DUAL EDUCATION IN ROMANIA: BRIDGING THE IT SKILLS GAP AND PREPARING INDUSTRY-READY TALENT

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ABSTRACT

This study explores the role of dual education in addressing the IT skills gap in Romania, evaluating its effectiveness at both pre-university and university levels in preparing industry-ready talent. With the adoption of Law 199/2023, Romania introduced 18 dual degree programs across five universities, though only a small number focus specifically on the tech industry. These programs aim to bridge the disconnect between academic training and labor market demands. By analyzing employer perspectives and public policies, the research examines whether dual education can provide a sustainable solution for IT workforce shortages.

The study employs a qualitative approach, conducting semi-structured interviews with IT professionals, HR specialists, and public administration representatives in Cluj-Napoca. Findings reveal that while dual education enhances practical training and accelerates graduate integration, challenges persist, including rigid curricula, a lack of transversal skills, and limited collaboration between universities and businesses. Employers stress the importance of critical thinking, adaptability, and digital literacy—skills that current programs often fail to cultivate. Additionally, the increasing influence of AI on job structures is reshaping demand, shifting focus from junior programmers to professionals with hybrid competencies in technology and strategic thinking.

The research highlights the need for stronger industry-academia partnerships, flexible learning paths, and investment in digital infrastructure to maximize dual education's impact. Public administration plays a crucial role as a key stakeholder in the dual education system, facilitating partnerships through economic clusters, ensuring infrastructure investment, and supporting funding access. This involvement benefits not only the education system but also contributes to city development, fostering a highly skilled and adaptable workforce that aligns with long-term economic growth strategies. Without structural reforms and broader accessibility, dual education risks being a partial solution, benefitting only select regions and industries. The study concludes that a well-implemented dual education system, with active participation from public administration and businesses, can serve as a catalyst for Romania's economic development and IT sector competitiveness.

KEYWORDS: *dual Education; IT Workforce; Employability; industry-academia collaboration; technological skills development; public administration; economic growth*

J.E.L. Classification: I23, J24, O33

1. INTRODUCTION

This article examines to what extent dual education, both at pre-university and university level, can meet the specific requirements of the IT industry in Romania, contributing to reducing the skill gap and training a workforce adapted to current technological dynamics. Given Romania's evolving technological landscape, the research evaluates whether dual or vocational education can be an effective skills development model, particularly from the perspective of private sector employers in Cluj-Napoca, Romania.

Following the adoption of Law 199/2023, five Romanian universities introduced 18 dual degree programs, including few specialized tech industry program. (Education, 2024). The law mandates a formal contract between the university, local administration, and economic operator to ensure structured collaboration in aligning academic training with industry needs. However, this study extends beyond higher education, assessing the feasibility of pre-university and tertiary vocational programs in equipping students with practical experience. Romania faces a growing technological gap compared to other European countries. The "Bridging the Gap" report (McKinsey, 2022) emphasizes the need for digital and technical skills to facilitate the adoption of emerging technologies, such as AI, automation, IoT, and renewable energy solutions.

This study investigates how strategic investments in dual education, industry-academia partnerships, and reskilling programs could enhance Romania's economic resilience and global competitiveness. By analysing employer perceptions and education policies, this research aims to determine whether dual education can provide a sustainable solution for IT workforce shortages, ultimately contributing to inclusive and long-term economic growth.

2. RESEARCH METHODOLOGY

The research methodology employs qualitative data collection through semi-structured interviews with IT industry professionals, particularly those involved in recruitment and human resource management. These interviews explore expert perspectives on the effectiveness of dual education in addressing labor market skill requirements.

Key topics include the perceived level of technical and professional training required for employment in IT, the impact of university studies on employability, challenges companies face in integrating graduates, and how dual training meets industry demands. Following the recommendations of Moser and Korstjens (2018), semi-structured interviews were chosen for their flexibility in capturing nuanced insights and subjective experiences (Moser, 2018)

Ten participants were selected through purposive sampling to ensure relevant insights, including industry representatives and a local public administration official overseeing dual education. The selection aimed to reflect diverse work environments, encompassing a top corporate manager overseeing 2,000 employees, three CEOs of small product companies, a corporate project manager with 2,000 subordinates, a freelance project manager with European experience, two additional corporate project managers, a programmer, and an HR manager. Three of the interviewees also have experience as university lecturers or in alternative education.

The analysis provides an in-depth understanding of IT employers' perspectives on workforce training and assesses whether dual education can effectively prepare skilled professionals. While the broader study also considers public policies addressing skill gaps, this article focuses specifically on employability.

This article focuses on employer perspectives regarding dual education in the IT sector. However, as part of a larger study, the author also conducted interviews with university decision-makers to assess whether their views align with industry expectations. Furthermore, a separate quantitative analysis was performed to identify the transversal skills most in demand in Romania's IT sector. These complementary approaches provide a more complete understanding of the skills gap and the potential of dual education as a solution.

3. DEFINITIONS AND KEY CONCEPTS

Employability. In the document "Strategic framework for increasing the participation, quality and efficiency of tertiary education in Romania 2014-2020", employability is defined as "the ability of graduates to obtain a job appropriate to the level and field of study, to maintain and develop career in the context of the ever-changing labor market" (Education, Strategic Framework for Increasing Participation, Quality, and Efficiency in Tertiary Education in Romania 2014–2020, 2014). This involves not only the technical skills acquired during studies, but also transversal skills such as adaptability, effective communication, and critical thinking, essential for integration and success in the labor market.

"Employability reflects the relevance of study programs for the labor market. Employability is one of the main goals of the Bologna Process and is defined as the ability of a person to obtain a job in accordance with his competences, to maintain it, to develop the entrepreneurship capacity of a person and his possibility to change his job." (Policies, 2025)

As demonstrated in Lee Harvey's article, „Defining and Measuring Employability", (Harvey, 2001) employability cannot be defined only by considering the employment rate of graduates. Harvey proposes that employability should be seen not just as an institutional achievement, but rather as an individual student's ability to get a job. In the author's opinion, employability is a complex concept, including characteristics such as the type of work for which the graduates are prepared, timing of employment after graduation, the attributes and skills that graduates possess, continuous learning ability.

Additionally, Harvey suggests that current employability indicators oversimplify reality and ignore the individual contribution of each institution to student preparation. Instead of using employment rates exclusively, the author proposes an audit of employability development opportunities within educational institutions, which would better reflect individual process and progress.

Harvey concludes that measuring employability solely by employment rates can be misleading and limits the ability of institutions to improve their educational practices. Instead, he recommends an internal approach based on audits and analysis of skills development processes. This would provide valuable information for improvements and contribute to a deeper understanding of the role of higher education in preparing students for the labor market.

„Graduate Employability and Competence Development in Higher Education—A Systematic Literature Review Using PRISMA" points out the importance of developing skills relevant to the labor market through higher learning (Abelha, Fernandes, Mesquita, Seabra, & Ferreira-Oliveira, 2020). Educational institutions are encouraged to adopt approaches that develop both technical and soft skills such as communication, teamwork, adaptability, and problem solving, all of which are valued by employers. Also, collaboration between universities and companies is essential to align the curriculum with the demands of the labor market, ensuring a better preparation of students. Practical experiences, such as internships, are crucial as they allow the

application of theoretical knowledge in real contexts, increasing graduates' competitiveness. In addition, fostering a mindset of continuous learning is vital to meet the demands of an ever-changing job market. The study also highlights the need for more effective assessment methods that correctly measure the development of relevant skills, overcoming the limitations of traditional examinations. These findings support a flexible, practical, and future-oriented education designed to support graduate adaptability and success.

In the theory of human capital, developed by Gary S. Becker (Becker, 1993), he explains how education contributes directly to increasing labor productivity. He uses economic models that show how education increases skills and knowledge, which increases the individual's contribution to overall productivity and, by implication, economic growth. Becker made an important distinction between general human capital (skills applicable in any job) and specific human capital (skills that are valuable only to a particular employer or industry). This distinction is crucial for understanding how employers and employees invest in training.

Studying the phenomenon of on-the-job training, Becker observes that employers are more willing to invest in specific capital because it remains valuable only in the context of the respective organization. General capital, on the other hand, is more often a personal investment because the individual can apply those skills anywhere.

4. CURRENT LANDSCAPE OF IT EDUCATION AND WORKFORCE DEVELOPMENT IN ROMANIA
4.1. THE ROMANIAN IT INDUSTRY

The Romanian IT sector has experienced significant growth over the past decade, but recent data suggests a period of stagnation. According to the ANIS report ((ANIS), 2024), turnover in the industry increased from €1.5 billion in 2008 to €15.5 billion in 2023, with the workforce growing from 50,000 to 133,000 employees. However, in 2024, the IT sector's contribution to GDP remained at 7.8%, identical to the previous year, indicating no significant economic growth (Adevărul, 2024).

This stagnation is influenced by global and domestic challenges, including the economic slowdown, restructuring in major international tech companies, and new fiscal policies. Tax changes implemented on November 1, 2023, affected IT professionals earning above 10,000 gross lei, potentially altering employment dynamics. Despite 12.16% growth in 2023, solidifying the IT industry's role as a key economic driver, 2024 has marked a phase of adjustment and contraction (ZF.ro, 2023).

The IT job market reflects this shift, with five times more applicants per job in early 2025 than the previous year, signaling fewer job openings and rising competition (Wall-Street.ro, 2025) (Puterea.ro, 2024). While certain sub-sectors—such as AI, machine learning, cloud computing, electric vehicles (EV), and IoT—are expanding, other areas are experiencing slowdowns like stagnations in hardware manufacturing and the automotive industry due to market saturation and supply chain issues.

Economic Projections and Digital Competitiveness. According to McKinsey & Company (McKinsey C. &., 2025), Romania's digital economy is expected to reach €52 billion by 2030, contributing 10% to GDP. Between 2017 and 2021, the IT&C sector experienced an annual growth rate of 8%, though it still lags other European "Digital Challenger" countries. Government-led

programs, such as the PNRR (National Program for Recovery and Resilience) Digitization, aim to improve IT infrastructure and workforce digital skills to maintain sector growth.

The World Competitiveness Center Digital Report 2024 (IMD, 2024) ranks Romania 47th out of 67 economies in digital performance, reflecting slow progress despite maintaining stability. The country ranks 51st in knowledge, 50th in technology, and 51st in future readiness. Challenges include low business agility (ranked 68th), a rigid regulatory framework (47th), and weak capital investment (84th), which hinder the scalability of digital transformation.

Within Europe, the Middle East, and Africa (EMEA), Romania ranks 32nd out of 43 economies, placing it in the lower tier of European digital competitiveness. Among countries with over 20 million inhabitants, Romania ranks 28th out of 37, highlighting gaps in IT investment and policy efficiency.

Despite market stagnation, digital skills remain critical, with increasing demand across industries. The UNESCO Global Education Monitoring Report 2021/2 (UNESCO, 2021) highlights that the COVID-19 pandemic accelerated digital transformation, with 84% of companies adopting digitized work processes and 44% of employees transitioning to remote work. This shift has expanded the digital economy, making digital literacy a priority in education and workforce development.

Governments worldwide are investing in digital education. Panama has digitized public services, while South Africa has introduced computer science and coding into its curriculum. The European Union's Digital Education Action Plan (Commission, 2020) aims to improve digital literacy and workforce adaptability, ensuring competitiveness in an increasingly digitalized world.

The Romanian IT industry faces both opportunities and challenges. While the sector has matured, 2024 marks a period of stagnation and restructuring. Emerging technologies like AI, quantum computing, robotics, and cybersecurity will drive the next phase of innovation, reshaping industries from manufacturing to services. However, to remain competitive, Romania must invest in digital education, IT infrastructure, and workforce training, ensuring that businesses and professionals can adapt to the evolving demands of the global digital economy.

4.2. THE IT SECTOR- EMPLOYABILITY

Figure 1 Labor market demand for ICT specialists in online job advertisements, by NUTS 2 region - % of online job advertisements - experimental statistics (Eurostat, 2025)

Although digitization continues to be a priority for many companies, the pace of IT hiring has slowed compared to previous years. Analysts were predicting an increase in IT teams of around 15-20% by the end of 2024, but according to the first data this prediction did not come to pass. According to Eurostat data, there is a noticeable downward trend in the percentage of newly advertised positions. Although there are no final dates for 2024 yet what was noticed was that some companies resorted to redundancies, while others continued to expand and expand their portfolio of services. During the interviews held, we also identified the attributes that make an employee preferable in relation to colleagues.

The World Competitiveness Center Digital Report 2024 (IMD, 2024) highlights a decline in Romania's rankings for talent (45th), education and training (57th), and scientific concentration (48th), reflecting a weakening ability to attract and develop human resources in technology and science. The country performs moderately in digital skills (32nd) but struggles with attracting foreign specialists (44th) and city management (57th). Education faces challenges in public investment (57th) and employee training (60th), while scientific concentration remains low in R&D spending (53rd) and technological patents (35th). However, Romania excels in the share of female researchers (13th) and maintains a solid R&D productivity level through publications

(23rd). These findings indicate the need for greater investment in education, research, and development to enhance Romania's global competitiveness in technology.

ROMANIA
FACTORS BREAKDOWN - STRENGTHS AND WEAKNESSES

▶ Overall Top Strengths   ▷ Overall Top Weaknesses

KNOWLEDGE

Sub-Factors	2020	2021	2022	2023	2024
Talent	51	50	51	50	45
Training & education	54	59	55	56	57
Scientific concentration	39	43	44	47	48

Talent	Rank
Educational assessment PISA - Math	41
International experience	30
Foreign highly skilled personnel	44
Management of cities	57
Digital/Technological skills	32
Net flow of international students	39

Training & education	Rank
▷ Employee training	60
Total public expenditure on education	57
Higher education achievement	55
Pupil-teacher ratio (tertiary education)	49
▶ Graduates in Sciences	16
Women with degrees	54
Computer science education index	50

Scientific concentration	Rank
Total expenditure on R&D (%)	53
Total R&D personnel per capita	48
▶ Female researchers	13
R&D productivity by publication	23
Scientific and technical employment	48
High-tech patent grants	35
Robots in Education and R&D	37
AI articles	46

Figure 2 Romania – Strong and weak points (WCCDDR) (IMD, 2024)

According to the country report on Romania for 2024 regarding the digital decade (Eurostat, Science, technology, and digital skills data browser, 2025) over 72% of the Romanian population does not have basic digital skills, highlighting the need for additional measures to improve these skills.

In 2024, the Ministry of Education presented the conclusions of the ICILS (International Computer and Information Literacy Study) (Eurostat, Eurostat News: Digital Skills Gap in the EU, 2024), which analyzes the digital skills of eighth grade students in Romania (Commission, omania 2024 Digital Decade Country Report, 2024). The results indicate that only 28% of students have basic digital skills, placing Romania in last place in the European ranking. There are also significant differences between urban and rural environments, with students in cities performing better than those in rural areas. The Ministry emphasizes the need for urgent measures to develop digital skills, including the modernization of the school curriculum and the training of teaching staff.
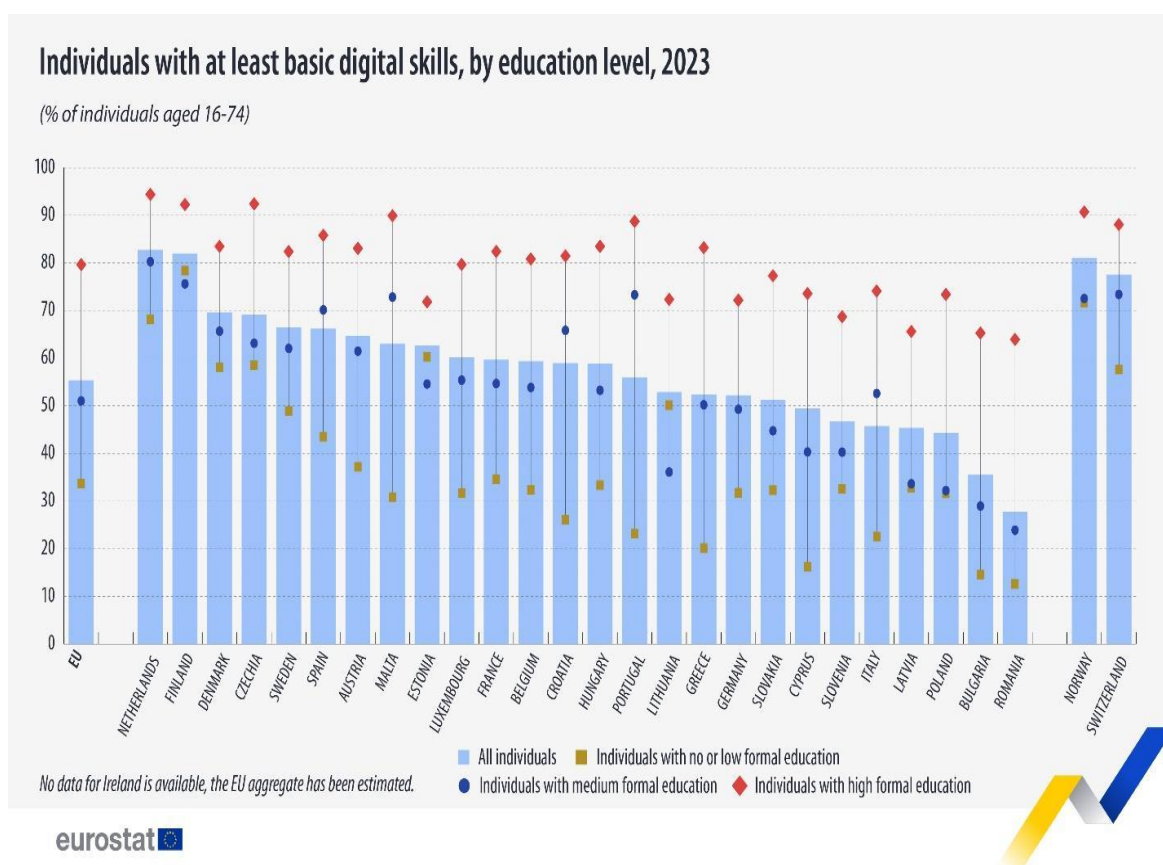
Figure 3 Individuals with at least minimal digital skills by educational level (Eurostat, Eurostat News: Digital Skills Gap in the EU, 2024)

Figure 3, *Individuals with at least minimal digital skills by educational level, 2023,* highlights significant disparities in digital skills across European Union countries, Norway, and Switzerland. Nordic countries like the Netherlands, Finland, and Denmark have the highest percentages of individuals with basic digital skills, whereas Romania and Bulgaria rank lowest. A strong correlation exists between education level and digital competency, with individuals possessing higher education displaying significantly greater digital proficiency than those with lower education, particularly in Portugal, Greece, and Malta. Conversely, countries like Estonia, Finland, and Lithuania exhibit smaller gaps between educational groups, indicating a more balanced distribution of digital skills. The findings emphasize the role of education policies in reducing the digital divide, with Nordic countries excelling due to sustained investments in digital education and technology access, while Romania and Bulgaria face challenges in improving digital literacy, especially among individuals with lower levels of education.
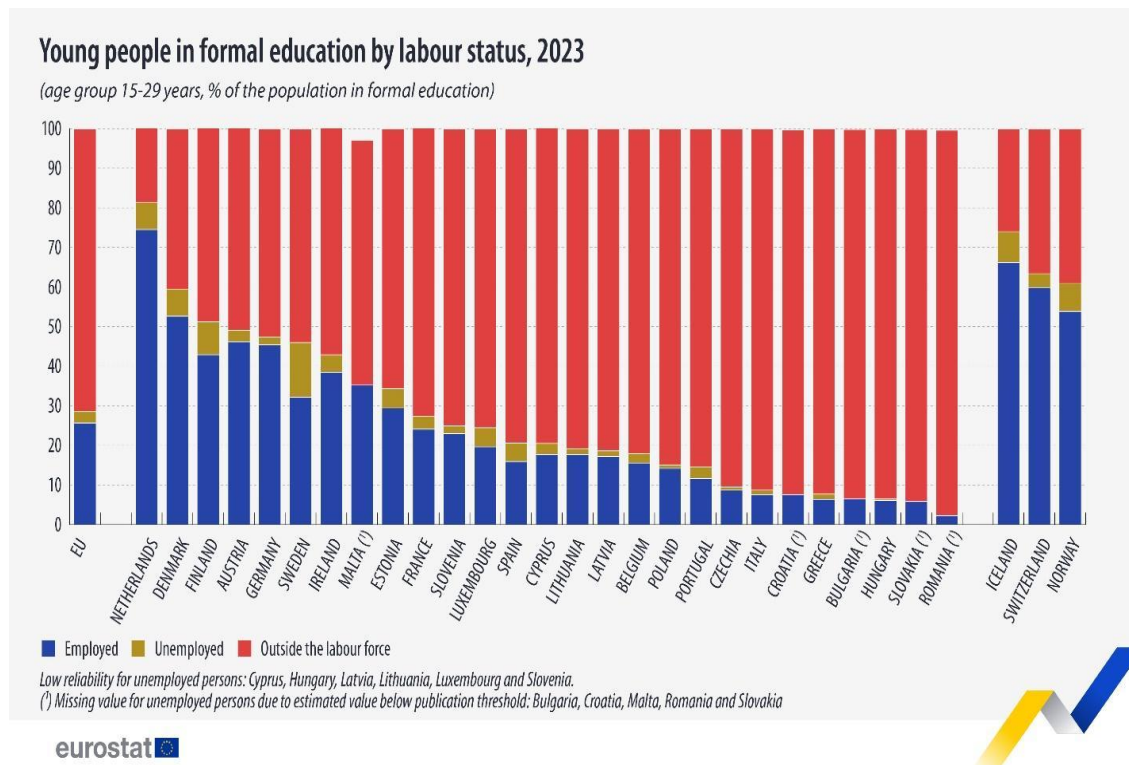
Figure 4 Young people in training compared to their status in the labor market (Eurostat, Eurostat News: Digital Economy and Society Statistics - ICT Usage in Enterprises, 2024)

Regarding employability, what we can observe from the statistics at the European level is the fact that Romanian students seem to be employed much later than students from other European countries. According to Eurostat, in 2023, 25.7% of young Europeans (aged 15-29) were employed during formal education. At the same time, 71.4% were out of the labor force and 2.9% were available for employment and actively looking for a job (unemployed) while in formal education.

4.3 DUAL LEARNING ACROSS THE WORLD, FOCUSED ON THE IT INDUSTRY

Dual education in IT plays a crucial role in training a skilled workforce, aligning education with industry needs. While the United States lacks a formalized dual system, Cooperative Education (Co-Op) programs at universities like Northeastern, Drexel, and Cincinnati integrate practical training into academic curricula. Programs such as Apprenticeship USA and Work-Study further support hands-on learning. Leading universities, including Stanford, MIT, and UC Berkeley, collaborate with major companies such as Google, Apple, and Amazon, offering internship and research opportunities through initiatives like the NSF Industry-University Cooperative Research Centers (IUCRC).

In Europe, structured dual education models provide both classroom learning and professional training. Germany's "Duales Studium", adopted by institutions like DHBW, partners with SAP, Siemens, and Bosch, allowing students to earn degrees while working. Switzerland's "Berufslehre" system provides IT apprenticeships with UBS, Credit Suisse, and Swisscom. Austria's "Lehre mit Matura", Denmark's "EUX Programme", and the Netherlands' BBL system follow similar approaches, integrating vocational training with formal education. These models ensure IT professionals are workforce-ready by combining theoretical and applied learning.

4.4   DUAL LEARNING IN ROMANIA
4.4.1 PRE-UNIVERSITY DUAL LEARNING

Introduced in 2017, Romania's dual education system addresses the labor market's need for skilled professionals in sectors like IT, construction, and industry. Programs last at least three years, with students alternating between theoretical instruction and work-based training (24 weeks over three years). Economic operators initiate classes and provide practical training under formal contracts. Dual education is offered in state, private, and religiously affiliated institutions, remaining tuition-free in public schools (Education, Dual Education: Guide for Students and Parents, 2024).

Unlike dual education, vocational education includes two primary pathways: practical training – 720-hour internships after the 10th grade and professional education – A three-year program after the 8th grade, part of upper secondary education (Education, Vocational Education, 2024).

The impact of dual education on employability is evident in the 2020 study by the Ministry of Education, which found that 53% of dual graduates secured jobs, with 32% employed by partner companies and 21% by non-partner firms. Among 236 economic operators involved, 53% hired graduates, while the rest did not recruit from the dual education system. The data, collected from county school inspectorates (ISJ) and ISMB, highlight dual education's role in bridging the skills gap. (Education, Analysis of Dual Education: Labor Market Insertion, 2024)

4.4.2 UNIVERSITY DUAL LEARNING

Starting in 2024, following the adoption of Law 199/2023, five Romanian universities introduced 18 dual degree programs for high school graduates. Institutions such as the Technical University of Bucharest, "Babeș-Bolyai" University of Cluj-Napoca, and the Technical University of Timișoara launched programs integrating academic studies with professional practice through industry partnerships.

Dual university programs hold the same accreditation as traditional ones, ensuring nationally and internationally recognized degrees, granting graduates full rights for further studies and employment. The curriculum balances theoretical coursework with practical training, adhering to ECTS credit standards and the National Register of Qualifications, maintaining compatibility with conventional higher education paths. (Education, Dual Education, 2024)

ARACIS established specific quality standards for dual university programs, detailing their structure and evaluation in accordance with Romanian educational legislation. (ARACIS, 2024) Universities implementing these programs must formalize partnerships with industry or public institutions to provide structured internships. The curriculum is tailored to market needs, combining theoretical knowledge with applied learning.

Student performance is assessed by both academic staff and industry experts, ensuring a comprehensive evaluation. Higher education institutions offering dual programs must implement continuous quality monitoring mechanisms to align education with labor market demands.

5. EXTENDING DUAL EDUCATION TO IT: AN ANSWER TO THE SKILLS SHORTAGE?

To explore the issue, a qualitative method was employed, consisting of ten semi-structured interviews with specialists in management and recruitment from companies of various sizes within the Romanian IT sector. The respondents were divided into five categories based on the size of the organizations they work for.

The respondents interviewed are key decision-makers across large, medium, and small companies in the Cluj IT market, offering diverse insights into the industry's dynamics. Among large companies, participants included a top manager from a 2,000-employee corporation with academic experience, a project manager from a 20,000-employee multinational, a software developer from a 7,500-employee firm, and another project manager from a 17,000-employee company. Additionally, a Global SVP in Data & AI Strategy contributed insights from a 13,000-employee organization.

In medium-sized companies, a human resources manager from a firm with 45 local and 800 national employees provided expertise on workforce trends. The small company sector was represented by two CEOs: one leading a 10-person company in smart home automation, and another managing a 7-person IT consulting firm. Startups were also included, with a CEO from a six-person SAP consultancy and an independent IT project manager offering insights into the freelance sector.

This selection captures strategic and operational perspectives across different company sizes, ensuring a relevant analysis of the Cluj IT ecosystem.

The study examined the balance between technical and support functions in IT companies, revealing significant variation based on company size and specialization. Large corporations reported a predominantly technical workforce, with up to 95% of employees in technical roles, while smaller firms had a more balanced distribution, often integrating external collaborators. Medium-sized companies maintained a lower but still technical-heavy ratio. Although not a comprehensive industry analysis, the findings provide valuable insight into workforce structures and skill requirements across different IT environments.

To assess respondents' perceptions of the importance of higher education for IT employment, a survey included the question: *"How relevant do you think it is for applicants to have completed higher education in order to be employed in your company?"* The study also examined the differences in education requirements for technical and non-technical roles, as well as the constraints faced by candidates with secondary education when applying for technical positions.

The responses revealed a consistent approach, enabling classification into four categories: the relevance of higher education for technical positions, differences between technical and non-technical functions, access of candidates with secondary education to the IT market.

5.1. THE RELEVANCE OF HIGHER EDUCATION FOR TECHNICAL ROLES

Most respondents agree that a college degree is a significant advantage for IT roles but not always mandatory, as practical experience can compensate for the lack of formal education. R4 emphasizes that while a degree is not a strict requirement, candidates without one must demonstrate strong skills or relevant experience. The need for higher education is justified by several factors, including the ability to understand complex problems and abstract concepts (R4,

R2), high cognitive and behavioral abilities (R3), and technical and algorithmic skills (R5), with university studies reinforcing logical thinking and problem-solving. Additionally, tax incentives for employers (R5) and client demands for degreed professionals (R1) influence hiring decisions. In start-ups, communication and management skills are crucial, with R6 highlighting that passion and adaptability often outweigh formal training. While career progression in IT is possible without a degree, many respondents stress that higher education provides long-term advantages, especially for specialized roles and leadership positions (R1, IN). Given the rapid evolution of AI and automation, a strong educational foundation ensures greater flexibility and adaptability in a constantly changing industry.

The responses reflect a diversity of perspectives and do not indicate a unanimous opinion on the requirement of higher education for technical and non-technical positions:

Technical roles: Respondents opinions are varied. R8 and R7 believe that higher education is not mandatory for technical positions, emphasizing the importance of a technical background although there is a preference for candidates who have completed university studies. R8 explains that "for technical positions, it does not necessarily matter to have completed a specialized university, but to have a technical background". However, it is noted that the training time of an employee without higher education "means a very high consumption of resources", which can make the recruitment process more difficult. In contrast, R3, IN and R4 argue that the mere acquisition of technical knowledge is insufficient to cope with the complexity of the requirements.

Non-technical roles: Consensus is more clearly defined in terms of support or coordination functions, where most respondents, such as R9 and R7, consider higher education essential. These roles involve a high level of understanding and responsibility, skills often associated with university education.   R9 notes that "for support functions, at least 80% of roles require higher education, even if it's not in that field". R7 states that, in small companies, "support functions need people with higher education and certifications." However, R6 notes that, in some cases, practical experience can replace a university degree, especially in small firms, where adaptability and passion play a key role.

Regarding the access of candidates with secondary education to the IT market it seems is generally limited, though opinions vary based on job requirements. Most respondents prefer hiring candidates with higher education, with recruitment processes reflecting this bias. R9 notes that secondary education graduates are typically restricted to production or support roles involving standardized tasks and predefined software. Exceptions exist, but candidates without higher education must demonstrate significant experience to compensate for the lack of a degree, making such cases rare.

The role of dual education at the high school level in IT is debated. Supporters argue that it helps build technical skills, particularly in IT support or software operations, while critics highlight that it lacks depth in programming and data analysis, limiting career progression. Partnerships between companies and schools can facilitate job integration, but success depends on the quality of training and private sector involvement.

Education remains inaccessible to many students, with R9 emphasizing that vocational pathways should be available after the 8th grade to prevent school dropouts. R7 and R2 argue that the current education system fails to offer viable alternatives for students who could excel in technical fields, while R5 advocates for early exposure to dual programs to help students identify career paths sooner.

Integrating technology into pre-university education is essential to better align graduates with labor market demands. R4 stresses that technology should be embedded in all subjects, ensuring relevance in a rapidly evolving industry. Dual education should also extend beyond IT, applying emerging technologies to fields like manufacturing and services to enhance graduates' value in the workforce.

Training employees without higher education demands significant time and resources, making recruitment more challenging, especially for smaller firms. While some companies invest in training, it remains a costly process. Higher education is generally valued for providing structured training, discipline, and career opportunities, though practical experience remains essential in hiring decisions.

These perspectives underscore the limited access of secondary education graduates to IT roles, the potential of dual education, and the need for continuous adaptation of training programs to meet market demands through greater technological integration.

5.2. THE NEEDS OF THE BUSINESS ENVIRONMENT IN RELATION TO THE UNIVERSITY PREPARING STUDENTS FOR THE LABOR MARKET

Respondents unanimously agree on the need for closer collaboration between universities and the business sector, though opinions differ on the role of university education. Some emphasize general competencies, arguing that universities should produce adaptable graduates with critical thinking and problem-solving skills rather than focusing solely on current market demands. Others advocate a practical approach, warning that outdated curricula leave graduates unprepared for real-world challenges. This divide highlights the necessity of structured dialogue between academia and industry to balance long-term adaptability with immediate employability.

Key challenges include the gap between university curricula and labor market demands, with many subjects being outdated and lacking in practical application. Theoretical training dominates, with students often unexposed to real industry projects, leading to companies having to invest in extensive on-the-job training for junior employees. Additionally, soft skills and teamwork are underdeveloped, with respondents noting that graduates struggle with collaboration, communication, and applying knowledge creatively.

To address these issues, universities need major reforms: modernizing curricula, integrating practical training, expanding university-industry partnerships, and enhancing transversal skills development such as critical thinking and adaptability. Expanding dual education and internship programs can provide students with real-world experience, while reforms in teaching methodologies should prioritize problem-solving over memorization.

Generative AI is reshaping the IT industry, reducing demand for junior programmers while increasing the need for creativity, critical thinking, and communication skills. AI democratization enables non-technical individuals to build software, shifting recruitment trends toward mid and senior-level professionals who can strategically integrate AI tools into workflows. As a result, IT companies are investing less in traditional software development and restructuring their teams accordingly.

Essential future skills include logical structuring of ideas, persuasive communication, and storytelling, as AI strategists and prompt engineers become crucial roles. Respondents emphasize that technology alone will not define success—those who can merge technical expertise with strategic thinking and creativity will have a competitive edge. The perception of programming as

an elite profession is shifting, aligning with global trends where software development is seen as a technical, rather than prestigious, occupation.

To remain competitive, digital literacy will be essential across all industries, with companies prioritizing employees who can effectively interact with AI-driven solutions. The evolving IT landscape underscores the importance of integrating technology, creativity, and strategic thinking into education to prepare graduates for a rapidly transforming job market.

5.3. THE BENEFITS OF DUAL EDUCATION IN DEVELOPING THE TECHNICAL SKILLS REQUIRED FOR THE IT SECTOR

All respondents highlighted the advantages of this education system in the formation of technical skills and as a potential solution for the IT field:

Practical integration: R9 underlines the success of the French model, where "the exam is actually practice in a company...students could put into practice the theory they had learned". This practice benefits both companies and students: "Many of them were retained after they graduated from college." This model aligns with Harvey's concept of "employability", whereby practical training develops transferable skills that increase the chances of integration and success in the labor market. Connecting with industry: R6 mentions that partnerships between economic operators and educational institutions are "beneficial if you, as an economic operator, have the resources to take over the education of the learners". This may respond to an urgent need for skilled personnel in technical trades. R8 adds that dual programs can create a more effective bridge between education and industry but stresses the importance of educational institutions working closely with firms to develop customized programs that reflect current requirements. R8 also warns that without such collaboration, there is a risk that students will be prepared for an already outdated labor market.

R3 considers dual education to be a welcome solution for IT, but stresses that it must include both technical and soft skills, such as communication and critical thinking, to ensure successful integration into the labor market. R5 emphasizes the importance of a close relationship between the educational and business environment, considering that only through a continuous adaptation of the dual programs to the needs of the IT industry can their success be ensured. R1 notes that dual education can address the immediate need for a skilled IT workforce, but cautions that programs must remain flexible enough to allow for adaptation to rapid technological change.

However, some respondents, such as R4 and OS, warn of an important risk: training students strictly for work in a specific firm may limit their long-term adaptability. R4 argues that such a system may produce "people who fit the demand of the moment" but who will become vulnerable to market and technology changes. In their view, it is essential that dual education training remains sufficiently generalist and flexible to allow graduates to broaden their horizons and adapt to new opportunities.

Although higher education is preferred for positions in the IT environment, an emerging consensus emerged from the interviews is that dual education should start much earlier, offering students opportunities for practical training and clear professional directions from high school. IN points out that this system would allow students to be connected to the labor market in a pragmatic way, providing them with technical skills adapted to the needs of the market. R4 adds that dual education should integrate technology in all fields, emphasizing that "almost every field of human activity will be touched by technology in the next 5-10 years" and that students must be prepared to work with modern tools regardless of their professional direction. R9 agrees with this view and mentions that early practical training would help students better understand the reality of work and

develop useful skills, suggesting that clearer targeting of students could reduce school dropout or additional strain on families. R7 supports this approach, pointing out that practical training during high school would allow students to discover their interests earlier and reduce the discrepancies between education and the demands of the labor market.

All respondents agree that the integration of technology, combined with earlier practical training, would help to create an educational system more adapted to the current and future demands of the economy. This approach not only eases students' transition into the workforce, but also provides them with a solid foundation to adapt to future technological changes, thus reducing the risks of to narrow a specialization.

One of the key insights from the interviews came from the representative of the local administration, who highlighted the significant role public institutions can play in fostering dual education programs. The administration's involvement in economic clusters—whether as an owner, partner, or member—creates a unique opportunity to connect educational institutions with a broad network of businesses and investors. This strategic positioning allows the administration to act as a facilitator for stronger collaboration between companies and schools, ensuring that dual education programs align with market needs. In pre-university education, the administration also holds direct responsibility for investing in school infrastructure, making its participation essential in ensuring modern and well-equipped facilities for vocational training. Moreover, for attracting funding, the city hall serves as a key guarantor in accessing European or national development funds, strengthening the sustainability of dual education initiatives. Throughout the discussion, the respondent emphasized that the well-being and continuous growth of a city are deeply linked to the development of its educational system. Supporting education to reach its full potential not only benefits students and employers but also enhances the overall prosperity of the local community, ensuring long-term economic and social stability.

5.4. CHALLENGES AND RISKS OF DUAL EDUCATION IN THE DEVELOPMENT OF TECHNICAL SKILLS FOR THE IT FIELD

Interviews with Cluj IT industry representatives highlight that dual education alone cannot fully meet labor market demands. Beyond technical training, the main challenge is the lack of essential skills such as critical thinking, communication, collaboration, and adaptability. For dual education to be effective, it must integrate soft skills development and strengthen collaboration between universities and businesses.

R10 emphasizes that universities must go beyond technical knowledge to prepare students for adaptability, teamwork, and problem-solving in a fast-changing industry. R3 adds that universities could better train mid-level managers by incorporating more practical experience alongside theory. Success in IT requires more than technical expertise; emotional intelligence and communication skills are equally important. The consensus is that a well-rounded dual education must develop both technical and transversal skills to ensure smoother workforce integration.

Many respondents stress that IT careers involve more than coding. R5 criticizes outdated university curricula, noting that employees often gain more practical knowledge in two months of company training than in four years of university. R6 adds that many graduates struggle with teamwork, organization, and task prioritization, skills rarely taught in academic settings.

A key concern is that dual education may become too tailored to corporate needs, limiting graduates' adaptability. R9 warns that overly company-specific curricula could make graduates struggle to transition as industry trends shift. R4 reinforces this, arguing that narrow specialization

in one technology can be a long-term disadvantage. Instead, education should focus on strategic thinking, adaptability, and lifelong learning.

To be effective, dual education must provide broad and flexible training, emphasizing critical thinking and problem-solving over narrow technical skills. It should encourage knowledge diversification, enabling students to transition between technologies and industries. R4 summarizes that the industry values professionals who can analyze complex systems, find creative solutions, and collaborate effectively rather than those who simply master a programming language.

6. CONCLUSIONS

The study highlighted the potential of dual education to contribute to the formation of a competitive workforce in the IT industry in Romania. By integrating employers' perceptions and analyzing the educational and economic context, a series of essential conclusions and perspectives are outlined:

Dual education, both at pre-university and university level, offers a practical approach adapted to the demands of the labor market. Respondents highlighted that hands-on training, combined with the integration of emerging technologies, can reduce the skills gap and accelerate the integration of graduates into IT companies. This finding validates the human capital theory proposed by Gary S. Becker, according to which investment in education and practical training increases individual productivity and contributes to economic growth.

The results of the study suggest that dual education at the high school level has limited applicability in the IT industry, as most employers prefer university students or graduates for advanced technical roles. However, this educational model can have value in developing basic skills and training young people in IT-related fields, such as technical support and systems administration.

The study highlights the potential of dual education in developing a competitive workforce for Romania's IT industry, though its effectiveness depends on practical integration and industry collaboration. Respondents emphasize that hands-on training and emerging technologies can bridge the skills gap and accelerate graduate integration into IT companies, aligning with Becker's human capital theory. However, dual education at the pre-university level remains limited, as employers generally prefer university graduates for advanced technical roles. While it can support entry-level positions in IT support and system administration, it lacks depth for complex software development, making university education essential for specialized careers.

Despite its potential benefits, current limitations include rigid curricula, weak industry-academia collaboration, and a lack of trained teachers. Many respondents argue that dual education alone is insufficient for preparing graduates for high-level IT roles and that universities should integrate more applied internships and technological adaptability into their programs. The study also validates Becker's theory, as employers prioritize on-the-job training for specific technical skills, while expecting education systems to develop critical thinking and problem-solving abilities.

For dual education to succeed, stronger partnerships between companies and universities are necessary, along with public policies, infrastructure investment, and continuous monitoring to ensure relevance. Without national strategies ensuring flexibility and accessibility, dual education risks benefiting only major urban centers, leaving students in rural areas at a disadvantage. Additionally, generative AI is reshaping skill demands, shifting the focus from junior programming

to creativity, strategic thinking, and AI integration, which universities must address through curriculum modernization.

The findings from this qualitative study, alongside quantitative data on transversal skills and interviews with university decision-makers, suggest that bridging the IT skills gap requires stronger partnerships between academia and industry. While businesses demand more adaptable graduates with diverse competencies, universities face systemic challenges in modernizing curricula. Addressing this disconnect will be essential for maximizing the impact of dual education in Romania's digital economy.

Future research should evaluate employment outcomes of dual education graduates, identify effective collaboration models between industry and academia, and analyze the impact of transversal skills on employability. If effectively implemented, dual education could become a key driver of competitiveness and innovation in Romania's IT sector, preparing graduates not just for jobs but for the rapidly evolving digital economy.

REFERENCES

Abelha, M., Fernandes, S., Mesquita, D., Seabra, F., & Ferreira-Oliveira, A. T. (2020). *Graduate employability and competence development in higher education—A systematic literature review using PRISMA. Sustainability*, 1-21.

Adevărul (2024). *The IT sector is no longer the tiger of the economy: GDP contribution stagnates in 2024 [Sectorul IT nu mai este tigrul economiei: contribuția la PIB în stagnare în 2024]*. Retrieved from https://adevarul.ro/economie/sectorul-it-nu-mai-este-tigrul-economiei-2387200.html

ANIS (2024). *The IT industry in 2023: 12.16% growth and a major multiplier effect on the entire economy*. Retrieved from www.anis.ro/2024/10/23/industria-it-in-2023-crestere-cu-1216-si-efect-multiplicator-major-asupra-intregii-economii/

ARACIS (2024). *Specific quality standards for the dual organization form of bachelor's/master's degree programs*. Retrieved from www.aracis.ro/wp-content/uploads/2024/06/Standarde-specifice-dual.pdf

Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis, with special reference to education*. Chicago: University of Chicago Press.

Commission, E. (2020). *Digital education action plan 2021–2027: Resetting education and training for the digital age*. Retrieved from https://education.ec.europa.eu/focus-topics/digital-education/action-plan

Commission, E. (2024). *Romania 2024 digital decade country report*. Retrieved from https://digital-strategy.ec.europa.eu/ro/factpages/romania-2024-digital-decade-country-report

Education, M. o. (2014). *Strategic framework for increasing participation, quality, and efficiency in tertiary education in Romania 2014–2020*. Retrieved from https://www.academia.edu/11467690

Education, M. o. (2024). *Analysis of dual education: Labor market insertion*. Retrieved from www.edu.ro/sites/default/files/_fi%C8%99iere/Minister/2020/inv.preuniversitar/Rapoarte_Analize/Analiza%20Dual%20-%20INSERTIE%20pe%20piata%20muncii.pdf

Education, M. o. (2024). *Dual education: Guide for students and parents*. Retrieved from www.edu.ro/sites/default/files/*fi%C8%99iere/InvatamantPreuniversitar/Dual%202020/INFO%20Dual%20*%20Elevi%20si%20parinti.pdf

Eurostat (2024). *Eurostat news: Digital economy and society statistics - ICT usage in enterprises*. Retrieved from https://ec.europa.eu/eurostat/en/web/products-eurostat-news/w/ddn-20241125-1

Eurostat (2024). *Eurostat news: Digital skills gap in the EU*. Retrieved from https://ec.europa.eu/eurostat/en/web/products-eurostat-news/w/ddn-20240222-1

Harvey, L. (2001). *Defining and measuring employability. Quality in Higher Education*, 97-109.

IMD (2024). *World Competitiveness Center Digital Report 2024*. Retrieved from https://imd.widen.net/s/xvhldkrrkw/20241111-wcc-digital-report-2024-wip

McKinsey, C. &. (2025). *Digital challengers on the next frontier*. Retrieved from www.economica.net/investitiile-in-itc-si-comertul-online-pot-creste-economia-digitala-a-romaniei-de-35-ori-pana-in-2030-raport_612840.html

Moser, A., & Korstjens, I. (2018). *How to use and assess qualitative research methods*. *European Journal of General Practice*, 1-6.

Puterea.ro (2024). *Shock in the Romanian labor market: The collapse of the IT sector and the rise of new leaders in 2024*. Retrieved from https://www.puterea.ro/cutremur-pe-piata-muncii-din-romania-prabusirea-sectorului-it-si-ascensiunea-noilor-lideri-in-2024/

UNESCO. (2021). *Global Education Monitoring Report 2021/2: Non-state actors in education: Who chooses? Who loses?* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000379875.

Wall-Street.ro (2025). *Significant contraction in the IT market: Competition for a job is five times higher than in 2024*. Retrieved from https://www.wall-street.ro/articol/Careers/313481/contractie-mare-in-piata-it-batalia-pe-un-post-e-de-cinci-ori-mai-mare-decat-in-2024.html

ZF.ro (2023). *ANIS Study: Romania's IT industry reached 15.5 billion euros in 2023*. Retrieved from https://www.zf.ro/business-hi-tech/studiu-anis-industria-it-romania-atins-15-5-miliarde-euro-2023-22523356