New Skills and Knowledge for Digital Entrepreneurs in the age of Artificial Intelligence

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Abstract: Digital technologies are becoming increasingly complex and integrated, leading to significant transformations in society and the economy. The article aims to explore and summarize the new opportunities and potential risks of the widespread use of artificial intelligence (AI) in all aspects of life, to define the new skills and necessary knowledge of digital entrepreneurs and to highlight the need for transformation in modern education. Recognizing that the relationship between technology and business is two-way and becoming stronger, revealing that well-prepared employees are a guarantee of success and prosperity of companies in various fields, we try to focus on the main groups of qualities, skills and basic knowledge of students in the age of artificial intelligence. The development of the Internet, expansion of connectivity through social networks, the advent of AI, 3D printing, and immersive technologies like Augmented Reality, and Virtual Reality, require new knowledge and skills, leading to new challenges in education. Qualified personnel in this modern world must have solid professional training and systemic thinking (knowledge, skills, accumulated information), developed cognitive abilities, and personal skills based on collecting and analyzing large amounts of diverse information from heterogeneous sources. Questions arise: how can multiple information sources be combined effectively, and how can the fusion of multiple sources provide additional information to support decision-making processes? Combining information obtained from the real world makes the results heterogeneous and more informative. It follows the need to develop machine learning methods to extract relevant information from increasingly complex data sets. The goal is to improve the accuracy of the applied classification algorithms by combining predictions from multiple models, as well as obtaining a more stable final classification evaluation, effective handling of noisy data, adaptation to changing conditions, and improving stability when solving problems. On the other hand, how to ensure that the enormous potential of artificial intelligence, virtual reality, connection with the physical world, machine learning, and pervasive networks of people and machines will be fully used to improve the quality of life and contribute to the building of stable societies. Changes must be subordinated to policy and investments for reliable artificial intelligence and based on an ethical and human-centered approach. All of these should be established as a fundamental principle of training in Higher education which imposes the need for transformation in modern education.

Keywords: Artificial intelligence, Machine learning, Data fusion, e-Learning, Entrepreneurship

1. Industry Development and Labor Market Change

The new reality in which we live and work is closely related to Artificial Intelligence and Industry 4.0. This necessitates the acquisition of new knowledge and skills by the modern entrepreneur to guarantee the success and prosperity of the company, which is the matter of the main research question in the paper. The first part of the article discusses the basic concepts such as AI, Industry 4.0, machine learning and its application for data mining. The second part presents the challenges facing modern education and the need for new approaches and changes. In the third part, contemporary requirements for an interdisciplinary approach and the need for transformation of modern education, combining theory and practice, are explained.

Comprehensive digitalization of activities in the economy, organizational systems, trade, and services and the penetration of Artificial Intelligence (AI) in all areas has led to the development of industry and a radical change in the labor market. Industry 4.0 is emerging. In Germany, the term "Industry 4.0" first appeared during the Hanover exhibition in 2011. Professors from the Massachusetts Institute of Technology (MIT) Erik Brynjolfsson and Andrew McAfee use the term "second machine age" in their book of the same name, published in 2014 (Brynjolfsson and McAfee, 2014).

According to Schwab (2017), "The fourth industrial revolution is a stage in the development of society, characterized by the rapid development and progress of digital technologies and their massive penetration into all spheres of life." It is based on intelligent and interconnected machines and systems. New concepts appear Internet of Things (IoT), Internet of events, Internet of people (social networks - Facebook, Twitter, LinkedIn, etc.), and Internet of location (mobile phones, smartphones, tablets, etc.). Such networks are created

to restructure economic and societal processes in such a way as to exclude the need for human involvement in a large part of actions and operations.

Digital technologies are becoming increasingly complex and integrated, and as such they are causing significant transformations in society and the economy. Artificial intelligence is at the heart of this transformation because the scientific breakthroughs associated with it form fields whose functioning depends to a large extent on the representation of knowledge and the imitation of human reasoning abilities. Artificial Intelligence and Data Science are evolving: Machine Learning; Natural language procedures; Image recognition; Computer intelligence; Intelligent robotics etc. A rapid development of technologies directly related to Artificial intelligence follows, such as: Web; IoT; Cloud technologies; Computing - supercomputers, GPUs, etc.

According to the study (Chege and Wang, 2020), technological innovation has a significant positive impact on job creation in small businesses and serves as a major engine for economic growth. The effective application of information technology in these enterprises significantly improves their competitiveness and provides them with access to global markets. According to the authors (Ciarli et al, 2021) digitalization is not just replacing jobs, but is related to the transformation of activities and their reorganization. For example, in agriculture, technology-driven digital transformation is bringing change far beyond simply training farmers to operate farm machinery. Instead, farm owners will have to shift to making high-level strategic decisions about software and equipment upgrades, requiring both financial expertise and technical skills.

In the book “Digital Entrepreneurship Impact on Business and Society” (Soltanifar et al, 2021) focuses on digital entrepreneurship and the main factors that influence digital business. The main digital technologies that are considered are related to Cloud Computing, VR/AR, IoT, AI, and Distributed Ledger Technologies. According to the authors, good knowledge of digital technologies is a prerequisite for generating good ideas at the right time and place. Therefore, the digital entrepreneurial personality must maintain the following competencies:

- Creativity, organizational skills, and sense of market opportunities;
- Knowledge of the technical requirements and competition of the surrounding environment;
- Courage to apply creativity to their own business.

Alongside the positive impact that digitalization has, people's dependence on it is also increasing and the likelihood of cyber attacks and security breaches is growing.

Social networks open doors and minimize barriers to connection and communication, but they also give rise to new forms of social anxiety. Digitization facilitates payments and commerce but also stimulates new types of fraud. Technologies that speed up and expand information processing can also drastically cut jobs. The increasing complexity and interdependence of technologies are accompanied by a significant increase in risk factors. This requires studying and deciding on monitoring, controlling, and assessing risk in the context of multi-criteria decision-making, with emphasis on fuzzy logic models, algorithms, and applications (Popchev and Orozova, 2021). In the book "Industries of the Future", Ross (2017) summarizes the main features and dangers: the forces that "unleash unprecedented progress" in lifestyles and wealth accumulation also have the potential to allow identity theft or invasion of personal living space.

With the adoption of digitalization in various spheres, a change is needed in the way of perceiving the world, work, training, and the opportunities that are revealed. People with entrepreneurial skills are constantly looking for new possibilities and ways to achieve their goals. Knowledge of new technologies and ways to apply them will unlock powerful creative energy, help create and offer new services to the market, and offer innovative approaches to solving new and existing problems.

2. The Challenges to Training and the Need for new Approaches

Considering the wide application of artificial intelligence (AI) in various sectors, it becomes extremely important to study its potential impact on the business models (BM) of entrepreneurs (Pfau and Rimpp, 2021). Trained personnel in this modern world must have stable professional training and system thinking (knowledge, skills, accumulated information), developed cognitive qualities, and personal skills such as:

- ability to analyze multiple project perspectives;
- apply a set of appropriate criteria for a realistic assessment of projects in terms of development and implementation time, price, risk, and security;
- to work successfully in a team on real projects with a clear final goal;

- competence in artificial intelligence (AI), big data, and information and communication technologies, to have interdisciplinary thinking, etc.

AI is not a new concept and it has long been present in various spheres of our daily life. Some of these applications are well-known to users, while others often go unnoticed. Examples include shopping recommendation systems, facial recognition technologies, and voice assistants (Intel Corporation, 2020).

Technology continuously monitors and measures various aspects of the learning environment, producing large amounts of data. The sources cover a wide field, including fixed and mobile sensor networks, human-provided data, domain knowledge, and more. The effectiveness of AI methods depends largely on the quality of the data it is trained on. In an educational context, this means providing accurate, representative, and diverse data for training algorithms. Next comes the need to develop methods for collecting, preparing, and managing such data, as well as developing machine learning algorithms to extract relevant information from increasingly complex data sets.

The questions arise: how to efficiently combine several data sources and how to combine the results of the work of different classification algorithms. Data fusion aims to improve classification accuracy by combining the predictions of multiple models, on the other hand obtaining a more stable final classification, dealing with noisy data, and adapting to different changing scenarios and conditions.

According to (Pereira et al, 2024)'s comparative study of automatic data fusion methods, they are divided into early and late fusion categories. Early fusion is divided into sensor data fusion and feature data fusion. Early sensor-level fusion methods can be applied: Bayesian Inference, Kalman Filter, Fuzzy Logic, Artificial Neural Networks, Dempster–Shafer, etc. Early Fusion from Features methods can be Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Multidimensional Scaling (MDS)), and Deep Learning. Late fusion is divided into Late Fusion from Scores and Late Fusion from Decisions.

For example, an artificial intelligence and machine learning method of the type Early feature fusion (Pereira et al, 2024) performs the combination of features extracted from different levels of a neural network at an early stage of the model architecture. This integration allows the unification of both low- and high-level functions, allowing the simultaneous capture of detailed and abstract information. By fusing features at the beginning of the network, classifiers and regression models can generate more comprehensive descriptions of the input data.

This representation has the potential to improve the performance of various tasks, including image classification, object detection, and semantic segmentation. AI models can be improved using early feature fusion, thus advancing several data analytics applications. Figure 1 (Pereira et al, 2024) shows a block diagram of the stated method. Data sources are processed to extract the characteristic features that describe them. The most informative of them are selected. The selected features are used for regression and/or classification. The results can be applied to decision-making.

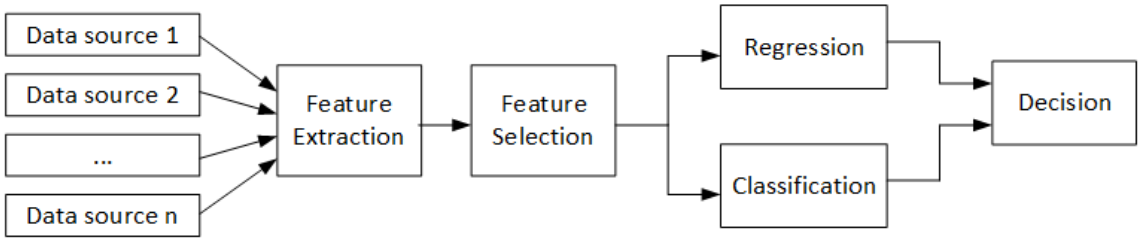

Figure 1: The early feature fusion method

3. Contemporary Requirements for an Interdisciplinary Approach

Current demands on education require an interdisciplinary approach, drawing resources, knowledge, and expertise from both the field of learning and specialists in learning theory, AI, big data, and psychology. Artificial intelligence resources can be methods, algorithms, programs, and positive experience in applying AI in many fields; development of AI-based learning management systems (LMS), intelligent training systems (ITS), etc., general-purpose AI-based intelligent systems (such as recommending systems, recognition and search systems). Cloud computing serves as a medium for AI and as part of our everyday life could be successfully implemented in business and would lead to competitive advantages (Delinov et al, 2022).

Augmented reality (AR) and virtual reality (VR) devices can be used to create interactive online ecosystems for specific training programs, offering participants virtual challenges and tests necessary to successfully complete the training. These platforms can be adapted to any industry, with virtual customers or patients being served by AI bot avatars, resulting in an immersive and engaging learning experience.

Cognitive sciences also provide methods for the development of higher cognitive functions such as critical thinking, problem-solving, innovation, decision-making, etc. On the other hand, the classical basic philosophical theories of learning: behaviorism, cognitivism, constructivism, connectivism of learning, can be a main source of ideas. They are the basis of already established private learning theories such as active learning, problem-based learning, project-based learning, etc.

There are many specific theories of learning, each focusing on particular characteristics or procedures. These theories can be useful in forming certain guidelines or limitations in the development of digital learning. The pedagogical framework TPACK (Mishra and Koehler, 2006) helps educators realize the power of technology and ways to properly integrate it into learning by combining their knowledge and pedagogical principles. According to the model, the knowledge, skills, and experience of the educator are essential to use the technological potential to achieve educational goals.

The successful implementation of young people in the modern world also requires business competence, entrepreneurial spirit, and leadership qualities. A transformation of higher education is needed. The requirement for modernity and the responsibilities towards the educational system requires that in the curricula of bachelor's and master's programs, depending on the professional direction and specialty, training in the following areas, as well as the connections between them, must be included: Artificial intelligence, Big data and their processing (DataScience), Digital Transformation, Industry Development / Entrepreneurship and Cloud computing.

Research in (Kruger, 2021) and their proposed conceptual model connect business functionalities and the necessary competencies that will allow entrepreneurs to cope with the challenges posed by Industry 4.0 and the change in the way enterprises are managed and business in its essence. The main competencies are related to Innovation, Creativity, Integrated business and technology skills, Leadership and communication, Networking, and sales.

The use of modern technologies such as virtual reality (VR), artificial intelligence (AI), augmented reality (AR), and robotics includes different teaching methods, allowing entrepreneurship education to be included in the curricula not only in business schools but also in science and technology students. This can serve as a starting point for changing and updating curricula and programs to meet the requirements of entrepreneurs.

Taking into account the various limitations (financial, available material base, certification requirements, etc.), the learning process can be planned by: appropriate differentiation of the learned content using the means of electronic learning; conducting interdisciplinary research and project work; personalized learning opportunities, collaborative learning in changing roles; international exchange (Erasmus+ program), etc. Personalized learning is a complex and highly uncertain system that can be realized by using Big Data and technologies based on artificial intelligence.

Students must come to the understanding on their own that obtaining knowledge is a complex process of research, gathering and processing data and information, asking questions and answers, forming and testing hypotheses, making a decision, and summarizing. AI tools have the potential to greatly enhance teaching, but they should not replace it. Overreliance on these tools can lead to a loss of human contact and individual attention which are essential components of effective education. The role of transmitters of support, guidance, and motivation is indispensable and a key component of successful education.

4. Conclusion

The article summarizes the new opportunities and potential risks of the widespread use of artificial intelligence in all aspects of life, defines the basic skills and necessary knowledge of digital entrepreneurs and emphasizes the need for transformation in modern education. In the opinion of the authors, the training should focus to a much greater extent on the study of problems from the real world, acquiring knowledge and skills for their use; conducting scientific research together with the students, and activities related to the formation of skills for independent learning, practice-oriented learning and maximum preparation for work in real conditions, as well as nurturing an entrepreneurial spirit during the studies at the university. The implementation of these tasks requires various resources and, above all, knowledge, experience, and prioritized new research and

development agreed upon at different levels, subordinated to the problem of adaptation to the current hyper-connected world. Changes should be subject to policy and investments for reliable artificial intelligence (Policy, 2019) and based on an ethical approach (Ethics, 2019), which should be established as a basic principle of training in the Higher School.

The transformation of higher education in the era of artificial intelligence requires innovative solutions, as well as actions related to the need to overcome contradictions and difficulties of an objective and subjective nature. Constructive cooperation between the Ministry of Education and Science, business, and the Higher Schools of the country is necessary.

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