practical skills. The third is social activities. The implementation of creative education is not only the responsibility of the school, but also of the whole society. If the society can create a good social environment for creative education, it is also an effective means to nurture and realise students' innovative abilities. For example, various quizzes conducted by CCTV and various newspapers and periodicals have aroused the creative desire and interest of many young students, and many new creations have emerged and excellent results have been achieved (Shunkov, V., Marushko, L., Mykhailov, V., Lutsenko, Y., & Teslenko, S., 2023).

Such utilitarian learning has a quite obvious blocking of creativity, which is manifested in the following: firstly, it leads to a weakening

of the subjective spirit and initiative of students, which affects the formation of creative qualities; secondly, blind injection strengthens students' ability to absorb and accept, but the problem awareness and research ability necessary for creation have been reduced due to lack of development; Thirdly, standardised exams only require memorisation of rules and adherence to a fixed format, which limits students' thinking, inevitably leading to boredom, and monotony and boredom corrodes the passion for creativity. Therefore, creative education will only be possible when education is truly aimed at free development of the individual and the development of individuality.

Looking at our previous educational goals, it is easy to find that we have almost no rules about the goals of creative education, and the qualities necessary for creativity, such as a unique personality and respect for diversity, are rarely involved, and it is difficult to see the creation of goals in the curriculum system. Requirements for learning objectives created in the examination assessment system are also rare. In terms of specific learning objectives, what we have always required is a knowledge-ability-emotion learning sequence, which has also led to a situation where too much emphasis is placed on knowledge and skills, neglecting creativity. In the process of creating educational goals, we believe that "emotions should lead, abilities should follow, and knowledge should follow". Don't worry about over-correcting, but rather sacrifice a small amount of knowledge to set a goal of stimulating creativity. Including shorter textbooks, less complexity, more active students, richer courses, etc., a series of practical measures should be taken to enhance the status of creativity, and the purpose of education to create a human being should be used to guide and adjust the various tasks of the school. "Without quality teachers, there will be no quality education." The key to implementing creative education is to have a high-quality team of teachers with innovative spirit and abilities. Only when every teacher has innovative consciousness and innovative ability can "creativity" be reflected in the whole process of education and teaching, cultivate students' innovative consciousness and ignite the spark of students' creativity (Punchchenko O., Voronkova V., Punchchenko N., 2019).

The main qualities that a creative teacher should have are: respect for the personality of students, good individual psychological training,

strong creative intent and independent critical spirit, the ability to unleash the creative potential of students, and the ability to create education. Ask yourself, how many teachers in China today have these qualities? Some teachers not only do not answer students' questions during class, but instead consider them "disturbing" and ridicule them. The reason for the weak creative quality of teachers is mainly because current teaching in ordinary colleges does not pay enough attention to creative education and the strength is not strong.

"The knowledge economy and innovation awareness are crucial for the 21st century. In today's situation of global economic integration, only by developing the knowledge economy can we improve international competitiveness, and the key to developing the knowledge economy lies in knowledge innovation, which requires increased innovation awareness. Therefore, we must completely get rid of the old concepts of "conservative, not innovative" and "only focus on implementation, ignoring innovation", and firmly establish the new concept of "perish if you do not innovate". Leaders and staff members are responsible for popularising and educating innovation awareness, making innovation the consensus of the whole people and turning it into practical actions, creating a good social atmosphere of "resolute innovation, pioneering and enterprising", and removing ideological obstacles to the development of creative education.

First of all, it is necessary to strengthen research on creative education. Make full use of the latest research findings on creative education and related disciplines at home and abroad, deeply study the basic laws of creative education, build a sound theoretical system, form a holistic educational thought, educational system, teaching content and teaching methods, and make creative education more mature.

Second, it is necessary to transform and innovate creative education. Creative education originated in the United States and has Western cultural characteristics. Ultimately, the characteristics of a discipline are a specific reflection of social and cultural characteristics based on the discipline. Since the social and cultural traditions of my country and the United States are different, when introducing creative education, we should not copy it mechanically, but should transform and innovate. In implementing creative education, combine the advantages of Eastern

culture in overall view, overall coordination, dialectical thinking and adaptability with the advantages of Western culture in emphasising essences, scientific analysis, emphasising individuality, and emphasising techniques, to form creative education with Chinese characteristics. Third, it is necessary to promote experimentation and popularisation of creative education.

At present, more than 1,000 primary and secondary schools and 27 colleges and universities in my country are experimenting with creative education and have achieved some results, but they are still immature. The creative education experiment of enterprises is almost empty. As for the promotion of creative education, it is far from successful. Creative education in our country still has a long way to go. To this end, it is necessary to take a number of effective measures to actively promote the experiment and the development of creative education. It is necessary to continue to conduct school experimental work, pay close attention to the weak link in the entrepreneurial experiment, and constantly research effective ways to implement creative education in our country and gain successful experience. The successful experience of creative education should be actively promoted in universities, secondary schools, primary schools and various enterprises so that it can flourish and bear fruit throughout the country and gradually replace traditional education (Nikitenko Vìtalina, Voronkova Valentyna, Oleksenko Roman, Andriukaitiene Regina, Holovii, Liudmyla, 2022).

Today, many countries mainly implement traditional education, which has a number of disadvantages for the development of students' creative potential:

1. Paying attention only to the transfer of knowledge, lacking the development of creative thinking abilities.

The ability to think creatively is the basis of creativity, and it directly kills students' creativity.

2. Insisting on learning materials as the centre limits students' vision. Deep knowledge and a broad outlook are the basis of creativity. Restricting students' learning knowledge to textbooks and narrow knowledge will undoubtedly weaken the basis of creativity.

3. Explicit cultivation of commonality, which suppresses the development of individuality. Personal development is the key

to creativity. Suppressing individual development kills students' independent and unique thinking and reasoning ability, and hinders the development of creativity.

4. Emphasis on intellectual factors, ignoring non-intellectual factors. Non-intellectual factors are important psychological conditions for the formation of creativity. Neglecting non-intellectual factors will lead to the loss of psychological guarantees for the development of creativity.

5. focus on classroom learning, ignoring practical learning. Social practice is a source of creativity. Neglecting practical training will make the formation of creativity a source of living water.

In short, traditional education nurtures inherited talents, not creative ones. The various shortcomings of traditional education show that traditional education needs to be reformed. We must take a variety of effective measures to vigorously promote the in-depth development of education reform and make the transition from traditional education to creative education.

Change the concept of education. We need to deepen our understanding of the significance of creative education: it is not only connected to the future of education in our country, but also to the rise and fall of the country and the fate of the nation. This is a sacred historical mission entrusted to us by the new era. We must dare to break the shackles of traditional educational concepts and establish the right educational concept. Make the transition from the traditional educational concept, which focuses on the transfer of knowledge and the development of inherited talents, to a creative educational concept, which emphasises the development of creative thinking abilities and the development of innovative talents.

Reform the education system. The education system includes aspects such as teaching, administration, party and group work. The following will only discuss the reform of the education system in relation to the main part of the education system, i.e. learning (Scientific and Educational Transformations in the Modern World, 2021).

First, change the management of learning. Transform the rigid and unsustainable teaching management system of traditional education, which emphasises knowledge transfer, into a flexible and dynamic

teaching management system that emphasises creativity in creative education.

From the perspective of teaching management, it is necessary to create an inspiring, innovative and enterprising teaching style and cultivate a diligent, inquisitive, exploratory and innovative learning style. Formulate a system of rewards and punishments to encourage teachers and students to invent and innovate, develop a series of quantitative and qualitative indicators, evaluate the innovative abilities of teachers and students, and reward the good and punish the bad. From the perspective of pedagogical management, it is necessary to organise the study or encourage teachers to study creative pedagogy on their own, to master the principles and methods of creative pedagogy, and to improve the level of theoretical knowledge of creative education.

At the same time, it is necessary to actively encourage teachers to engage in innovative practical activities: on the one hand, to organise teachers to systematically participate in scientific and technical development of school enterprises, innovation management of planning centres, creative activities of literary and artistic circles; on the other hand, to actively participate in various innovative activities in society, to constantly accumulate innovative experience while performing educational tasks at school. In terms of managing teaching materials, since creative education has just started in my country, teaching materials for creative education are scarce and cannot meet the needs of teaching. Therefore, it is necessary to actively contact and purchase teaching materials for creative education, and even more so, it is necessary to organise teachers to compile such teaching materials to make awards.

Second, reform the content of teaching. Expand the knowledge of students. The broad cultivation of knowledge is a fertile ground for the flowers of creativity and wisdom to bloom. Especially with the current trend of interpenetration and comprehensive development of various disciplines, broadening students' knowledge becomes even more important. Thus, it is necessary for students in the humanities to acquire some knowledge of natural sciences such as science and engineering, and students in the natural sciences and engineering should acquire some knowledge of social sciences

and humanities to broaden their horizons and lay a solid foundation for the development of creativity. We need to add creative disciplines. Creative disciplines have a direct impact on the development of creativity, so it is necessary to add courses such as creative pedagogy, creative science, creative psychology, science of thinking, methods of creative thinking and innovative methods to increase students' innovation awareness and abilities. To highlight illogical thinking. Creative thinking includes logical thinking and illogical thinking. The function of illogical thinking is innovation, and the function of logical thinking is argumentation.

Traditional education emphasises logical thinking while ignoring illogical thinking, which makes students lack innovative spirit and innovative ability. Therefore, it is necessary to strengthen the teaching of illogical thinking by focusing on imaginative thinking, imaginative thinking, intuition, inspired thinking and divergent thinking. Pay attention to non-intellectual factors that are the psychological basis for the formation of creativity. It is necessary to pay attention to the education of students' commitment to scientific work, collective awareness of friendly cooperation, a strong interest in innovation and the search for differences, courage and perseverance in order not to be afraid of risk, to improve their creative psychological quality (Voronkova V. G., & Kyvliuk O. P., 2022).

Third, to change the teaching methodology towards heuristics. In creative education, the most important method of heuristic teaching is the research method, i.e. the teacher first asks questions, then allows students to think for themselves, and through inspiration and induction allows them to try again the best knowledge gained by their predecessors according to the law of repetition of knowledge. An exciting process, learning creative problem-solving methods, followed by explanation and commentary by the teacher at the end.

In the process of searching for answers, students can not only gain new knowledge, but importantly, receive comprehensive training in courage, will and thinking methods, cultivate innovative consciousness and innovative ability, and combine heredity and innovation well. It is necessary to change the "one size fits all" to teach students according to their ability. Teaching students according to their abilities is an effective means of developing students' personalities and

cultivating creativity. According to the knowledge base, characteristics, preferences, hobbies and interests of different students, we should adopt appropriate teaching content and teaching methods, and embrace breadth, depth and complexity, so that students of different types and levels can obtain their own excellent development. It is necessary to change the "centre on classroom education" to classroom and practice.

The main teaching method for developing students' creative potential is to pay equal attention to classroom and practice. Classroom learning focuses on the acquisition of innovative theoretical knowledge, while practical learning focuses on the development of students' innovative abilities. A combination of theory and practice can be realised, and innovative theoretical knowledge can be transformed into innovative abilities. Given that traditional education despises practice, we must do a good job in the practice link. In addition to continuing to do a good job in student experiments, internships, theses and graduation projects, we must also do scientific work. and technological inventions, management simulation planning, and literary and artistic creativity to show students' creativity (Voronkova, Valentyna, Nikitenko, Vitalina, Bilohur, Vlada, Oleksenko, Roman, & Butchenko, Taras, 2022).

Fourth, improve the exam grading system. Examination evaluation is an important part of the development of students' innovation ability, so we must pay attention to the evaluation and assessment of students' innovation ability. When setting test questions, it is necessary to increase the proportion and complexity of creative questions, and to assess students' innovation ability from both the quantitative and qualitative aspects. There are two main ways to put forward a proposal: one is to write a case based on facts, let students analyse it according to the principles of creationism, point out the reasons for the success or failure of the case, and gain enlightenment from it. And stimulate creativity; Simulate innovation based on learning principles so that students can train and improve their innovation ability. Exams should be in open-book form to avoid mechanical memorisation and allow them to focus on creative ideas and flexibly use the knowledge they have learnt to analyse and solve problems. Students' test results consist of two parts: innovation theory and innovation practice.

The effectiveness of innovation practice should be assessed by a system of indicators that combines quantitative and qualitative ones. Finally, the achievements of innovation theory and innovation practice are used to comprehensively assess the overall score of students' innovation ability.

To sum up, the era of the knowledge economy is an era of great need for creativity. The times demand creative education. As long as we attach great importance to creative education and actively promote it, cultivate and train a large number of high-quality innovative talents, vigorously introduce knowledge innovation, and contribute to the rapid development of our country's economy and society, we will definitely be among the leaders. However, teachers lack the quality of creative education. Without quality teachers, there will be no quality education. The key to implementing creative education is to have a high-quality team of teachers with innovative spirit and abilities. Only when every teacher has innovative consciousness and innovative ability can "creativity" be reflected in the whole process of education and teaching, can cultivate students' innovative consciousness and ignite the spark of students' creativity.

The main qualities that a creative teacher should have are: respect for the personality of students, good individual psychological training, strong creative intent and independent critical spirit, the ability to unleash the creative potential of students, and the ability to create education. The reason for the weak creative quality of teachers is mainly that current teaching does not yet pay enough attention to creative education and the strength is not strong. First of all, it is necessary to strengthen research on creative education. Make full use of the latest research results of creative education and related disciplines, study the basic laws of creative education in depth, build a sound theoretical system, form a holistic educational thought, educational system, teaching content and teaching methods, and make creative education more mature. It is necessary to transform and innovate creative education. Creative education originated in the United States and has Western cultural characteristics. When introducing creative education, one should not copy the traditions of creative education mechanically, but should transform and innovate. Introduce creative education, combine the advantages of Eastern and

Western culture in the overall view, overall coordination, promote experimentation and popularisation of creative education.

5.2 The Digital Education Model as a Factor in the Formation of Digital Competences in Accordance with the European Programme DigiComp 2.0

In DigComp, digital competence involves the confident, critical and responsible use and interaction with digital technologies for learning, working and participating in society. It is defined as a combination of knowledge, skills and attitudes". (Council Recommendation on Key Competences for Lifelong Learning, 2018).

The DigComp conceptual reference model includes the following competence areas:

1. Information literacy.
2. Communication and collaboration.
3. Creating digital content.
4. Security.
5. Problem solving.

The DigComp framework defines the key components of digital competence in 5 areas:

1. Information and data literacy: to formulate information needs, find and retrieve digital data, information and content. To judge the relevance of a source and its content. To store, manage and organise digital data, information and content.

2. Communication and collaboration: to interact, communicate and collaborate using digital technologies, while being aware of cultural and generational diversity. Participate in society through public and private digital services and civic engagement. To manage digital presence, identity and reputation.

3. Digital content creation: to create and edit digital content. To improve and integrate information and content into the existing body of knowledge, understanding how to apply copyright and licences. Know how to give clear instructions to a computer system.

4. Security: to protect devices, content, personal data and privacy in the digital environment. Protect physical and psychological

health and be aware of digital technologies for social well-being and social inclusion. Be aware of the environmental impact of digital technologies and their use.

5. Problem solving: identify needs and problems, and solve conceptual problems and problem situations in the digital environment. Use digital tools for innovative processes and products. To keep abreast of digital evolution.

There are 21 competences related to these areas, and their names and descriptors form a conceptual reference model. Additional dimensions describe levels of proficiency (dimension 3), examples of knowledge, skills and attitudes (dimension 4) and use cases (dimension 5).

1. Information literacy includes:

1.1 Browsing, searching and filtering data, information and digital content. To formulate information needs, to search for, access and navigate data, information and content in the digital environment. To create and update personal search strategies.

1.2 Evaluate data, information and digital content – analyse, compare and critically evaluate the validity and reliability of data, information and digital content sources. Analyse, interpret and critically evaluate data, information and digital content.

1.3 Managing data, information and digital content – to organise, store and retrieve data, information and content in digital environments, organise and process them in a structured environment (Andriukaitene Regina, Metelenko Natalia, & Voronkova Valentyna, 2022).

2. Communication and collaboration includes:

2.1 Interacting through digital technologies – interacting through a variety of digital technologies and understanding the appropriate digital communication tools for a given context.

2.2 Sharing through digital technologies – sharing data, information and digital content with others using appropriate digital technologies; acting as a facilitator, being aware of referencing and attribution practices.

2.3 Engage in citizenship through digital technologies – participate in society through the use of public and private digital services. Seek opportunities for self-improvement and civic engagement through appropriate digital technologies.

2.4 Collaboration through digital technologies: use digital tools and technologies for collaborative processes, as well as for the co-design and co-creation of resources and knowledge.

2.5 Networking etiquette: know the norms of behaviour and know-how when using digital technologies and interacting in a digital environment. Adapt communication strategies to specific audiences and be aware of cultural and generational diversity in the digital environment.

2.6 Manage digital identities: create and manage one or more digital identities, be able to protect your own reputation, deal with the data you create through multiple digital tools, environments and services (Ajaža, M., & Ostenda, A., 2022).

3. Digital content creation;

3.1 Digital content development – create and edit digital content in different formats, express yourself digitally.

3.2 Integrating and reworking digital content – to modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.

3.3 Copyright and licences – to understand how copyright and licences apply to data, information and digital content.

3.4 Programming – to plan and develop a sequence of clear instructions for a computer system to solve a given problem or perform a specific task.

4. Security:

4.1 Security – to protect devices and digital content, and to understand the risks and threats in the digital environment. Be aware of security measures and due diligence in relation to reliability and confidentiality.

4.2 Protecting personal data and privacy – to protect personal data and privacy in the digital environment. To understand how to use and share personal information, being able to protect yourself and others from harm. To understand that digital services use a "Privacy Policy" to communicate how personal data is used.

4.3 Protecting health and well-being – avoid risks to health and physical and psychological well-being when using digital technologies. Know how to protect yourself and others from possible dangers

in the digital environment (e.g. cyberbullying). Be aware of digital technologies for social well-being and social inclusion.

4.4 Environmental protection – be aware of the environmental impact of digital technologies and their use.

5. Problem solving:

5.1 Solving technical problems – to identify technical problems in the operation of devices and use of digital environments, and to solve them (from troubleshooting to solving more complex problems).

5.2 Identify needs and technological responses – to assess needs and identify, evaluate, select and use digital tools and possible technological responses to address them. To customise and adjust the digital environment to meet personal needs (e.g. accessibility).

5.3 Use digital technologies creatively – use digital tools and technologies to create knowledge and innovate processes and products. Engage individually and collectively in cognitive processing to understand and solve conceptual problems and problem situations in the digital environment.

5.4 Identify digital competence gaps – Understand where your own digital competence needs to be improved or updated. To be able to support others in developing their digital competence. To look for opportunities for self-development and keep abreast of digital evolution (From Disruptive Technologies to the Digital Economy: Monograph, 2022).

The Digital Competence Framework for Citizens (DigComp) provides a common understanding of what digital competence is. It refers to the confident, critical and responsible use and engagement with digital technologies for learning, working and participating in society. It is defined as a combination of knowledge, skills and attitudes" (Council Recommendation on Key Competences for Lifelong Learning, 2018). DigComp defines the key components of digital competence in five domains and 21 specific competences, summarised in the figures above. The framework also describes eight proficiency levels, examples of knowledge, skills and attitudes, and use cases in the context of education and employment. The DigComp project is run by the Joint Research Centre on behalf of the European Commission. It began in 2010 and since then, awareness among

Member States has steadily grown of DigComp as a pan-European framework for digital skills policy-making, and for the development and measurement of digital competence. The DigComp remains central to the EU's goals to improve the digital skills of the whole population. DigComp is an important tool to support the EU Action Plan for Digital Education 2021–2027, which in turn contributes to the Commission's priority of 'Europe fit for the digital age' and the Next Generation EU. DigComp is used for many purposes, such as the development of competence assessment tools, the creation of training courses and materials, and the definition of professional digital profiles in the context of employment, education and training, and social inclusion. Being digitally competent is a challenge for a 21st century citizen. The DigComp 2.2 integrated framework provides more than 250 new examples of knowledge, skills and attitudes that help citizens to work with digital technologies confidently, critically and safely. Digital competence is a set of skills, knowledge and attitudes that are essential for learning, professional integration and civic life in a society with a constantly changing technological environment.

"The 'Vision for Digital Education for European Schools' states that digital competence should be developed in every student: "Every pupil and student develops digital competence throughout their European school education to facilitate the confident, critical, responsible and creative use of, and engagement with, digital technologies for learning, working and participating in society." Digital competence is also one of the eight core competences, a set of cross-curricular responsibilities identified in the Key Competences for Lifelong Learning in European Schools. In order to better support the development of digital competences, the Joint Study Committee has endorsed the Digital Competence Framework (DCF). The Digital Competence Framework (DCF) The DCF is based on the DigComp. The Digital Competence Framework (DCF) is based on the European Digital Competence Framework for Citizens (also known as DigComp). Main reasons: – The DigComp has been developed with the participation of a large number of experts and endorsed at European level. – DigComp contributes to the creation of a common language and understanding of digital competence. – DigComp offers interoperability with

European national systems for better recognition of education obtained in European schools, as well as mobility of students and teachers. DigComp offers a tool to improve the digital competence of any individual and since 2013 it has become a reference for the development and strategic planning of digital competence initiatives at both European and Member State level. DigComp 2.1 is based on the reference conceptual model published in DigComp 2.0. DigComp provides important guidance and support in defining educational and training actions for the development of digital competence (Voronkova, Valentina, Vasylchuk, Gennady, Kaganov, Yuri, Nikitenko, Vitalina, & Metelenko, 2023).

The DCF for European schools corresponds to the five competence areas and twenty-one sub-competences of DigComp7, but made minor changes to the descriptors. To meet the needs of European schools, the DCF is structured using cycle progression guidelines to cover all students from kindergarten to secondary. It mirrors the Digcomp proficiency levels of European schools' cycles. DCF therefore offers six proficiency levels. The description of the tasks, problems to be solved and levels of autonomy are sometimes adapted to better match the European Schools' educational cycles. Each proficiency level represents a step in the acquisition of competence by pupils and students according to its cognitive task, the complexity of the tasks they can handle and their autonomy in completing the task. Each learning level takes into account several factors at the same time: 1) the student's level of familiarity with the proposed situation (simple, relevant, new); 2) the complexity of practices with digital tools (elementary, complex); 3) the degree of independence (with help, independently, together with others); 4) the complexity of the procedures (application, development) and goals to be achieved; 5) the knowledge required to perform them. From kindergarten to high school, school curricula include the need to acquire and master digital skills. All lessons can mobilise digital tools and resources that contribute to the development of these skills. The inclusion of digital competences in the curriculum should not be seen as an obstacle, but as an empowering opportunity (just like other key competences). DCF takes a holistic approach. Acquiring digital competence is a long-term endeavour that requires a progressive and interdisciplinary

approach. This approach looks at the learner holistically and offers several possible development paths, broken down into small steps that can be individually tailored to each learner. All educators can mobilise digital tools and resources that support the acquisition of digital competence. However, while digital competence can be applied to a large number of subjects, it should not be artificially imposed on all subjects. Furthermore, as the ideas for teaching and learning tasks should reflect the growing experience and knowledge in the field of digital learning as well as new technologies, this appendix will be continuously updated on the intranet. Digital skills are an important element of learning, professional integration and civic life in a society whose technological environment is constantly changing. The Digital Skills Reference Framework (DSRF) defines digital skills and levels of progressive mastery throughout schooling. The Pix platform allows for the monitoring of achievement and the issuing of certificates at the end of cycle 4 and in the final cycle. The digital skills defined by the baseline below and acquired by students are the subject of a national certification issued through the Pix online platform. The Pix certification allows for the certification of a digital skills profile certified and recognised by the state and through registration in the inventory of the National Commission for Professional Certification (CNCP). The platform provides students with a digital skills certificate at the end of cycle 4 and at the end of the final cycle. The Pix platform allows students in Cycle 4 to self-assess and assess their progress based on workable tests. Starting from the 5th grade, students register on the free Pix platform, where they track their progress. Students keep their Pix account when they change schools. Public and private schools have a contracted Pix Orga space that allows teams of teachers to generate test paths for different digital skills, track students' results, and thus support them in acquiring skills until they receive a certificate (Voronkova Valentyna, Vasylchuk Gennadii, Kahanov Yurii, Nikitenko Vitalina, & Metelenko Nataliia, 2023).

Five areas of digital skills. The Digital Skills Reference Framework consists of five domains and sixteen digital skills. It proposes eight levels of progressive mastery of these skills for students in school education, for students in higher education and in the context of adult

learning. The proficiency levels 1 to 5 are offered specifically for primary, secondary and high school students. These digital skills are the subject of a certification issued by the Pix platform at the end of the fourth cycle of secondary school and the last cycle of secondary school. The teaching and assessment of digital skills takes place in lessons linked to curricula and a common knowledge, skills and culture base in line with the standard framework for digital skills. Levels of digital skills are assessed on a scale defined by a reference framework. At the end of Cycle 4 and at the end of the final cycle, all students are issued with a digital skills certificate. The principal organises the awarding of this certificate at his/her institution for students in the 3rd and final years of school, as well as for students in courses offered at secondary school. The certificate is recorded in the student's school record book. The accompanying document provides a reference framework for digital skills to support resources for teachers, supervisors, students and their families. For each skill, the appendices describe levels of proficiency and suggest ways to implement it. To succeed in today's world, digital skills have become essential, and especially necessary for employment. The European Commission has defined a framework of digital competence that a so-called competent European citizen should have. Digital literacy has become a priority. This means digital skills, which refer to the ability to understand and use digital technologies without the help of others. This approach is important because many employers now consider digital competence to be one of the skills needed for work. The European Commission has created the Digital Competence Framework, a framework of 5 domains and 21 competences that are necessary for European citizens to be sufficiently competent in digital technologies. Each domain contains between 3 and 6 skills to be mastered, which are themselves divided into 3 levels of user skills: basic user, intermediate user or advanced user. With digital competencies, you can innovate, create and solve problems with digital tools.

5.3 Application of Artificial Intelligence (ChatGPT) in Education as a New Digital Technology in the Age of Big Data

ChatGPT is a chatbot with a large language model developed by OpenAI based on GPT-3.5, with the ability to interact in the form of a conversational dialogue and give answers that may seem adequate, effective, necessary, and human. ChatGPT works on the basis of Reinforcement Learning with Human Feedback (RLHF) and refers to an additional level of learning in which a person participates to help generate responses that are needed (Kivliuk O. P., Voronkova V. G., Nikitenko V. O. (2023).

ChatGPT is a generative artificial intelligence that is very different from previous rule-based artificial intelligence. It is a milestone in the history of information technology development and is a "feature". The impact of ChatGPT on education is still in its infancy. In the face of the "tsunami" caused by ChatGPT in the social and educational fields, we need to face the functional characteristics, core values, and potential risks of ChatGPT and handle them carefully to overcome the cognitive bias of applying artificial intelligence technology in education. The role of AI in education is not yet well understood, but it is clear that we should expect great potential from the use of AI in education. This creates a cognitive bias of overestimating the immediate effects of AI and underestimating its long-term effects. As a typical artificial intelligence technology, ChatGPT is a double-edged sword that has its pros and cons. We have to think about how to use it as an effective tool for teaching and learning, not just turn it off. The continuous development of technology is a constant realisation of human nature. Heidegger also pointed out that the essence of modern technology is the technological way of human existence, that technology is of utmost importance to people, and that technological progress is absolutely necessary for people. We should not see the development of technology as a threat to people. We must realise that the development of ChatGPT will necessarily contribute to the freedom and liberation of people. The machine has become more capable not because the machine has become smarter, but because the people who created it have become smarter and have

more advantages over machines. Compared to previous AI chatbots, ChatGPT, as a representative of generative artificial intelligence, can more accurately understand the needs behind natural language and generate more "effective" answers. It has applied value in the field of education, but also carries risks for education. The potential impact of ChatGPT on education mainly includes three aspects: 1) promoting the transformation of learning models; 2) adapting to the digitalisation of education; 3) transforming digital education and moving away from the traditional teacher-student principle and towards the teacher-student-machine principle (Fursin O. O., 2023).

The essence of education has always been to help individuals realise their self-worth and meet the needs of social development. Compared to the traditional binary structure, the three-pillar structure empowered by technology will increase efficiency, putting more emphasis on the value of developing skilled talent. ChatGPT can accelerate the process of knowledge transfer by allowing students to better understand and apply knowledge in a research-based manner. The future assessment system will be a combination of "knowledge + literacy". The use of this educational platform will help to transform intelligent educational programmes from an isolated to an intelligent educational platform. As an open artificial intelligence system, ChatGPT can be deeply integrated with existing educational platforms to achieve a comprehensive upgrade and improve the efficiency of intelligent educational programmes. The use of ChatGPT in education can lead to a crisis of educational integrity, which can trigger a series of integrity crises. Students can use it to write homework, researchers can use it to write research reports, undermining academic ethics. Faced with this challenge, education should improve the assessment system and promote the diversification of assessment methods. Although ChatGPT can provide quick access to a large amount of information, due to its standardised text format, it is difficult for users to be correctly identified, requiring users to double-check or confirm, which may lead to new privacy concerns. It is unclear how ChatGPT stores and processes information about user interactions. This "black box" of data will raise public concerns about personal privacy, data security, and ethical issues. ChatGPT can become an important learning partner and assistant for students,

promote the development of students' divergent thinking, creative thinking, critical thinking. ChatGPT can help people to achieve high-quality education development to a certain extent, the way of knowledge dissemination and teaching will undergo a fundamental change. ChatGPT has shown the keys to this change, which directly affect the reformatting of educational concepts and the reconstruction of talent training models (Gramchuk M. A., 2023).

The impact of using ChatGPT in education should be analysed according to specific application scenarios, comparing ChatGPT functions with all aspects of the entire education and teaching process. Students will have it as a data retrieval tool, and its smart application can become a smart assistant for teachers and students. ChatGPT helps in writing assignments and papers, making full use of the excellent dialogue and content creation capabilities. With this capability, ChatGPT can be integrated into many educational scenarios such as intelligent learning, teaching and management decision-making system, helping to improve the quality and efficiency of education and teaching. But it will also bring hidden concerns, such as students relying too much on ChatGPT, which brings a lack of independent thinking. The profound impact relates to the challenges for the entire education system. ChatGPT can replace many basic professional tasks. The further development of artificial intelligence technology will bring many unpredictable and complex impacts on education, especially the expansion of instrumental rationality will have a destructive impact on "human development" in education. For teachers, in the face of advanced artificial intelligence technology in the future, some teachers may worry about being replaced, and some teachers may overly trust artificial intelligence, causing their own ability to decline due to over-reliance on it, and gradually lose the ability to reflect on learning. For learners, the changing role means changing learning concepts and learning methods. However, due to the intervention of artificial intelligence technology, autonomous learning by students may become ineffective. In particular, the new generation of artificial intelligence technology, represented by ChatGPT, is taking the highest university exams. This can lead to a decrease in the ability and quality of students, which is not conducive to student growth and the development of education. The current settings of humanities and social sciences

subjects are based on the existing level of productivity development, and the new generation of artificial intelligence will change and improve the paradigm of social productivity. Many old subjects will be eliminated, leading to huge "sunk costs" for existing unattractive investments in education. At the same time, the development of artificial intelligence will also eliminate teachers who do not have original abilities. The emergence of ChatGPT makes the impact of information technology more clearly visible, but given the changes in intelligent technology, it is necessary to continue to actively recognise the changes, actively respond to the changes, improve the talent training system, build intelligent pedagogy, use new artificial intelligence tools such as ChatGPT, and change teaching methods to meet future needs. Information technology is having a revolutionary impact on education, and the revolutionary impact has already taken place due to the active promotion of education informatisation (Sliusar, Mykyta, 2023).

During the COVID-19 epidemic over the past three years, information technology has comprehensively entered the teaching and learning process with unprecedented scale, scope and depth. The in-depth application of intelligent technologies such as ChatGPT has "impacted" students, teachers, parents, educational researchers and other actors to experience the impact of information technology on changes in learning, work and life. Information technologies, represented by the Internet and artificial intelligence, have indeed had a revolutionary impact on education. For example: artificial intelligence and learning analytics can make the learning process more personalised and intelligent, and VR/AR technology can increase the immersion and richness of the learning experience for students. To achieve this, basic support capabilities such as data, algorithms and computing power should be improved, and artificial intelligence should be further advanced. The integration of intelligent technologies such as ChatGPT into education and training can stimulate the endogenous force of educational reform, especially in terms of improving teachers' information literacy. In the future, teachers who do not use AI technology may be replaced by teachers who are well versed in AI technology. Taking personalised learning for students as an example, ChatGPT will play a role in three aspects: 1) knowledge acquisition, ChatGPT can quickly generate teaching materials to help

students review and learn the course content; 2) self-study, multiple rounds of smart technology such as ChatGPT; 3) learning partner. With the maturity of intelligent technology, ChatGPT and other intelligent technologies can provide students with a variety of learning support services in the future. ChatGPT may become a technology that will show that mechanised writing is no longer a manifestation of individual ability, and education should pay more attention to students' high-level abilities such as logical thinking, critical thinking, and creative thinking. The ability to use intelligent tools effectively will become an important part of students' basic literacy. ChatGPT is a new technology programme and digital technology in the age of big data.

5.4 Intellectualisation and Digitalisation of Regional Economic Development in the Focus of New Post-War Prospects in Ukraine

We would like to draw attention to the fact that in the post-war period, the development of entrepreneurial activity in different regions of Ukraine will be uneven, due to military operations and long-term occupation of territories (Kherson and Kherson region, Mariupol, Zaporizhzhia region, Kharkiv region, etc.) This unevenness contributes to the creation of innovation clusters, which are an integral system of enterprises and organisations involved in the production and consumption of a finished innovative product, including the entire innovation chain from the development of a fundamental scientific idea to the production and distribution of finished products, as well as a system of close ties between firms, their suppliers and customers, and knowledge institutions that facilitate the emergence of innovations. Education and science play a crucial role in these processes. In the regions that have been severely affected, there is a prerequisite for the creation of clusters, taking into account its potential. For example, in Kherson region, there are prerequisites for the formation of an innovative territorial cluster in the areas of energy and environment, information and communications, aviation, manufacturing and engineering, transport and mobility. In such extremely difficult conditions of the post-war recovery of the national

economy, the processes of intellectualisation and digitalisation are becoming particularly relevant (Gramchuk M. A., 2023).

The characteristic features of the information economy are a high level of economic dependence on information, widespread use of information technology in business practice, growing importance of the IT industry for the economy, a significant increase in the information component in the cost of products and services, and the transformation of information products into one of the main commodities. In the information economy, business processes are being computerised and automated, and the volume and speed of business information processing and transmission are increasing. An innovative economy takes place when breakthrough innovations occupy the largest share in the structure of innovations, there is a steady increase in the share of the knowledge-intensive sector of production and a decrease in the material and energy intensity of production due to the active implementation of innovations, the share of economic efficiency indicators (achieved through innovative factors) exceeds half, and the reproduction process is aimed at achieving technological competitiveness. Thus, there is an effective innovation process, as well as the development of economic processes that determine the direction of positive changes through the development of more advanced technologies, expansion and renewal of the production range, and the involvement of new resources in circulation.

The issues of digitalisation are becoming essential in the study of intellectualisation. It is important for national producers to acquire the skills to learn how to work with large amounts of information and transform them into goods and values that can be demanded by the market. The digital economy is a field of activity that reduces rather than increases the number of jobs, as is the case in conventional sectors and industries. Transactions in the sphere of circulation, derivative financial instruments of the stock market, objects of the so-called intellectual property often generate huge revenues and are more significant in achieving high levels of economic development of countries, companies, and individuals. In bringing goods to the consumer using the digital economy and information technology, relations between agents (entities) are built through digital electronic platforms (e-commerce services), when one can obtain a particular product without intermediaries through an online store, the agent pays

for and receives the goods by delivery or mail. This is the digital process of exchanging goods and services.

The process of intellectual development of mankind is an accumulative measure of the intellectual development of man as a biological, social and thinking being. In its essence, it means not so much the physical growth of a person's intellectual capabilities as his or her ability to effectively transform intellectual potential into intellectual capital with an accumulative effect on the general processes of society's intellectualisation, which entails numerous synergistic effects. Thus, a prerequisite for the intellectualisation of the economy is the growing human need for such benefits that, at a minimum, do not destroy the individual and the social and natural reality surrounding him or her. In this economy, the system of socio-economic and related relations is aimed at the comprehensive and most complete development of a person.

With the transition to the information economy and information society, which replaced the market economy, where the main object is a commodity in economic relations, the importance of technology, innovation and knowledge has increased. New terms such as "information society" and "information economy" have become a characteristic of the world's most developed countries and economies. With the development of civilisation and progressive human advancement, it has become clear that (Andriukaitene Regina, Voronkova Valentyna, Nikitenko Vitalina, & Oleksenko Roman, 2023):

– information in modern conditions has become the most important productive, public and social resource of development, a commodity and a driver of the modern economy;

– knowledge is the core of information, its most important part, and therefore it is this knowledge that determines the common names and characteristics of the modern economy of the world's advanced countries, emphasising the importance of information and information technologies for the economy and for the development processes of modern society;

– modern information systems and technologies and their globalisation have led to the formation of a single information space, globalisation of cultures, education, knowledge and economies.

The process of intellectualisation directly involves:

– formation of innovative quality of economic development, its inherent connection with improving the quality of goods and services;

– introduction of scientific and technological progress into various spheres of the economic and social environment;
– sustainable economic development in the context of environmental protection and compliance with global environmental principles;
– growth of social infrastructure;
– intensification of investment in intellectual capital;
– improvement of working conditions;
– strengthening the social orientation of economic development.

The above qualitative results are achieved through the following conditions that will be widely implemented in the system of the global social order:

– intellectualisation of individual characteristics based on continuous quality training, improvement and acquisition of new experience and knowledge;
– large-scale intellectualisation of technological structure objects: equipping buildings, business centres, infrastructure and industrial facilities, utilities, cultural, leisure and health centres with the latest digital and information and communication technologies, etc;
– development of the intellectual and information space, including the Internet, communications, their continuous improvement and widespread implementation;
– general automation, robotisation, creation of artificial intelligence.

In our convincing opinion, the process of intellectualisation of the economy can be represented as the transformation of information and knowledge into both an economic resource and an economic good; in turn, the transformation of knowledge into an economic resource in the process of intellectualisation leads to an increase in the share of knowledge-intensive production, i.e. innovations and knowledge-intensive technologies become a key factor of production, which allows for the generation of intellectual rent and ensures economic growth through increased added value (Krupa A. A., 2023). The intellectualisation of the economy is becoming an indicator of quality and an imperative for the economic growth of the world economy, which is responsible for the level of knowledge intensity of social production. In our opinion, as a result of this process, the model of economic intellectualisation is based on a certain structure, which includes a priority attitude

to intellectual property, creative labour, knowledge-intensive production, continuous education and the growing need for self-realisation. The processes of rapid intellectualisation ensure that the economy recognises the most important role of knowledge over other factors of production and the key element in creating economic value.

Thus, the intellectualisation of the economy is a process of continuously increasing the level of materialisation of the latest innovative knowledge, which is formed through the capabilities of the educational environment, taking into account the needs for specific competences, supported by the system of continuous education and improving the quality of individual and aggregate human capital. As the definition shows, the essential element and the main actor in the intellectualisation of the economy is human capital as the main source of idea generation. As a result of intellectualisation, all production processes and products manufactured in the leading sectors of the global economy are becoming increasingly complex and high-tech.

It should be noted, firstly, that the intellectualisation of the economy is not directly determined by the informatisation of society and the economy. The intensification of the information space is only a favourable condition for the intellectualisation of the economy, but it is not its very essence. Secondly, the quantitative growth and qualitative renewal of the information sector of the economy is not an argument in favour of the priority of the service sector over the transformational sector of the economy as a whole or material production.

The intellectualisation of labour activity is not only a global trend in economic development, but also acts as a factor in shaping the internal environment of an enterprise, as it is carried out in the system of formation, development and use of intellectual potential, intellectual capital of an enterprise, if it is associated with the capitalist mode of production. The expansion and acceleration of labour intellectualisation is the result of the spread of new ICTs in society and the economy [47, p. 80–96].

The intellectualisation of an enterprise involves the systematisation of specialised, technical, socially important knowledge in the profile of a given production, and the development of standards (norms) that simplify the exchange of titles. The intellectualisation

of enterprises includes both structural innovations and changes in the policy and ideology of modernisation and their development in the realisation of the potential of a person and society, where, according to natural data, 2–5 % of the population are innovators, 15–20 % are imitators, and 75–80 % are conservatives. The goal of enterprise intellectualisation is to provide intellectual resources for the production of new socially useful goods and services, to ensure an advanced system of training and retraining of personnel, progressive forms of organisation and motivation of creative approach to work. The development of the knowledge economy is focused on the intellectualisation of production and labour, accompanied by its institutionalisation, the formation of a set of interrelated institutions and agencies – statuses, formal information norms and rules, behavioural models, decision-making, organisation of their implementation, control, and widespread use of ICT.

Digital development should be understood as fundamental changes in the technological order in society and society, which are realised in the increase in the complexity and interconnectedness of the socio-economic system based on the growth of the scale and depth of ICT penetration into production and social life of people, which contribute to economic growth, qualitative improvement of production factors, increased efficiency of resource use and social progress (Andriukaitene Regina, & Voronkova V. G., 2023).

The experience of using digital technologies reveals problems and patterns: relations between equals and unequals are being restructured; the problem of personal data protection (third-party cybercrime) arises; theft of commercial and state information in the Internet space, etc. The state of digitalisation as a factor in the development of intellectualisation can be studied by the Networked Readiness Index, which is calculated by the World Economic Forum and published in The Global Information Technology Report. The Index shows how effectively economies around the world use digital technologies to improve their competitiveness and assesses the factors that influence the development of the digital economy. It is a comprehensive indicator that characterises the level of development of information

and communication technologies and the network economy in countries around the world.

Given the great interest of society in the problems of digitalisation, the digital economy, and artificial intelligence, only spirituality, scientific approach, and responsibility can make it possible to assess the positives and risks associated with the development of scientific and technological progress, which should actually become social and technological progress. The digitalisation process today covers not only Europe, but virtually all countries of the world, with each country determining its own digital development priorities. More than 15 countries are currently implementing national digitalisation programmes. China, Singapore, New Zealand, South Korea, and Denmark are leading the way in the digitalisation of their national economies. China's Internet Plus programme integrates digital industries with traditional ones, Canada is creating an ICT hub in Toronto, Singapore is forming a Smart Nation driven by ICT, South Korea's Creative Economy programme focuses on human capital development, entrepreneurship and the dissemination of ICT achievements, and Denmark is focusing on the digitalisation of the public sector.

Creating a society based on information and advanced information technologies is especially important for preserving the integrity and independence of Ukraine, restoring its industrial potential and fully preserving the nation's cultural heritage in order to pass on all the accumulated and multiplied values to future generations. To this end, information technologies should be the basis for the preservation at this stage and further revival of all components of the regional economy, which will be a condition for the country's reconstruction in the post-war period. It should also be emphasised that an important condition for economic recovery and guaranteeing the further territorial integrity of Ukraine should be close cooperation of leading experts of the IT sector with the country's defence industry, on the basis of which new models of equipment and means of protecting the population and infrastructure of the country from any external aggressive actions should be created and put into operation. It is also important to use the latest advanced information technologies in the processes of restoring and building new housing, creating or rebuilding industrial and other infrastructure in the regions that have been physically affected by Russian military aggression.

The first factor in the activation of the information component of the regional economy is the educational system that has been created and is functioning in the region.

The level of quality of all types of education and the progressiveness of higher education in all areas of training will determine the effectiveness of human capital accumulation in the region. Particular attention should be paid to the training of specialists in the group of specialities "computer science and cybernetics", since it is the specialists in these specialities who should create innovative products and technologies aimed at preserving, multiplying and transferring the latest knowledge (Buhaichuk Oksana, 2023).

The study allows us to propose measures to overcome the negative effects and create the basis for the transition from a post-industrial to an information society in Ukraine:

– development of education, in particular in the field of IT, on a new modern basis;

– prevention of the emergence of negative manifestations of the past in the economy: raw material models, monopolism, use of outdated technologies;

– generation and implementation of own innovations in the economy, including regional ones;

– comprehensive analysis of borrowed technologies and their testing to Ukrainian realities.

We believe that in order to integrate into the global innovation and intellectualisation processes, which would ensure the preservation of competitiveness and economic development of Ukraine today, it is first and foremost necessary to:

– develop new government programmes to support, borrow and create innovative projects, new technologies, start-ups;

– stimulate the development of education on the basis of personal expression, design and innovation approaches, with a focus on IT education;

– to improve patent legislation, ensure the observance of intellectual property rights to enable their developers to profit from their ideas.

Conclusions to Chapter 5

As a result of this study, we have analysed the transformation of the needs-based educational paradigm, shown the directions of implementation of the concept of "open education and lifelong learning"; developed directions for the formation of a common digital ecosystem, revealed the reconstruction of the modern infrastructure system with digital intelligence, and revealed the reconstruction of the system for developing scientific and technological talents with the help of digital intelligence. It is proved that the development of digital intelligence reflects the fundamental transformation of society and the economy to a new paradigm, shaping educational innovations and reconstruction of industrial organisation models, modern infrastructure systems, systems for training scientific and technical personnel and models for managing social development. Gaining knowledge and generating ideas is the first stage of the functioning of the ecosystem of innovation and entrepreneurial education. The second stage is the transformation between innovation and entrepreneurship. The third stage is the value chain. Thus, the effective mobilisation of cooperation opportunities between schools and enterprises, regions and government and services can create more reliable cross-fields and provide guarantees for entrepreneurial activity. Teaching innovation and entrepreneurship is an important part of the national education system for students, and is an effective starting point for improving the quality and efficiency of learning (Krupa A. A., 2023).

The process of intellectualisation of the economy can be represented as the transformation of information and knowledge into both an economic resource and an economic good; in turn, the transformation of knowledge into an economic resource in the process of intellectualisation leads to an increase in the share of knowledge-intensive production, i.e. innovations and knowledge-intensive technologies become a key factor of production, which allows for the generation of intellectual rent and ensures economic growth through increased added value. The intellectualisation of the economy is becoming an indicator of quality and an imperative for economic growth of the global economy, which is responsible

for the level of knowledge intensity of social production. Given the great interest of society in the problems of digitalisation, the digital economy, and artificial intelligence, only spirituality, scientific approach, and responsibility can make it possible to assess the positives and risks associated with the development of scientific and technological progress, which should actually become socio-technological progress. In order to integrate into global innovative intellectualisation processes, which would ensure the competitiveness and development of Ukraine's economy today, it is first of all necessary to: to develop new government programmes to support, borrow and create innovative projects, new technologies, start-ups; to stimulate the development of education based on the principles of individuality, design and innovation, with a focus on IT education; to improve patent legislation, ensure the observance of intellectual property rights to enable their developers to profit from ideas. Digital transformation is an organisational change caused by the trend of new digital technologies aimed at developing a digital person and digital competences.

REFERENCES

Azhazha, M. A. (2020). The role of dual education in the professional training of future specialists in the context of education modernisation / Public management and administration in the digital society: a monograph / G. V. Ortina et al. Melitopol : FOP Odnorog T. V. P. 126–135. URL: http://eprints.mdpu.org.ua/id/eprint/10419/

Azhazha, M., & Ostenda, A. (2022). Theoretical foundations of internationalisation of higher education. *Scientific Notes of Berdiansk State Pedagogical University. Series: Pedagogical sciences: a collection of scientific papers.* Berdiansk : Berdiansk State Pedagogical University. № 2. P. 11–27.

Azhazha M. A. (2019). Public administration of the modernisation of higher education in Ukraine. Zaporizhzhia : Classical Private University. 428 p.

Andriukaitiene, Regina, Voronkova, Valentyna, & Nikitenko, Vitalina (2021). The concept of digital transformation of e-education in the countries of the European Union: the European experience / European vector of economic modernisation in the conditions of sustainable development of the industrial region : monograph / edited by Doctor of Economics, Professor N. G. Metelenko. Kyiv : Interservice, P. 72–86.

Andriukaitene, Regina, Metelenko, Natalia, & Voronkova, Valentina (2022). System analysis of new problems and trends in economic development in the digital revolution. *System analysis in management: interdisciplinary research* : materials of the IV All-Ukrainian scientific and practical conference with international participation on 26–27 May 2022 / National Pedagogical Dragomanov University. Kyiv : Oreol-Service. P. 126–129.

Andriukaitene Regina, Voronkova Valentyna, Nikitenko Vitalina, & Oleksenko Roman (2023) Digital healthcare technologies in China. February 2023. *Socio-ethical and deontological problems of modern medicine (non-medical problems in medicine)* : proceedings of the IV International Scientific and Practical Conference (23–24 February 2023). Zaporizhzhia : ZSMU. 207 p. P. 189–190.

Andriukaitene, Regina, & Voronkova, V. G. (2023). Digital transformation of education as a global problem of our time. *Social and*

humanitarian dimensions of the rule of law : materials of the International scientific and practical conference (Dnipro, 14 April 2023). Dnipro : Dnipro State University of Internal Affairs, 2023. P. 11–16.

Alshammari, K. H. (2023). The potential impacts of digital transformation on organizations. *Amazonia Investiga.* № 12 (64). P. 9–18. DOI: https://doi.org/10.34069/AI/2023.64.04

Andrushchenko, V., Yershova-Babenko, I., Kozobrodova, D., Seliverstova, A., & Lysakova, I. (2022). Digitalization of society: implications and perspectives in the context of the psycho-dimensionality of social reality / psychosynertics. *Amazonia Investiga.* № 11 (56). P. 183–195. DOI: https://doi.org/10.34069/AI/2022.56.08.19

Areshonkov, V. Y. (2020). Digitalisation of higher education: challenges and answers. *Bulletin of the National Academy of Pedagogical Sciences of Ukraine.* № 2 (2). P. 1–6.

Afanasieva, L. V., Muzya, E. M., Koleva, K., & Oleksenko, R. I. (2017). Intercultural dialogue in the context of Ukraine's unity. *Ukrainian Studies Almanac.* № (21). P. 15–20.

Bilohur, Vlada, Andriukaitiene, Regina, & Makieshyna, Yuliia (2021). Educational policy in the field of sport during the COVID-19 pandemic: challenges, threats, development trends. *Hhumanities studies* : Collection of Scientific Papers. Zaporizhzhia : Zaporizhzhia National University. 2021. № 7 (84). P. 65–74. DOI: https://doi.org/10.26661/hst-2020-7-84-08

Bilohur, Vlada, & Andriukaitiene, Regina (2020). Sports culture as a means of improving the integrity of sports personality: philosophical-cultural and anthropological analysis. *Humanities studies.* № 6 (83). P. 136–152. DOI: https://doi.org/10.26661/hst-2020-6-83-10

Bilohur, Vlada (2019). Formation of the concept of innovative sports management in Ukraine. *Humanities Studies.* № 1 (78). P. 27–38.

Bilohur, Vlada, Andriukaitiene, Regina & Makieshyna, Yuliia (2021). Educational policy in the field of sport during the COVID-19 pandemic: challenges, threats, development trends. *Humanities studies* : Collection of Scientific Papers. Zaporizhzhia : Zaporizhzhia National University. № 7 (84). P. 65–74. DOI: https://doi.org/10.26661/hst-2020-7-84-08

Buhaichuk, Oksana, Nikitenko, Vitalina, & Voronkova, Valentyna (2023). Formation of a digital education model in terms of the digital economy (based on the example of EU countries). *Baltic Journal*

of Economic Studies. Vol. 9. № 1. Riga, Latvia : Baltija Publishing. P. 53–60. URL: http://www.baltijapublishing.lv/index.php/issue/article/view/2009/2018

Buhaychuk, Oksana, Nikitenko, Vitalina, Voronkova, Valentyna, Andriukaitiene, Regina & Malysh, Myroslava (2022). Interaction of the digital person and society in the context of the philosophy of politics. Interacción persona digital y sociedad en el contexto de la filosofía política. *Cuestiones políticas.* Vol. 40. № 72. P. 558–572. URL: https://produccioncientificaluz.org/index.php/cuestiones/article/view/37783

Buhaichuk, Oksana (2023). The strategy of digitalisation of industrial production as the implementation of the concept of "industry 4.0" (German experience). *Young Science-2023* : Collection of scientific works of students, postgraduates, doctoral students and young scientists. In 5 vols. Zaporizhzhia : ZNU. Vol. 5. P. 200–202.

From breakthrough technologies to the digital economy : monograph (2022) / edited by O. Kubatko, B. Kovalev. Sumy : Sumy State University. 256 p.

Vengerskaia N. S., Voronkova V. G., & Bezkorovaina L. V. (2022). Creative industries as a new model for the growth of the tourism economy. *Theoretical and applied aspects of tourism and hospitality development in the context of international economic integration* : All-Ukrainian scientific-practical conference, 27 May 2022. Dnipro : Dnipro Humanitarian University. P. 13–15.

Voronkova, V. G., & Kivliuk, O. P. (2022). Responsible digital citizenship in the digital age. *Modern scientific strategies of development* : a collective monograph / Compiled by V. Shpak; Chairman of the Editorial Board S. Tabachnikov. Sherman Oaks, California : GS Publishing Services. P. 226–249.

Voronkova, Valentyna, Nikitenko, Vitalina, Bilohur, Vlada, Oleksenko, Roman, & Butchenko, Taras (2022). The conceptualization of smart-philosophy as a post-modern project of non-linear pattern development of the XXI century. *Cuestiones Políticas.* Vol. 40. № 73. P. 527–538. URL: https://produccioncientificaluz.org/index.php/cuestiones/article/view/38416/42625

Voronkova, Valentyna, Oleksenko, Roman & Fursìn, Alexander (2021). Formation of the concept of the socially responsible state as a factor of increasing the public governance and administration

efficiency. *Humanities studies* : Collection of Scientific Papers. Zaporizhzhia : Zaporizhzhia National University. № 7 (84). P. 113–122. URL: http://humstudies.com.ua/article/view/220903/233017

Voronkova, Valentyna, Kyvliuk, Olga, & Nikitenko, Vitalina (2023). The concept of smart education as a factor in enhancing digitalization and intellectualisation. *Prospective directions of scientific and practical activity* : collective monograph / Compiled by V. Shpak; Chairman of the Editorial Board S. Tabachnikov. Sherman Oaks, California : GS Publishing Services. P. 91–110. DOI: 10.51587/9798-9866-95921-2023-011-91-110

Voronkova, Valentyna, Nikitenko, Vitalina, Oleksenko, Roman, Andriukaitiene, Regina, Kharchenko, Julia & Kliuienko, Eduard (2023). Digital technology evolution of the industrial revolution from 4g to 5g in the context of the challenges of digital globalization. *TEM Journal*. Vol. 12. Issue 2. P. 732–742. URL: https://www.temjournal.com/content/122/TEMJournalMay2023_732_742.pdf

Voronkova, Valentina, Nikitenko, Vitalina, Metelenko, Natalya (2022) AGILE-economy as a factor in improving the digital society. *Baltic Journal of Economic Studies.* Riga, Latvia : Baltija Publishing. Vol. 8. Is. 2. P. 51–58. DOI: https://doi.org/10.30525/2256-0742/2022-8-2-51-58

Voronkova Valentyna, Vasylchuk Gennadii, Kahanov Yurii, Nikitenko Vitalina, & Metelenko Nataliia (2023). Developing a model of digital education in the context of the European programme DigiComp 2.0. *Humanities studies* : Collection of Scientific Papers / Ed. V. Voronkova. Zaporizhzhia : Publishinghouse "Helvetica". № 15 (92). P. 101–111. URL: http://humstudies.com.ua/article/view/285087.

Voronkova V. G., & Kivliuk O. P. (2022). The concept of active responsible citizenship for democracy and civil society. *Humanities studies* : Collection of scientific papers / Edited by V. G. Voronkova. Zaporizhzhia : Helvetica Publishing House. 11 (88). 110–119. URL: http://humstudies.com.ua/article/view/261926.

Voronkova VG, Oleksenko RI, & Nikitenko VO (2023). Global digital education at the crossroads of challenges, opportunities and changes. *Man/World at the Crossroads: Technologies, Resources, Social Institutions* : Proceedings of the International Scientific and Methodological Seminar. Practical studies. 4–6 May 2023, Kharkiv, NTU "KhPI". 12–15. URL: https://repository.kpi.kharkov.ua/server/api/core/bitstreams/fcc98461-9264-4b92-9a68-fe9751fc60d9/content

Voronkova, Valentina, Andryukaitene, Regina, & Oleksenko, Roman (2022). Google and Facebook as a way of life for millions of people in the digital society. *Quarterly German scientific/popular science Bulletin "The results of the work of scientists"; Sociology, Criminology, Philosophy, Political Science.* Vol. 3. № 9. P. 36–47.

Voronkova, Valentina, Nikitenko, Vitalina, Andryukaitene, Regina, & Oleksenko, Roman (2021). Artificial intelligence as the main decisive force that can change humanity. *Quarterly German scientific/popular science Bulletin "The results of the work of scientists": Sociology, Criminology, Philosophy, Political science*. Vol. 2. № 6. P. 32–37.

Voronkova, V. G., & Kivlyuk, O. P. (2023). Artificial intelligence as a global problem of our time: technological, ontological, anthropological dimensions. *Quarterly German scientific/popular science Bulletin "The results of the work of scientists": Sociology, Criminology, Philosophy, Political science.* Vol. 4. № 11. P. 56–71.

Girvan, C. (2018). What is a Virtual World? Definition and Classification. *Educational Technology Research and Development.* № 66 (05). P. 1087–1100.

Gramchuk, Marina, & Nikitenko, Vitalina (2023). Present trends and prospects of smart city development. *Humanities studies* : Collection of Scientific Papers / Ed. V. Voronkova. Zaporizhzhia : Publishinghouse "Helvetica", 2023. № 14 (91). P. 35–41. DOI: https://doi.org/10.32782/hst-2023-14-91-04

Gramchuk, M. A. (2023). Development of creative industries as a factor of increasing the competitiveness of cities. *Strategic priorities for the development of entrepreneurship, trade and exchange activities* : materials of the IV International Scientific and Practical Conference, 10–11 May 2023 / Edited by Prof. A. M. Tkachenko. Zaporizhzhia : National University "Zaporizhzhia Polytechnic", 2023. P. 212–216.

Hrynevych, L. M., Morze, N. V., & Boyko, M. A. (2020). Scientific education as a basis for the formation of innovative competence in the context of digital transformation of society. *Information technologies and learning tools*. Vol. 77. № 3.

Dionisio, J. D. N., Burns, W. G., & Richard, G. (2013). 3D Virtual Worlds and the Metaverse: Current Status and Future Possibilities. *ACM Computing Surveys*. № 45 (3). P. 1–38.

Design of the environment. (2018). Dictionary and reference book / Edited by Doctor of Philosophy, Professor I. S. Ryzhova, V. F. Prusak, S. P. Migal, N. O. Rezanova. Lviv : Prostir-M.

Dzhurylo, A. P., & Shparyk, O. M. (2019). ICT competence for secondary school teachers and students in the context of education informatization: global experience and challenges for Ukraine. *Інформаційні технології і засоби навчання.* № 70 (2). P. 43–58. URL: https://doi.org/10.33407/itlt.v70i2.2438

Drozich, I., Drobin, A., Skrypka, I., Mamchych, O., Mykhailenko, O., & Kurach, M. (2023). The role of education in the innovative society. *Amazonia Investiga*. № 12 (64). P. 45–56. DOI: https://doi.org/10.34069/AI/2023.64.04.4

Dovgal, O. A., & Dovgal, G. V. (2021). Digital globalisation in the era of the fourth industrial revolution: the potential for transformation. *Economic Space.* № (167). P. 7–13. DOI: https://doi.org/10.32782/2224-6282/167-1

Dychkovskyy, S., Maksymchuk, M., Protsyk, I., Kulikova, S., & Zviahina, H. (2023). Digitalization of the management of social-cultural activities in the conditions of modern challenges. *Amazonia Investiga.* № 12 (63). P. 341–350. DOI: https://doi.org/10.34069/AI/2023.63.03.32

Education of Ukraine under martial law (2022): management, digitalization, *European integration aspects* : Book of Abstracts of the IV International Scientific and Practical Conference (electronic scientific publication), October 25th, 2022. Kyiv : SSI "Institute of Educational Analytics". 360 p.

European Commission. (2019). 2nd Survey of Schools: ICT in Education. URL: https://digital-strategy.ec.europa.eu/en/library/2nd-survey-schools-ict-education-0

European Commission. (2021). Digital Education Action Plan (2021–2027). URL: https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

Europe 2020 strategy. URL: https://ec.europa.eu/ digital-single-market/en/europe-2020-strategy

European Guidelines for the Development of Ukraine in the Context of War and Global Challenges of the XXI Century (2023). *Synergy of Scientific, Educational and Technological Solutions* : in 2 volumes : materials of the International Scientific and Practical Conference (Odesa, 19 May 2023) / edited by S. Kivalov – Odesa : Yurydyka Publishing House. Vol. 2. 828 p.

Innovative technologies in the modern educational space (2020) : a collective monograph / edited by G. L. Efremova. Sumy : Sumy State

Pedagogical University named after A. S. Makarenko. P. 444. URL: http://repositsc.nuczu.edu.ua/bitstream/123456789/14608/1/MonPaluch.pdf

Innovative technologies in the modern educational space: a collective monograph (2020) / edited by H. L. Efremova. Sumy: Sumy State Pedagogical University named after A. S. Makarenko. 444 c.

Kivliuk, O. P., Voronkova, V. G., & Nikitenko, V. O. (2023). Integration of virtual reality and education in the context of creativity and modern trends in digital development / Compiled by V. Shpak ; Chairman of the Editorial Board S. Tabachnikov. Sherman Oaks, California : GS Publishing Services. P. 47–63. URL: https://www.eo.kiev.ua/resources/arhivMonographs/mono_2023_13/mono_2023_13.pdf.

Kivliuk, O. P., Voronkova V. G., Nikitenko V. O. (2023). Digital human rights as an expression of digital attributes: socio-philosophical justification. *Educational discourse* : a collection of scientific papers / edited by O. P. Kivliuk. Kyiv : Scientific and Information Agency "Science-Technology-Information" LLC. Issue 40 (4–6). C. 7–22.

Kindratets, O. (2019). Problems of digital transformation of education. *Humanitarian Bulletin of Zaporizhzhia State Engineering Academy.* P. 59–60.

Kostyria, I., Bereziuk, D., Sadovyi, M., Podoprygora, N., & Tryfonova, O. (2023). Use of smart technologies in the training of specialists in higher education institutions. *Amazonia Investiga.* № 12 (62). P. 149–157. DOI: https://doi.org/10.34069/AI/2023.62.02.13

Kohli, R, & Melville N. (2019). Digital innovation: a review and synthesis. *Information Systems Journal*. № 29 (1). P. 200–223.

Krupa, A. A. (2023). Chatbots as factors of IT service management, transition to self-service and automated processes. Strategic priorities for the development of entrepreneurship, trade and exchange activities: materials of the IV International Scientific and Practical Conference, 10–11 May 2023 / Edited by Prof. Tkachenko A. M. Zaporizhzhia : National University "Zaporizhzhia Polytechnic", 2023. P. 140–145.

Krupa, A. A. (2023). Characteristics of the ICT paradigm of the post-information society. *Communication space of the post-information society: problems and prospects* : Proceedings of the All-Ukrainian Scientific and Practical Conference (Kyiv, 30 May 2023). P. 47–49.

Kucherak, I. (2020). Digitalisation and its impact on the educational space in the context of the formation of key competences. *Innovative*

Pedagogy. № 2 (22). P. 91–94. URL: http://www.innovpedagogy.od.ua/archives/2020/22/part_2/22.pdf

Leleka, V., Zabiiaka, I., Tsviakh, O., Grubi, T., & Vytrykhovska, O. (2022). Innovative approaches to teaching students in the modern educational information environment in the USA and Great Britain. *Amazonia Investiga.* 11 (60). P. 156–166. DOI: https://doi.org/10.34069/AI/2022.60.12.17

Maksymeniuk, M. Y., Nikitenko, V. O. (2016). Formation of the paradigm of information and communication society as a kind of complex social system and interaction. *Humanitarian Bulletin of Zaporizhzhia State Engineering Academy*. Issue 66. P. 266–278.

Marienko, V. Y. (2023). Data security in the era of big data as a strategic resource of the country. *Strategic priorities for the development of entrepreneurship, trade and exchange activities* : materials of the IV International Scientific and Practical Conference, 10–11 May 2023 / Edited by Prof. A. M. Tkachenko. Zaporizhzhia : National University of Zaporizhzhia Polytechnic. P. 76–80. URL: http://eir.zntu.edu.ua/bitstream/123456789/10033/1/Strategic_priorities.pdf.

Marienko, V. Y. (2022). Information support of management in organisations as complex systems in the context of digitalisation. *Modern scientific strategies of development* : a collective monograph / Compiled by V. Shpak ; Chairman of the Editorial Board S. Tabachnikov. Sherman Oaks, California: GS Publishing Services, 62–81. DOI: 10.51587/9781-7364-13395-2022-008-62-81

Matviienko, O., Vytrykhovska, O., Veremijenko, V., Zabiiaka, I., & Tyulpa, T. (2023). Innovative development of the education industry in the European higher education area. *Amazonia Investiga.* № 12 (64). P. 136–145. DOI: https://doi.org/10.34069/AI/2023.64.04.13

Michael, Michalko (2019). 21 ways to think creatively / translated from English by T. Boyko. Kharkiv : Book Club “Family Leisure Club”. 400 p.

Michio, Kaiku (2017). Physics of the Future. How science will influence the fate of humanity and change our everyday life in the 21st century. Lviv : Litopys. 432 p.

Michio, Kaiku (2020). The Future of the Mind. Scientific attempts to comprehend, perfect and enhance intelligence / translated from English by Angela Kamianets. Kyiv : Litopys. 420 p.

Metelenko, Natalya, Vasyl’chuk, Gennadiy, Kaganov, Yuriy, Nikitenko, Vitalina, & Voronkova, Valentyna (2023). Digital cultural development

under new threats and challenges. *Humanities studies* : Collection of Scientific Papers. Zaporizhzhia : Publishing house "Helvetica". № 15 (92). 33–43. URL: http://humstudies.com.ua/article/view/284985

Metelenko, Natalia, & Voronkova, Valentyna (2022). Managing digital transformation in PHD programmes in management. *Digital transformation of socio-economic, managerial and educational systems of modern society* : Proceedings of the International Scientific and Practical Conference 23–24 November 2022. Lviv – Torun : Liga-Pres. P. 637–641.

Metelenko, N. G., & Andriukaitene, Regina (2022). New generation ICT as a factor in the development of the innovative economy of the digital age. *Economic, legal and socio-technical directions of the evolution of the digital society* : materials of the international scientific and practical conference : in 2 volumes. Volume 2. Dnipro : University of Customs and Finance. P. 449–451.

O'Connor, Joseph, & McDermott, Ian (2018). Systems thinking. Search for extraordinary creative solutions. Kyiv : Nash format. P. 240.

Oltrade, Dagogo (2021). New thinking. From Einstein to artificial intelligence: science and technology that changed the world / translated from English by I. Vozniak. Kharkiv: Vivat. 368.

O'Neill, Kate (2020). BIG DATA. Weapons of mathematical destruction. How big data is increasing inequality and threatening democracy. Kyiv : Force Ukraine. 336 p.

Nambisan, S., Zahra, S. A., & Luo, Y. (2019). Global platforms and ecosystems: implications for international business theories. *Journal of International Business Studies*. № 50 (9). P. 1464–1486

National report on the state and prospects of education development in Ukraine : monograph (2021) / National Academy of Pedagogical Sciences of Ukraine ; editors: V. Kremen (chairman), V. Luhovyi (deputy chairman), O. Topuzov (deputy chairman) ; edited by V. Kremen. Kyiv : CONVI PRINT. 384 p.

Scientific and educational transformations in the modern world (2021): collection of materials of the All-Ukrainian interdisciplinary scientific and practical conference (Chernihiv, 15 July 2021) / Scientific and Educational Innovation Centre for Social Transformations, Chernihiv. Sumy : Rostok A. V. T. Ltd. 476 p.

Continuing pedagogical education in foreign countries: information and analytical materials (2018) / N. M., Avsheniuk, K. V., Godlevska,

L. M., Dyachenko, K. V., Kotun, M. M., Marusynets O. I., Ogienko, N. O., Postryhach, Y. M., Pylynskyi ; edited by N. M. Avsheniuk. Kyiv : DKS Centre LLC. 150 p.

Nikitenko, V. O., Voronkova, V. G., & Oleksenko, R. I. (2023). Smart eco-city as a factor in the introduction of green building and digital technologies. *Green Construction* : Proceedings of the II International Scientific and Practical Conference. Kyiv : Kyiv National University of Construction and Architecture. P. 166–172. URL: http://repositsc.nuczu.edu.ua/bitstream/123456789/17369/1/KNUBA%20Gornostal%2014_04_2023.pdf

Nikitenko, Vitalina, Voronkova, Valentyna, Andriukaitiene, Regina, & Oleksenko, Roman (2021). The crisis of the metaphysical foundations of human existence as a global problem of post-modernity and the ways of managerial solutions. *Propósitos y Representaciones Jan.* Vol. 9. SPE (1). e928 ISSN 2307-7999. URL: http://revistas.usil.edu.pe/index.php/pyr/article/view/928

Nikitenko, Vitalina, Voronkova, Valentyna, Oleksenko, Roman, Andriukaitiene, Regina, Holovii, Liudmyla (2022). Education as a factor of cognitive society development in the conditions of digital transformation. *Revista de la universidad del zulia.* Vol. 13. № 38. P. 680–695. URL: https://produccioncientificaluz.org/index.php/rluz/article/view/38736/43155

Nikitenko, Vitalina, Metelenko, Natalia, Voronkova, Valentyna, & Vasylchuk, Gennadiy (2023). The concept of transformation of the educational paradigm based on needs and "lifelong learning". *Humanities studies* : Collection of Scientific Papers / Ed. V. Voronkova. Zaporizhzhia : Publishing house "Helvetica". № 14 (91). P. 93–101. DOI: https://doi.org/10.32782/hst-2023-14-91-11

Nikitenko, V. O., Oleksenko, R. I., & Kivliuk, O. P. (2022). Formation and development of education in a digitalised society. *Humanities studies* : Collection of Scientific Papers / ed. V. Voronkova. Zaporizhzhia : Publishing house "Helvetica". № 10 (87). P. 53–63. URL: http://humstudies.com.ua/article/view/254703.

Nikitenko, V. O. (2020a). Culture and civilisation: interaction and interrelation in the context of socio-philosophical analysis. *Humanities studies* : a collection of scientific papers / Zaporizhzhia National University : ZNU. № 3 (80). P. 49–64.

Nikitenko, V. O. (2020b). Innovative and creative potential of the individual as the main driver of the formation and development of the innovation and information society. *Economics and management in the period of digital transformation of business, society and state* : materials of the Anniversary International Scientific and Practical Conference (28–29 May 2020, Zaporizhzhia) / Scientific editor N. G. Metelenko. Zaporizhzhia : ZNU Engineering Institute. P. 67–72. URL: https://web.znu.edu.ua/NIS//2020/sbornik.pdf.

Nikitenko, Vitalina, Voronkova, Valentyna, Oleksenko, Roman, Matviienko, & Halyna, Butkevych, Oksana (2023). Sustainable agricultural development paradigm formation in the context of managerial experie nce of industrialized countries. *Revista de la universidad del ZULIA*. 3ª época. Año 14N° 39. 81–97. DOI: http://dx.doi.org/10.46925//rdluz.39.05

Nikitenko, V. O. (2013). Modern Geoculture as a Socio-Cultural Phenomenon Humanitarian. *Bulletin of Zaporizhzhia State Engineering Academy*. Zaporizhzhia : ZGIA. № 53. P. 261–270.

Nikitenko, V. O. (2015). Formation of geo-values in the process of teaching Ukrainian as a foreign language. Gilea. Historical sciences. Philosophical sciences. Political sciences: scientific bulletin: a collection of scientific papers. Kyiv : Publishing house of UAS LLC SPE VIR. Issue 100. P. 219–223.

Nikitenko, Vitalina, Andriukaitiene Regina, Punchenko Oleg (2019). Developing corporate management to improve the quality of customer service. *Humanities studies* : Collection of Scientific Papers . Zaporizhzhia : ZNU. № 1 (78). P. 140–153.

Nikitenko, V. O. (2022). Network platforms as a way of life for millions of people in the digital society. *Actual problems of modern philosophy and science: challenges of the present* : a collection of scientific papers / ed. Horokhova, O. Chaplinska [et al. Zhytomyr : Publishing Centre of Ivan Franko State University of Zhytomyr. P. 57–59.

Newest technologies in scientific activity and educational process (2023): All-Ukrainian Scientific and Practical Conference of Students, Postgraduates and Young Scientists (Chernihiv, 19–20 April 2023): collection of abstracts. Chernihiv : National University “Chernihiv Polytechnic”. 436 p.

Oleksenko, R. I., Voronkova, V. G. (2020). Education as a flagship of human progress and the basis of competitiveness of higher education

institutions. *Improving the educational process in a higher education institution* : Collection of scientific and methodological works. Issue 24. Melitopol : Tavria State Agrotechnological University named after Dmytro Motornyi. P. 202–210.

Oleksenko, R. I. (2017). A person in the conditions of the information society as an object of socio-economic reflection. *Formation and development of the information society as a basis for ensuring Ukraine's competitiveness in the world and sustainable development of society and the state.* P. 59–62.

Oleksenko R. I. & Garbar G. A. (2021). Innovative education as a factor of creative development of a personality in the context of global challenges : a monograph / R. Oleksenko, G. Garbar. Zaporizhzhia : Odnorog TV. 96 p.

Otych, O., Ordina, L., Ordin, Y., Ivasenko, B., & Velyka, K. (2023). Innovative infrastructure of higher education as a factor of the development of the economy of Ukraine. *Amazonia Investiga.* № 12 (65). P. 164–174. DOI: https://doi.org/10.34069/AI/2023.65.05.16

Plakhotnik, O., Zlatnikov, V., Strazhnikova, I., Bidyuk, N., Shkodyn, A., & Kuchai, O. (2023). Use of information technologies for quality training of future specialists. *Amazonia Investiga.* № 12 (65). P. 49–58. DOI: https://doi.org/10.34069/AI/2023.65.05.5

Pinker, Stephen (2019). Enlightenment today. Arguments in favour of reason, science and progress. Kyiv : Nash format. 560 p.

Punchenko, Oleg, Voronkova, Valentina (2019). New enlichtemment new fractality in transformation process of education. *Humanities Bulletin of Zaporizhzhe State Engineering Academy* : Proceedings Scientific publications. Zaporizhzhia : EPD of ZSEA. № 77. P. 144–159. URL: http://vestnikzgia.com.ua/article/view/177746

Punchchenko, O., Voronkova, V., Punchchenko N. (2019). The conceptual model of the "new Enlightenment" as a factor in the development of transformational processes in education. *Theory and practice: problems and prospects KAUNAS.* Lithuanian sports university. P. 66–67. URL: http://dspace.lsu.lt/handle/123456789/62.

O' Reilly, Tim (2018). Who knows what the future will be like? Kyiv : Nash format. 448 p.

Ramaswamy, V, & Ozcan, K. (2018). Offerings as digitalised interactive platforms: a conceptual framework and implications. *Journal of Marketing.* № 82 (4). P. 19–31.

Ryzhova, I. S. (2018). Influence of "SMART technologies" on the development of "SMART-city" in the information society. *Humanitarian Bulletin of Zaporizhzhia State Engineering Academy.* Zaporizhzhia. № 72. P. 81–90.

Safonov, Y., Usyk, V., & Bazhenkov, I. (2022). Digital transformations of education policy. *Baltic Journal of Economic Studies.* № 8 (2). P. 127–136. DOI: https://doi.org/10.30525/2256-0742/2022-8-2-127-136

Swab Dick (2019). Our creative brain / translated from German by Svyatoslav Zubchenko. Kharkiv : Family leisure club. 463 p.

Skinner, Chris (2020) The Digital Man. The fourth revolution in the history of mankind, which (2022). Will affect everyone / translated from English by G. Yakubovska. Kharkiv : Ranok Publishing House ; Fabula. 272 p.

Sliusar, Mykyta (2023). Stablishment and development of the network platform model in China and its impact on the formation of the digital economy. *Humanities studies* : Collection of Scientific Papers. Zaporizhzhia : Publishing house "Helvetica", 2023. № 14 (91). P. 165–175. DOI: https://doi.org/10.32782/hst-2023-14-91-19

Slyusar M. Y. (2023). Network platforms as a factor in the development of the digital economy. Strategic priorities for the development of entrepreneurship, trade and exchange activities: materials of the IV International Scientific and Practical Conference, 10–11 May 2023 / Edited by Prof. A. M. Tkachenko. Zaporizhzhia : National University "Zaporizhzhia Polytechnic". C. 174–178.

Social, economic and educational transformations in the digital era : monograph (2022) / S. V. Leonov et al. edited by Doctor of Economics S. V. Leonov, Candidate of Economics O. A. Krykliy. Sumy : Sumy State University. P. 204. URL: https://essuir.sumdu.edu.ua/handle/123456789/90056

Stoika, O., Butenko, N., Miziuk, V., Zinchenko, O., & Snikhovska, I. (2023). Information technologies in the educational process of higher educational institutions. *Amazonia Investiga.* № 12 (63). P. 156–163. DOI: https://doi.org/10.34069/AI/2023.63.03.14

Sukhonos, V. V., Garust, Y. V., Shevtsov, Y. A. (2019). Digitalisation of education in Ukraine: foreign experience and domestic prospects for implementation. *Legal Horizons.* № 19 (32). P. 79–86.

Tolochko, S. V. (2021). Digital competence of teachers in the context of digitalisation of educational institutions and distance learning.

Bulletin of the National University "Chernihiv Collegium" named after T. G. Shevchenko. № 13 (169). P. 28–35. DOI: https://doi.org/10.5281/zenodo.5077823

Tegmark Max (2019). Life 3.0 The age of artificial intelligence / translated from English by Zoryna Korablin. Kyiv : Nash format. 432 p.

Tapscott Don, Tapscott Alex (2019). Blockchain revolution. Lviv : Litopys. 492 p.

Tatlock Philip, Gardner Dan (2018). Superforecasting. The art and science of prediction / translated from English by Iryna Mazarchuk. Kyiv : Nash format. 368 p.

Florida, Richard (2018). Homo creatives. How a new class is conquering the world / translated from English by Maxim Yakovlev. Kyiv : Nash format. 432 p.

Ford, Martin (2016). The coming of the robots. Technology and the threat of the future / translated from English by Volodymyr Horbatko. Kyiv : Nash format. 400 p.

Foster, Provost, Tom, Fawcett (2019). Data science for business. How to collect, analyse and use data. Kyiv : Nash format, 2019. 400 p.

Fürst, Maria, Trinks, Jürgen (2018). Philosophy / translated from German by Vakhtanga Kebuladze. Kyiv : Dukh i Litera, St Thomas Aquinas Institute of Religious Sciences. 544 p.

Ukraine 2030E – a country with a developed digital economy (2022). URL: https://strategy.uifuture.org/kraina-z-rozvinutoyu-cifrovoyu-ekonomikoyu.html.

Ukraine on the way to recovery: the tasks of science and education in the Europeanisation of the state (2023) : materials of the All-Ukrainian interdisciplinary scientific and practical online conference (Kyiv, 17–19 May 2023) / compiled by L. I. Tkachenko, V. M. Shulha. Kyiv : Institute of Gifted Children of the National Academy of Pedagogical Sciences of Ukraine. 946 p.

Philosophy of the main spheres and directions of human activity (2022): Dictionary-reference book / On the initiative of Doctor of Sociology, Professor V. M. Picha; under the scientific editorship of Doctor of Philosophy, Professor V. L. Petrushenko. Lviv : Novyi Svit-2000. 342 p.

Fursin O. O., Muts L., Voronkova V. G. (2019). Formation of professional competences of a digital society specialist. *Education*

as a factor in the formation of creative competences in a digital society : Materials of the International Scientific and Practical Conference 27–28 November 2019. Zaporizhzhia : ZNU. P. 179–182. URL: http://vestnikzgia.com.ua/issue/view/11462/showToc

Fursin O. O. (2023). Technological foundations of communication as a social phenomenon: opportunities and prospects for development. *Communication space of the post-information society: problems and prospects* : Proceedings of the All-Ukrainian Scientific and Practical Conference (Kyiv, 30 May 2023). Kyiv : Tvory LLC, 2023. P. 49–52.

Digital transformation of open educational environments: a collective monograph (2019) / [team of authors]; edited by V. Y. Bykov, O. P. Pinchuk. Kyiv : Yamchynskyi O. V. 186.

Digital transformation of education and science (2023). URL: https://mon.gov.ua/ua/tag/cifrova-transformaciya-osviti-ta-nauki (accessed 25.07.2023).

Digital economy: textbook (2022) / T. Oleshko, N. Kasyanova, S. Smerichevsky, et al. Kyiv : NAU. 200.

Cherep, A., Voronkova, V., & Cherep, O. (2022). Humanocracy as a factor of improving human resources management in organizations. *Humanities studies* : Collection of Scientific Papers / ed. V. Voronkova. Zaporizhzhia : Publishing house "Helvetica". № 10 (87). P. 134–141. URL: http://humstudies.com.ua/article/view/254724

Cherep, Alla, Voronkova, Valentyna,Cherep, Oleksandr, & Kaliuzhna, Iuliia (2023). A humanistic and cross-cultural approach to organization management as a factor of people's democracy. *Humanities studies* : Collection of Scientific Papers. Zaporizhzhia : Publishing house "Helvetica". № 14 (91). P. 184–195.

Cherep, A. V., Voronkova, V. G., Cherep, O. G., Nikitenko, V. O. (2022). Exponential technologies as an economic resource of the digital economy concept. *Innovative resources of modern science* : Collective monograph / Compiled by V. Shpak; Chairman of the Editorial Board S. Tabachnikov. Sherman Oaks, California: GS Publishing Services. P. 48–58. URL: https://www.eo.kiev.ua/ua/content/148/.

Cherep, A., Voronkova, V., Nikitenko, V., Azhazha, M., Muts, L. (2019). Formation of a creative model of education and its impact on the development of the information and noosphere society. *Theory and practice: problems and prospects* : International scientific-practical

conference “” 2019, 9–10 May. Kaunas Kaunas : Lithuanian sports university. 15–16. URL: file:///C:/Users/Valentina/Downloads/mokslas_ir_praktika__3_2019_1.pdf

Cherep, Alla, Voronkova, Valentyna, Cherep Oleksandr (2022). Tolerance in the discurse practices of european society and business. *Humanities studies* : Collection of Scientific Papers. Zaporozhzhia: Publishing house “Helvetica”. № 12 (89). P. 160–173.

Shunkov, V., Marushko, L., Mykhailov, V., Lutsenko, Y., & Teslenko, S. (2023). Ways of implementing information technologies in professional training of future specialists. *Amazonia Investiga.* № 12 (62). P. 140–148. DOI: https://doi.org/10.34069/AI/2023.62.02.12

Shparyk, O. (2022). Digital transformation of secondary education: common strategic vectors of the USA and EU countries. *Ukrainian Pedagogical Journal.* № 3. P. 33–43. DOI: https://doi.org/10.32405/2411-1317-2022-3-33-43

Shparyk, O. (2021). Conceptual foundations of the digital transformation of education: European and American discourse. *Ukrainian Pedagogical Journal.* № 4. P. 65–76. DOI: https://doi.org/10.32405/2411-1317-2021-4-65-76

Zhiliang, G., Solianyk, A., & Karpenko, O. (2023). Digital services of regional centres for scientific and technical information in China. *Amazonia Investiga.* № 12 (61). P. 330–341. DOI: https://doi.org/10.34069/AI/2023.61.01.33

Schwab, Klaus (2019). The Fourth Industrial Revolution, Shaping the Fourth Industrial Revolution. Kharkiv : Family Leisure Club. 426.

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