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Challenges in Teaching Informatics

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Abstract – The rapid development of information technology has brought with it many new challenges in the field of education. Keeping up with rapid technological change and introducing students to the ever-changing world of information and communication technologies is a real challenge for educators. The rapid development of information technology and the introduction of the Industry 4.0 concept are also having a significant impact on the field of education. Education 4.0 relies on advanced technologies and innovative methods to prepare students for the new challenges of Industry 4.0. Industry 4.0 has brought new dimensions of digitalisation, automation, robotics and data analysis to industrial processes and manufacturing. Education needs to adapt to this paradigm shift and develop in students the skills to meet the requirements of the Industry 4.0 working environment. Education 4.0 focuses on interactive learning and the integration of technology. Instructors need to use flexible methods that allow students to learn at their own pace, according to their individual interests. Educational institutions should provide modern technological tools and smart devices that support active, participatory learning processes.

Linking Industry 4.0 and Education 4.0 creates new challenges for educators and educational institutions. Educators need to understand and adapt to new technologies and digital tools in order to effectively integrate these tools into the learning process. And educational institutions need to create the right infrastructure and resources to successfully implement the concepts of Industry 4.0 and Education 4.0. also offer opportunities to improve the quality and efficiency of education. Data analysis and the use of artificial intelligence can help to improve educational processes, monitor student performance and personalise education. In this article, we present some of the topics that should be focused on in the education process.

Keywords – Industry 4.0, Education 4.0, IoT, Artificial Intelligence, Blockchain, Drones

I. INTRODUCTION

The main challenges in teaching IT are content, what to teach and methodology. Education programmes need to be flexible to adapt to the changing technological environment. Interactive, hands-on learning methods can make IT education more effective by enabling students to solve real-world problems and gain experience. The rights of children must also be disciplined in the face of new challenges in education [1]. In the following, we make recommendations for educational content that can benefit from an Education 4.0 perspective.

II. MATERIALS AND METHOD

Computer science education in primary schools has a key role to play in developing students'

computational thinking and in teaching robotics and programming [2]. Robotics and programming education enables students to develop creative and innovative solutions to real-life problems [3]. Robotics and programming education in primary schools follows an interactive and hands-on approach to actively engage students in the learning process. It helps students to think logically and in a structured way, to design algorithms and to develop their problem-solving skills [4]. Robotics and programming education in primary schools should support students in gaining hands-on experience in technological fields. Teaching robotics and programming helps students learn to collaborate, work in teams and communicate [5]. It motivates and inspires students to explore the world of technology and work on creative projects. It also supports the development of students' digital literacy and helps them to use IT tools effectively [6], encouraging students to experiment, make mistakes and learn from them. By teaching robotics and programming, students learn about career opportunities in technology and prepare for the digital workforce [7], and should be exposed to different levels and methods of learning to ensure that all students can achieve and excel [8,9]. It encourages students of all ages to develop creativity, problem-solving skills and innovative thinking. It is important to support teachers to have the right training and tools to teach effectively [10]. The use of new technologies in education contributes to the development of students' digital competences, which is essential in modern society. It also encourages students to pursue technology studies and careers in STEM fields. By teaching robotics and programming, students will be prepared for the challenges of Industry 4.0 and a future driven by technology.

Microcontrollers allow students to interactively program and control different devices and systems. Visualisation plays a key role in teaching microcontroller-based programming by allowing students to visualise how code works [11,12]. Visualisation helps students to understand programming principles and processes. Teaching microcontroller-based programming takes an interactive and hands-on approach, where students can apply their programming skills through their own projects and students can visually see how programmed devices and systems work, which is motivating [13,14]. Teaching microcontroller-based

programming allows students to develop creative solutions to real-life problems. Visualization helps students to easily interpret and debug their programs, which develops logical thinking and problem-solving skills [14-16]. Together, teaching microcontroller-based programming and visualization help students to enter the digital world with confidence and prepare for a technology-driven future [17-19].

A. Teaching drones

Drone education plays an extremely important role in STEM education, as it gives students the opportunity to gain real-time experience in designing, building and piloting drones. In addition, drone education encourages creative and innovative thinking, as students can build their own drones and add new features. Drone education takes an interactive and hands-on approach. Students can build, program and control their own drones, allowing them to learn and experiment experientially. This allows students to develop their problem-solving and critical thinking skills, as well as their ability to work in teams. The teaching of drones is not only linked to technology but also to other subjects such as mathematics, physics and geography. This gives students an integrated and multi-disciplinary learning experience and gives them an insight into the wider context and applications of drones. Drone education also prepares students for the challenges of Industry 4.0. Drones have a wide range of applications in industry and the labour market, giving students the opportunity to learn and acquire the skills and knowledge needed. It is already possible to specialise in the teaching of drones in university computer science courses, such as the use of drones for photogrammetry [20-25], the use of drones in logistics [26], route planning and optimisation [27-30].

B. Teaching Artificial Intelligence

Artificial Intelligence (AI) has a significant impact on the Education 4.0 concept, which focuses on modernising education and the use of technology [31]. AI enables the automation and personalisation of educational processes, which helps to better serve the individual needs of students. AI-based systems are able to take into account students' learning styles, abilities and interests, thus providing a personalised learning experience. AI gives students the opportunity to learn at their own pace and access

content that interests and motivates them most. AI-based systems help educators to assess and monitor student progress more effectively [32]. AI can provide educators with data and analysis to develop tailored curriculum and teaching strategies. AI can provide students with support in the form of immediate feedback, enabling rapid learning and remediation. AI can automatically generate teaching materials and content, which can provide efficient and flexible teaching resources. AI-based chatbots and virtual assistants can help students answer questions and obtain information [33,34].

In education, it is important to note that not only the benefits of AI should be exploited, but also its use in different areas such as data security [35] or logistics [36] should be taught.

C. *Teaching blockchain*

The teaching of blockchains is becoming increasingly important in the field of education. Blockchain technology has a revolutionary potential and can be applied in many fields such as finance, healthcare, supply chains and education [37]. Blockchain education plays an important role in developing students' digital competences. Blockchain technology is increasingly penetrating the corporate and industrial sectors, making students with blockchain skills more likely to find a job in the future labour market [38,39].

D. *Teaching Industry 4.0 and IoT, smartphone opportunities and security*

Industry 4.0 and IoT (Internet of Things) are playing a major role in education and opening up new opportunities for students. The integration of Industry 4.0 technologies and IoT devices enables students to collect, analyse and share data in real time, and to learn and experience the real world interactively. The use of Industry 4.0 and IoT helps students to understand the relationship between technological developments and industrial processes. Students will gain personal experience in production processes, networked devices operation and data analysis.

Industry 4.0 and IoT have also become a key factor in the development of smart cities. IoT devices and sensors enable cities to collect and analyse real-time data on transport, energy use, infrastructure and other areas. This will allow cities to operate more efficiently, optimise transport, reduce energy use and make better use of resources [40-42].

IoT devices and mobile networks can make users' personal and confidential data vulnerable. Data theft, unauthorised access and cyber-attacks can pose a serious threat to the data accessible through IoT devices. Therefore, it is imperative that mobile devices and IoT devices are secure [43,44]. There are several aspects of mobile security in the IoT environment. First, it is important to have reliable and strong authentication and identification that protects users' personal data and ensures the secure use of devices. In addition, privacy and encryption are key to protect data stored or transmitted on IoT devices [45-47].

III. RESULTS

The rapid development of ICT brings new challenges for IT education. This challenge is not only for the learners, but also for the teachers. After all, teachers also need to master the subject matter and learn about the constantly changing technologies in order to pass on their knowledge to students. We have proposed different themes and will explain why it is worth teaching these technologies in the context of Education 4.0:

Chatbot: Teaching them can help students to search for information efficiently and provide instant answers, and can support individual learning pathways. In addition, chatbots can provide an interactive and playful learning experience that motivates students to learn and participate.

IoT devices: Interacting with IoT devices provides an opportunity to collect data in real time and encourage students to engage in creative problem solving.

Blockchain: teaching blockchain technology allows students to understand and apply secure data storage and sharing. The benefits of blockchain, such as reliability, transparency, and data integrity, can be demonstrated during the lessons. In addition, blockchain can help students understand the importance of digital identity and privacy issues.

Artificial Intelligence (AI): Students can learn the basics of machine learning and data processing, which are key in today's digital world. The teaching of AI will enable them to understand the applications of AI in different areas such as automation, data management and decision making. This will enable them to critically evaluate the impact of AI technologies and apply them creatively in problem solving.

Applications of drones in different fields: teaching drones provides an opportunity for students to learn about the applications of drones in different fields. For example, in agriculture and farming, drones can be used to map fields, monitor irrigation or monitor the condition of crops. In architecture and construction, drones are used to monitor design and construction processes, engineering surveys and safety checks. Drones are also used in rescue operations, media and film, scientific research and many other fields. Students can learn about these applications and create creative projects using drones to solve real-world problems. Teaching drones broadens students' horizons, introduces them to new technological possibilities and encourages creativity and innovation. Through this, Education 4.0 can prepare students for the challenges of the digital age and for careers in specific fields.

Teaching these technologies helps to develop students' digital competences and technological skills. It helps prepare them to successfully navigate in a digital world and to respond to new technological challenges.

IV. DISCUSSION AND CONCLUSION

Over the past decades, the demands on education systems have changed. People in the labour market need new competences, such as technical, methodological, social and personal competences. The aim of education today is to create a new educational paradigm that prepares the future workforce for the new challenges. This is the purpose of Education 4.0, which emphasises personalised learning and support for individual development. With digital tools, learners can progress at their own pace, focusing on their strengths and weaknesses. Adaptive learning systems, which can take into account individual needs and preferences, allow for differentiated teaching and individualised mentoring. Education 4.0 also encourages collaborative learning and teamwork. Online platforms and tools enable communication and collaboration between students, even at remote locations. Project work and interactive learning methods help students to work in teams, solve problems and find creative solutions. In this article, we have presented some possible content that can be used in differentiated ways from primary to university education. We presented the importance of developing computational thinking, focusing on the use of microcontrollers and

simulation. We suggested teaching the potential of drones, artificial intelligence, blockchains, Industry 4.0 and IoT.

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