

Industry 4.0 from the perspective of Education 4.0

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Abstract – Industry 4.0, or the fourth industrial revolution, means the automation of industrial processes, digitalization and the use of data in order to increase the efficiency and quality of production processes. Industry 4.0 also affects other areas of the economy, as well as education. The concept of Education 4.0 strives to modernize and apply education to the age of Industry 4.0 using new technologies and methods. The main goal of Education 4.0 is to prepare students for the challenges of Industry 4.0 and to give them skills and knowledge that they will need in the digital age. This new educational model is no longer only about the transfer of information, but also focuses on developing students' abilities and renewing their problem-solving skills. Education for student-centered education aims to increase student motivation, develop individual skills and improve learning outcomes.

To implement Education 4.0, educational institutions need to provide the infrastructure and infrastructure that enables students to use digital technologies and virtual learning. For students, Education 4.0 also includes interactive learning opportunities such as online courses, videos, and interactive learning materials. In this article, we present the methods and thematic units that should be taught so that students can meet the challenges of Industry 4.0.

Keywords – Industry 4.0, Education 4.0, Drone, Microcontroller, Blockchain.

I. INTRODUCTION

The industrial revolution significantly affects the labor market and education. Therefore, Industry 4.0 is considered a cyber-physical-social revolution [1]. The implementation of the concept of Industry 4.0 makes it possible to increase the productivity of the workforce, with significant changes in the labor market [2][3]. As a result of its implementation, some professions and jobs will cease, but new ones will also be created. Above all, physically demanding and routine jobs are disappearing,

replaced by robots. On the contrary, new jobs are being created that place higher demands on knowledge-based digital technologies and engineering skills [4]. In addition to the normal workload, workers have to make individual decisions, which is also supported by the introduction of new monitoring and optimization systems [5]. Only highly trained employees will be able to handle these new technologies. Qualified employees will be the key to the success of future companies. The competitiveness of companies

depends on highly qualified employees or timely and high-quality retraining of employees [6]. For this reason, the educational framework will be a very important part of the Industry 4.0 concept [7]. However, other aspects should not be forgotten, see [8].

II. MATERIALS AND METHOD

The concept of Education 4.0 suggests that students should acquire skills that prepare them for the age of Industry 4.0 and to prevail in the digital age. Students must learn to use digital technologies, including data analysis and automated processes [9][10]. They also need the ability to interpret data and communicate effectively with digital devices [11][12]. Education 4.0 emphasizes the development of students' creativity and innovation abilities to find solutions to new challenges and changing market needs [13]. In the project-based learning model, students have to work on practical projects that relate to real life, so they can acquire immediately applicable skills [14] [15]. Due to changing market conditions and the emergence of new technologies, it is important that students are flexible and adaptable to new situations. In the Education 4.0 model, students must learn to critically evaluate information and data and be able to think independently and solve problems, and it is also necessary to develop computational thinking [16].

III. RESULTS

The concept of Education 4.0 focuses attention on the use of new technologies and digital tools that enable the use of visualization and simulation in education. Visualization is the process of displaying information and data that enables students to visually understand relationships and complex data [17][18].

From the point of view of programming education, it is very useful to use different IoT devices to teach basic programming concepts. IoT devices provide a very visual experience for students to learn programming skills. IoT devices also serve as their visualization tools. Such IoT devices can be, for example, microcontrollers and sensors. Microcontrollers are increasingly being used in programming education to help students learn the basics of programming more quickly. By connecting sensors, motors and various electronic components to microcontrollers, we can achieve

spectacular results in teaching programming, such as movement, flashing, etc. It engages students and arouses their interest in programming. Visual programming is a new trend in programming that allows us to develop applications. Nowadays, visual programming is becoming more and more popular. The TinkerCad online application is very suitable for visual programming. Using the TinkerCad online application, we can assemble our circuit, write the program code, and then simulate the results. In fact, the app displays the steps taken. The application can be used well during an epidemic period, when students receive online education. There are many predefined components in TinkerCad that can be used for visualization on different platforms such as Arduino, Raspberry PI, Microbit, etc. In this paper, we present a teaching method in which programming instructions are visualized using the TinkerCad online application [19]. Based on experience, teachers should introduce microcontroller programming to students with simpler practical tasks and thus arouse their interest. Through the task, the students unintentionally get to know the operating principle of the electronic components used, and it becomes obvious to them how the simpler electronic equipment and IoT devices found in their environment work. This method offers a very good opportunity for the development of computational thinking [20][21]. Furthermore, there are other possibilities, see [22].

Industry 4.0 has a significant impact on the sustainability of the supply chain network. Industry 4.0 drone technologies also contribute to supply chain sustainability in business and industry. In the case of university education, great emphasis must be placed on innovative technologies, where research and analysis of sustainability is important. Efforts must be made to reduce carbon footprints, for which the use of drones is a good solution. In the coming period, drone technology is expected to gain ground in logistics. As a result, drone education should become common [23]. In fact, the use and education of drones is not only important in logistics, but also in other fields, such as agriculture [24][25]. Intelligent systems are becoming part of our daily lives. Agriculture is also one of the important areas. They can save labor or make the production process more efficient not only for large producers, but also for small ones. Typical examples e.g. automatic watering according to the current needs of plants,

maintenance of ideal climate parameters in foil trees or detection of ground frost. Therefore, it is very important to focus on education in this area already in secondary schools. The authors of [25] focus on the possibility of implementing the elements of intelligent systems in computing classes. According to them, the most important thing is to acquire adequate knowledge in the field of the behavior of such systems. Students learn to design models of real solutions in terms of electronic components and microprocessor programming. Various simulations are performed with these models. In their case, they used the TinkerCad environment. After that, the students can practically implement their proposal at home or in the school premises. They try to work with universal and available moduls. Their work does not just become a school project, but gains meaning as real-world work. They acquire practical skills that also contribute to their development. They can therefore connect theory with practice, taking into account the requirements of the modern age. In addition to IT knowledge, students also use knowledge of mathematics, physics or professional subjects. Since they are more complex solutions, they also require deeper knowledge acquired in the first years of secondary school, which is why interdisciplinary relationships are supported.

An additional field of use of drones is also manifested in the case of the exploration of cultural heritage [26][27]. With their help, life-like scaled-down copies of various 3D shapes can be created using stereophotogrammetry [28][29]. Moreover, different shape recognition solutions can also be used [30][31].

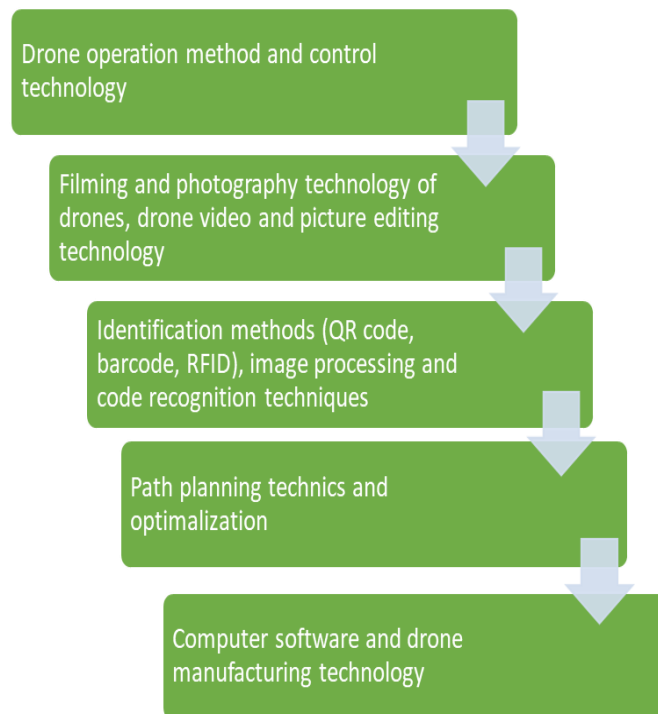


Fig. 1 Stages of university education of drones [23]

Today, blockchain technology is being used in more and more fields, including in education. According to the concept of education 4.0, blockchain technology makes it possible to make education more efficient and safer. Blockchain technology enables secure data storage that prevents data manipulation, modification, or loss [32]. These are especially important in education, where a lot of sensitive data needs to be stored, such as student and teacher data, assessments and diplomas. This technology allows students, teachers and employers to verify the authenticity of data. For example, storing a diploma on a blockchain allows employers to instantly verify a student's education without having to contact the university. Blockchain technology enables tracking of learning progress, which allows teachers to more effectively support students in learning, and allows students to have full control over data, which improves data protection.

The use of blockchain technology in the supply chain can bring significant benefits in terms of transparency, efficiency and security. It enables full transparency of the supply chain. Storing the data in a blockchain ensures that all parties have access to information about the journey of the given goods, where they were made, where they were stored, which warehouse they are in, as well as the time and place of delivery. Blockchain technology makes it possible to make the supply chain more efficient by reducing paperwork and time-consuming

administration. With the help of blockchain technology, participants in the supply chain can communicate directly with each other and share information, thus improving the efficiency of business processes. Storing data in a blockchain ensures the security of transactions and information. Blockchain technology enables the tracking of the origin of goods in the supply chain [33]. Storing the data in the blockchain allows for the exact identification of the origin of the goods, as well as the prevention of falsification of the labels. The aspect of sustainability is also very important. It makes it possible to make the supply chain more sustainable. The storage of data in the blockchain enables the monitoring and control of environmentally friendly, sustainable procurement and production processes. This can help companies involved in the supply chain to behave more responsibly towards the environment and society [10].

IV. DISCUSSION AND CONCLUSION

The concept of Education 4.0 focuses attention on the use of new technologies and digital tools that enable the use of visualization and simulation in education. It is recommended to use IoT devices such as microcontrollers and sensors in teaching programming, which can also serve as visualization tools. The TinkerCad online application provides an opportunity to visualize and develop the application with different platforms such as Arduino, Raspberry PI and Microbit. During the presentation of the teaching method, the programming instructions are visualized using the TinkerCad online application. The impact of Industry 4.0 on the sustainability of the supply chain network is also significant. Drone technology also contributes to supply chain sustainability in business and industry. During university education, great emphasis must be placed on Industry 4.0 technologies and the use of IoT devices during education.

Blockchain is a distributed system in which data is organized into blocks and the blocks are linked to each other, thus ensuring the security and authenticity of the data. Blockchain technology also offers great opportunities in the field of education, for example by digitizing and securely storing educational results and certificates. Educational applications using blockchain enable the monitoring of educational results, the transparency of educational data, and the protection of students'

rights. In addition, blockchain can be used to create educational content and learning materials that can be shared and used securely by students. Blockchain technology is gaining traction in the education sector and has many advantages in improving the efficiency and security of education. In supply chains, blockchain enables transactions and data to be recorded and securely shared and accessed by participants. Benefits of blockchain-enabled supply chains include more efficient and secure transactions, data transparency, and automated processes. In supply chains, blockchain is also used for things like tracking goods and services, recording and sharing data and documents, and making payments and transactions.

Specific examples of the use of blockchain in supply chains include the tracking of goods and services from production to the end user, food safety and quality control, automated management of contracts and invoices, and more efficient management of delivery and logistics processes.

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