

Digitalization of Romanian Education System: Is Romania Ready to Embrace Education 4.0?

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Due to the technological changes that have occurred in the last years, Education 4.0, a new educational paradigm has emerged. Romania, as any other country in the world, will face some challenges in order to adapt to the new educational context. Thus, the purpose of this paper is to provide an analysis of measures undertaken by our country in order to adapt to the changes. This paper relies on a theoretical study of the actions proposed by Romanian authorities. These actions will be analyzed in comparison with the regulations proposed by the European Union. Moreover, the study will focus on the degree of implementation of the actions and the perspectives our country has in order to meet the new global context. Overall, this paper contributes to the literature by placing Romanian education system in the new educational context brought to public attention by the Education 4.0 paradigm. In addition, it will find arguments in favor or against the alignment of our country with the new educational trends.

Keywords: Education 4.0, Romanian Undergraduate Education, Digitalization, Digital Education, Technologized Educational System

DOI: 10.24818/issn14531305/26.3.2022.02

1 Introduction

Recent years were marked by important technological changes, which impacted significantly the manufacturing processes [1] [2]. Due to those changes, the specialists started considering the appearance of a new industrial revolution, the fourth one in history [3]. The literature refers to it simply as Industry 4.0, but there are additional terms that may be used to label this concept: “*Smart factories, the Industrial Internet of Things, Smart industry or Advanced manufacturing*” [3].

One can briefly define the concept of Industry 4.0 as a paradigm shift in all the components of the manufacturing process [2] (the design, the management, the chain of production: the suppliers, the distributors and the products [3]) due to the development of new technologies that have emerged into production [3]. The main systems that lay the groundwork for this industrial transformation are the cyber-physical systems [1], shortly referred to as CPSs [4] [5]. They represent digital systems with great computational power [4] capable of big data management and analysis [5], but also of interaction with

humans [4]. CPSs involve the usage of sensors, robots and 3D printing [3] for collection of great amounts of data that will be analyzed through cloud computing and big data techniques [3]. Thus, in terms of technologies, Industry 4.0 relies on Internet of Things (IoT) (mostly Radio-Frequency Identification – RFID, Wireless Sensor Networks - WSN and ubiquitous computing), blockchain, cloud computing or information integration technologies [2].

Considering the context created by Industry 4.0, new sets of skills are needed for integration in the labor market. Therefore, students need to acquire necessary preparation to be able to adapt to the new working environment, dominated by automatization and virtualization [6]. The educational system should adapt in order to fulfil the new market requirements in terms of expertise [7]. So, a new concept will derive from Industry 4.0, which is Education 4.0, in which the technologization of the education system is mandatory.

European Union understood the necessity of more advanced digital skills in the new labor market, so it developed an initiative to

promote and provide guidance for the digitalization among the countries that belongs to the union. Romania, as part of the European Union, should as well treat the technologization as a top priority so that Romanian students should, after graduation, be assured with easy integration in the labor market.

Thus, the primary focus of this paper is to outline an analysis of the measures proposes both by EU and Romanian authorities in order to support the digitalization of the education system. included in the initiative as part of the digitalization of the education system.

Moreover, a comparison between the two approaches will be conducted. In the end, this study will attempt to answer to the question: is Romania ready for Education 4.0?

2 Education 4.0

Education 4.0 appeared as a transition based on the industrial context. So, several stages were considered throughout history since this new concept was brought to light. Fig. 1 shows the evolution towards the new educational paradigm, as well as the contextual factors that led to the emergence of the concept of Education 4.0.

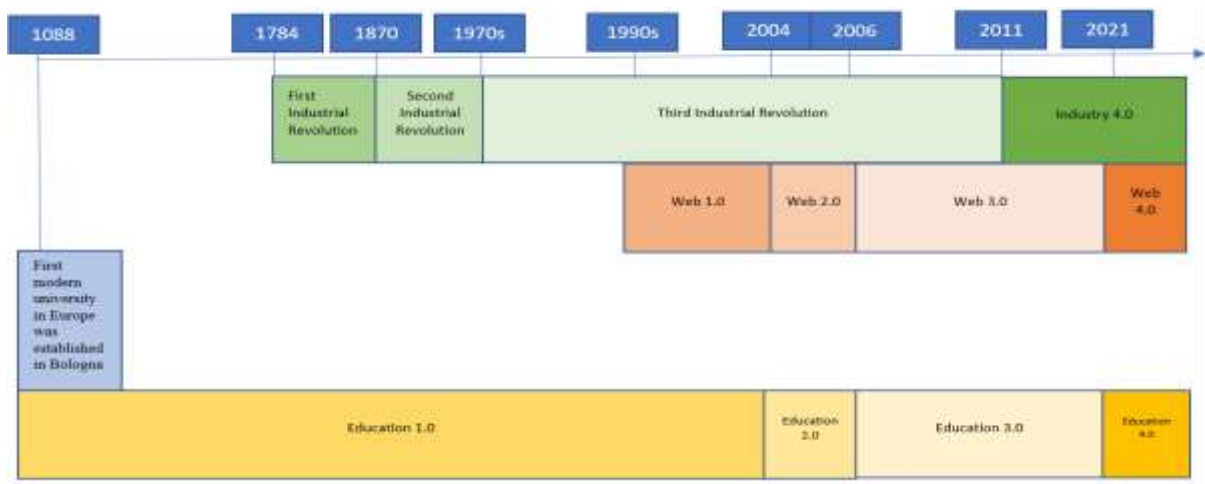


Fig. 1: Evolution towards Education 4.0

An important milestone in the history of education is represented by the establishment of the first modern university. It happened in 1088, when the university of Bologna was founded [8]. This is considered the starting point of what the literature calls Education 1.0 [8], which represents the traditional educational paradigm, with exclusively face-to-face interaction [8]. Education 1.0 was based on a transmissive learning process [8], conducted only via reading (participating to lectures) and written evaluation [9]. The students could only use the limited resources that were available in the university campuses [8] in order to acquire minimum knowledge that fulfil the needs of that particular period. Education 1.0 lasted for many centuries, with the same base principle. Nonetheless, slight changes occurred throughout the years, influenced by two major contextual changes

that occurred: the industrial revolutions and the development of the World Wide Web [8]. The first and second industrial revolutions came with new challenges for the manufacturing process, which implied an extended number of employees with a new set of skills. Thus, education became more accessible, more and more children being eligible to be part of the instructional process. Thus, more schools and campuses were built and the number of educational resources increased considerably, becoming more accessible as well [8]. The Third Industrial Revolution meant the introduction of the information technology in the industrial process [2]. This change created the context for the development of different ways of sharing information. Under this perspectives, Web 1.0 was born [10], allowing static content to be provided by different

business to their customers over a rudimentary network [10].

Technological development and wide spreading of the Internet allowed in 2004 the birth of a new concept, Web 2.0 [10], also called “read-write Web” [8]. The new web paradigm encouraged a collaborative approach, the user being able and encouraged to create content on their own rather than just reading the content provided by different business [10]. Thus, technologies such as blogs or wikis [10] became available, leading to a new stage of education, Education 2.0 [8]. Both educators and students benefited from the new platforms that begun to be introduced in the educational act. Moreover, social media sites (for instance Facebook groups) or LMS (learning management system) [11] / VLE (virtual learning environment) [11] gained more and more ground in the learning act [8]. The Internet improved the access to learning resources as well. They became more numerous due to the prolific usage of wikis and blogs that transformed into Open Education Resources [8]. This period is also the moment in which the MOOCs (Massive Open Online Courses [12]) started timidly to emerge, especially in universities [8]. So, Education 2.0 is mainly based on the introduction of open technologies in the traditional educational act that takes place in a school or university [9].

In 2006, the web paradigm advanced one more step towards Web 3.0 or Semantic web [10]. It had the capability to process data more rapidly and from multiple sources [10]. Moreover, the mobile technologies gained ground during the Web 3.0 phase [10], leading thus to new possibilities. Education became possible anywhere and anytime, the learning act requiring only a mobile device and Internet connection [8]. So, an important shift in terms of provider of the education happened: education is no more furnished only by schools and universities, but also by an independent source represented by the Internet [8]. All these concepts are gathered under the umbrella of Education 3.0.

Industry 4.0 came with fundamental changes within the manufacturing process due to the

technological advancements, but with a lack of qualified employees that can operate within the new digital reality [13]. So, the educational system needs to adapt to become relevant for the new economic context. Education 4.0 covers this new educational shift towards the values promoted by Industry 4.0. It represents a constantly adaptive learning paradigm [14] that allows students’ reeducation every time it is necessary [8]. Besides the necessary digital skills required by a strong digitalized world, the skills that students should develop within Education 4.0 are emotional intelligence [8], interculturality [6], out-of-the box thinking [6], creativity and collaboration [8].

Education 4.0 is characterized by several key features: flexibility, personalization [9] and customization [8]. First of all, the student should no longer be restricted to a place or a schedule for the learning process to be conducted [9]. The student can and should choose a learning place and time that is adapted to their own needs. The principle of Education 4.0 is that each student is unique and has different learning needs, different interests [8], so a customized learning process is preferred to a traditional linear non-adaptive one. In order to personalize the education process, the new technologies adopted by Industry 4.0 can be used, in this way the learning environment becoming more complex than before Education 4.0 [9]. Artificial intelligence, big data or cloud computing can determine the students’ profile and provide the adequate content for each of them [9]. Thus, the key word that could shortly define the new model of education is adaptability [9].

The new educational paradigm will conclude in some changes that will affect all the stages of the learning process (the teaching, the knowledge building and the evaluation). Technology will play an important role in all these steps, the creation of an intelligent smart environment being a priority in Education 4.0 [9]. Since the requirements of the labor market in terms of set of skills are changing due to the intense digitalization, the first aspect that needs to change is the curriculum. The

teaching part of the educational process needs to adapt in order to provide relevant expertise for the new job palette [8]. Moreover, the possibility to customize the content in order to fit to students' needs should be a priority during the learning stage. Therefore, the curriculum has to be more oriented towards creating practical expertise for the students [7] rather than developing general theoretical knowledge. In this way, students will be able to develop skills that can be applied to real world situations [13].

The teaching step should be reinforced by the same directions during the knowledge building phase. Students should experience production-based situation. Not only should they learn the new set of skills, but they should also have simulated situations in which to apply and enrich the skills they have acquired during the teaching phase [13]. The evaluation part should as well change from the traditional exams to a more practical approach [13]. It will not be sufficient to measure students' capability to memorize different concepts (as it mostly happens in today's exams), but it will be necessary to test the skills in projects related to the production world [13].

Several technologies can be used in order to draw the picture brought into discussion by Education 4.0. Every phase of the education process can benefit from them. Among them, one can consider 3D printing, augmented and virtual reality, holograms, cloud computing, Internet of Things, artificial intelligence, paper-thin smartphones and multi-touch LCD screens [15]. This new approach in education undoubtedly brings a series of advantages. They can be categorized, upon the actor of the educational act, in advantages for students, for teachers, but also for managers [7].

Education 4.0 is considered a student-centered system, so the affirmation that the student is the real beneficiary of the educational system should be more accurate than it has ever been [7]. By using the technologies introduced by Industry 4.0, the student will acquire more easily the collaborative and digital skills required by the new economic context [7]. Moreover, student's communication with both their colleagues and teachers will be

improved [7]. Through Education 4.0, students will develop relevant abilities that are applicative in the real production world [7], so the student will find a job more easily. In this way, the unemployment rate of a country will decrease.

Teachers, as a direct part of the educational act, could also benefit from Education 4.0. Introducing technology implies automatization of certain tasks (mainly administrative ones). Thus, teachers will no longer need to perform the administrative part [7]. Moreover, the role of the educator will considerably change. They will shift from a learning content provider to a facilitator that provides personalized content for students [7]. Managers, even though not directly involved in the learning process, they will also be the beneficiaries of Education 4.0 because students, by acquiring the new set of digital skills, will be able to use those skills within their companies. Since the students will already come with abilities from school or university, managers will no longer need to provide intense training to the new employees, reducing thus costs and increasing company's profit [7]. Moreover, the business model can become more efficient based on the new technologies [7].

Nevertheless, Education 4.0 comes also with some challenges. First of all, the integration of technology in the educational act. The current ITC infrastructure of schools and universities is not sufficient to be able to accommodate the new technologies. Moreover, technologies such as 3D printers or multi-touch LCD screens are not present in educational institutions. Therefore, additional funds will be needed in order to purchase the new equipment. In addition, teachers are a defining factor of a successful integration of technologies. Nonetheless, the system faces teachers' reluctance [16] to shift from the traditional learning system to a more student-centered one. The majority of them also lacks the digital skills necessary to operate the new equipment [13], so intense training for them is mandatory.

One of the skills required by Industry 4.0 is interdisciplinarity [6]. The course palette in

Education 4.0 should mirror this principle as opposed to nowadays when the curriculum is mainly based on independent subjects, with little connection between them. Thus, an in-depth change in the curriculum is more than necessary [6] to meet the challenges brought by the new economic environment. Alongside with the curriculum, the teaching methods should be adapted as well [8]. The traditional teaching and learning modes should be replaced by modern, technology-oriented ones that can contribute to the development of the new digital and emotional skills [8]. Education 4.0 is, indeed, a revolutionary approach that will completely change the educational process. The personalized learning content will result in better prepared future workforce that can more easily adapt to the labor market and its continuously changing requirements.

3 Research Methodology

This study focuses on an analysis of the response of both the European Union and Romania to the need of a more digitalized education system. Through this movement, the system will attempt to align with the new context created by Industry 4.0. The study has two main parts. The first part covers the directions suggested by the European Union in terms of technologization. The second one provides an analysis of the Romanian plan for digitalization for 2021-2027.

The theoretical approach of this paper is justified by the fact that, in order to take concrete actions in terms of digitalization, one firstly needs to understand the directions and the sectors that need to be given a more thorough attention. By using this method, one can obtain a complete image of the new necessities on the labor market as stated by the best specialists in the era of education from both the EU and Romania. This study starts with an analysis of the plan suggested by the European authorities since our country, as part of the Union, needs to align to these directions. Then, the paper continues with an overview on how Romania wants to follow EU's regulations and what the solutions for digitalization of the education system are,

according to local authorities. The findings are discussed in the following sections.

4 Findings

4.1. European Union regulations

European Union understood the Education 4.0 paradigm and the necessity of development of more advanced digital skills. Since the economic trend orients towards a digitalized world in which new technologies are introduced, the workforce capabilities are changing. Moreover, the COVID-19 pandemic showed the importance of digital skills [17]. Nonetheless, there is a huge lack of digital skills among European population (2 out of 5 people aged 16-74 do not possess the necessary digital skills [18]).

In order to accommodate to global trends, EU develops an initiative, Digital Education Action Plan (2021-2027). In addition to it, supplementary actions are considered. First of all, the EU plans to collaborate with the European Investment Bank to generate funds that the member states could access in order to develop the infrastructure [18]. Secondly, Erasmus+ programs should be updated so that the digital education is included [18]. Moreover, a better promotion of the needs of digital skills as an advantage for job opportunities should become a priority [18]. All these initiatives have an ultimate goal, which is that, by 2030, the computer and information literacy among European citizens is improved [18]. Less than 15% should have poor digital skills by 2030 [18].

The Digital Education Action Plan will approach two main areas: creating a performing ecosystem for digital education to be possible and develop the digital skills among the citizens [17]. Each of them will imply certain requirements. Not only digital infrastructure is needed to build the new digital ecosystem, but also creating qualitative digital learning content, developing teachers' level of digital skills, offering tools and secure platforms for conducting the learning process [17].

The enhancement of digital skills among citizens includes, first of all, that all citizens will poses basic digital skills starting with

early ages [17]. Moreover, a very good understanding of the new technologies of Industry 4.0 (AI, IoT or cloud computing) is mandatory [17]. Equality is also promoted, another goal being encouraging women to pursue careers in digital fields [17].

This Digital Education Action Plan was subdued from July to September 2020 to open public consultation [17]. In this way, the European citizens and institutions were able to submit proposals to improve the plan and to make it more applicable based on the real-life context. The open public consultation resulted in more than 2700 responses and 127 position papers [17]. As a result, a new version of the Digital Education Action Plan was adopted on September 30th 2020 [17]. It proposed a series of 13 actions that should be pursued in order to meet the goal. They were divided in two sections, based on the areas of interest. A common tool is the Digital Education Hub, a space dedicated to all member states in which they will be able to find guidance in applying the digital recommendation in their own national contexts [17].

The six actions [17] that the EU should take in order to develop the digital education ecosystem cover different directions. Some orient towards creating awareness about the importance of digitalization of education by Strategic Dialogue with the member states, creating the Council Recommendation for introducing blended learning in the undergraduate education system and the European Digital Education Framework [17]. Others were more focused on practice, such as providing trainings on AI and big data practices [17] or help to reduce the gaps in terms of connectivity in the schools of the European Union countries [17]. Moreover, the EU intends to provide digital transformation plans through the Erasmus+ program, Erasmus+ Teacher Academies and a new online tool called SELFIE for Teachers (a tool that will help teachers identify their strengths and weaknesses in terms of digital competences) [17].

In order to combat digital illiteracy, EU proposed seven actions. A first step would be to develop common guidelines for educators

in order to be able to promote the need of digital skills in today's labor market [17]. This will be reinforced by Council recommendation on useful methods that can be integrated in the educational act with the goal of developing students' digital skills [17]. Next, European Digital Competence Framework should be updated so that it covers the new technologies of Industry 4.0 (such as AI) [17]. In addition, EU intends to develop an official way to measure the level of digital skills through the European Digital Skills Certificate [17]. A common target in terms of level of digital skills should be established among the member states [17]. This will be supported by a thorough study each country will conduct to determine the actual digital skills level [17]. EU will also implement a project called "Digital Opportunity Traineeships" to offer to students the possibility to gain production experience in a digitized world [17]. Last but not least, EU encourages women to undertake digital careers through their participation in STEM [17].

4.2. Actions to support the digitalization in Romania

As a response to the European Union regulations, Romania developed in 2020 the Strategy for the digitalization of Romanian education 2021-2027 (SMART-Edu) [19]. It represented a dense legislative proposal structured based on the two main areas included by the EU in the Digital Education Action Plan: creating the ecosystem and combating the illiteracy among pupils and students.

The document began with a short description of the European and national contexts that enabled the improvement of digital skills. According to this document, the digitalization of the education system has been a priority of the government since 2016, once the Educated Romania project was launched [19]. Moreover, the document also stated that the DESI report of the European Commission for Romania 2020 claimed that the way in which Romania implemented the digital objectives from the Strategy for the Digital Agenda of

Romania 2020 is unknown [19]. The performance of our country in terms of digitalization is, according to DESI, very poor [19]. The only dimension in which Romania obtained a positive review is at the Connectivity level, due to the usage of broadband [19]. The digital crisis from Romania was also brought into attention by the COVID-19 pandemic. The learning processes conducted during this period were characterized as lacking predictability and sufficient digital skills both in the case of students and teachers [19].

After the public consultation, three pillars of digitalization that should be developed were identified [19]. The first one was represented by the administrative part of the education [19]. Several measures should be implemented (such as the digital catalogue, recordings) to automate some parts of the learning process [19]. A second pillar was dedicated to the teaching activity [19]. The learning process should be updated in such a way technology will be part of it [19]. The last pillar was represented by communication and collaboration between schools or school-family [19].

Apart from developing the digital competences of Romanian citizens, SMART-Edu intended to tackle other aspects as well: providing the context for digital citizenship, integrating technology for accessibility and inclusion purposes, promoting the idea of taking advantage of digital competences in personal and professional development and enhancing the creativity and innovation of using technology [19]. Concrete goals of this initiative were: having a rate of 90% of digital literacy at national level, all educational institutions from Romania should be provided with all the infrastructure and technological resources they required and create employment opportunities in the digital area for 82% of population aged 20-34 [19].

The SMART-Edu developed the action plans based on the two main directions included in the EU Digital Action Plan. In order to cover the combat of digital illiteracy, Romanian authorities proposed actions in relation with curriculum, lifelong digital education and

training the teachers in digital skills [19]. For creating the digital ecosystem, the focus was oriented more towards infrastructure, connectivity, creation of Open Educational Resources and cyber security [19].

The legislative proposal was subdued to public consultation between December 18th 2020 and February 15th 2021 [19], but no results can be found on the dedicated web page. According to Ligia Deca, the presidential counselor in the field of education in March 2021, the SMART-Edu project would be included in the Educated Romania project. [20] The main problem that can be observed here is the fact that this change implied also a drastic reduction of the project from almost 100 pages to only a subchapter of 4 pages [20]. Thus, one can be pessimistic in regard to the plans authorities have for the development of digital skills among our pupils and students.

The current minister of education, sustained during the pandemic period the need of an online education [21]. He reiterated the subject this year as well, during the Franco-Romanian Forum organized with the occasion of Europe Day [22]. The same ideas with the same topics and were brought into discussion by him, but uncertainty regarding the way all the objectives will be implemented existed.

Considering the position of Romanian authorities in terms of developing strategies for the digitalization of the education system, inconsistency and incoherence are the main characteristics. One might undoubtedly question their decisions and wait for a more concrete strategy to be adopted.

5 Discussion

There is no doubt that the European authorities consider the digitalization of the education system a priority in the legislative strategies. The Digital Education Action Plan they developed and already started to implement [17] captures the two principal directions to follow in the next years: technology integration and improvement of digital skills among all the actors of the educational process.

The goals the Digital Education Action Plan

has are very clearly depicted and covered by concrete measures and timetable [17]. The level of less than 15% of people of European Union to have poor digital skills by 2030 [18] is a very courageous, but a feasible one once the directives are implemented by each country and the common resources are used. Moreover, one should notice that the development of digital skills is not done in a randomly way, but targeted on the new technologies introduces by the Industry 4.0 era. Cloud computing, AI, IoT are the priorities for the next period as they will be the main technologies used in Education 4.0.

Nonetheless, Romania's strategy seems to be inconsistent and confusing. The first legislative proposal of our authorities, the SMART-Edu action plan, was a very thorough and detailed one, with the same goal as the one proposed by EU. Moreover, it was perfectly aligned to it, covering the same directions. It also had concrete measures to be implemented in the undergraduate education system so that the digitalization will be intensified and both pupils and teachers could improve the digital skills. The SMART-Edu project contained five components [19]: generalized connectivity at country level, all pupils and students benefiting from digital equipment, digital content for all subjects, all teachers being able to teach with the aid of online platforms and dedicated evaluation platforms. Unfortunately, this project stopped at the public consultation and, according to Jean Badea, the author of the project, did not seem to be planned to continue in future [22]. This initiative was brutally replaced by a short chapter in the Educated Romania initiative [22].

Therefore, one might consider that the actions and the declarations of the Romanian authorities are contradictory. On one hand, they claim that digitalization will always be a priority for the development of the educational system. On the other hand, their actions proved no more than the opposite. By abandoning the complex initiative represented by the SMART-Edu project, they oriented towards a more perfunctory approach that would result in a difficulty in the adaptation to

Education 4.0. Moreover, taking into consideration the intense lack of digital skills among teachers and students as highlighted by the position of our country at European level (27th position out of 28th [23]), the ability to work with complex technologies such as AI or cloud computing becomes even more difficult. Romanian students and teachers lack basic digital skills, so the necessity to use more advanced knowledge is almost impossible in a very short period of time.

The level of technologization of Romanian schools is also very low. The pandemic showed the challenges students and teachers faced because they did not possess the necessary equipment for conducting online courses [24]. Since Education 4.0 is based on complex networks [2], acquiring the necessary equipment, as well as introducing it in the educational act would certainly be a challenge for Romania.

So, Education 4.0, at a global level, can undoubtedly lead to a complete revolution of the education as it is today. Nevertheless, Romania does not seem very prepared to adapt to this profound transformation. The directions of European Union proved to redirect to the correct path, but our country chose to adopt a superficial approach that would encumber the process. The educational context of our country is not helpful either. The lack of infrastructure and digital skills is extremely profound and only improvisations were made in the last years. Thus, one can firmly affirm that Romania, at the present moment, is not ready to embrace Education 4.0.

6 Conclusions

Industry 4.0 is the first factor that laid the groundwork for a profound change in the way global economy operated. One of the most influenced activity domains is education, as a new educational paradigm, under the name of Education 4.0 has emerged in the last years. Thus, new terminology related to the field of education appeared. Terms like CBT, LMS or VLE are becoming more and more popular and one needs to understand the difference between all of them. The European Union

understood the complete transformation of the education system imposed by Education 4.0 and developed a Digital Education Action Plan. It follows to be implemented in the 2021-2027 period at European level, but, nonetheless, each member state should take individual actions to adapt to national context. Romania is not an exception, so it has to align to EU's regulation and intensify the digitalization of the education system.

This paper firstly offered to its reader a brief overview on what Education 4.0 means so that a complete image could be provided. It presented the evolution that led to this new era in education, as well as the advantages and disadvantages that are brought with this revolution. Then, this study wanted to provide an analysis of the way European and Romanian authorities responded to the imminent change in the educational sector.

On one hand, the findings confirmed a continuous interest at European level on aligning the education system to the new paradigm. The Digital Education Action Plan was formulated and it contains concrete measures that the member states should follow so that Education 4.0 would be integrated in the national systems. The actions are plausible and can be easily followed by each state. On the other hand, the study brought to light an incoherent and inconsistent attitude of Romanian authorities towards the digitalization of the education system. Even though the SMART-Edu project was subdued to public consultation, it was abruptly interrupted and transformed in a more light and incomplete approach. In this way, the process of integration of technology and development of digital skills became even more difficult.

Based on these results, this paper confirms that, at the present moment, Romania is not ready for the transformation brought by the Education 4.0 paradigm. A change in the way authorities approaches this topic could significantly improve this trajectory. The main focus should be firstly adapting concrete legislative initiatives that support the digitalization and, secondly, intensive actions against digital illiteracy.

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