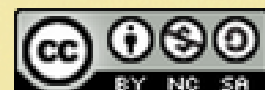




Bridging Gaps in ICT Education through Innovation and Labor Market Alignment - Research



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Archilab

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ABOUT THE PROJECT

The project titled "eLearning Architects: Designing the Future of the Labor Market" (acronym: **ARCHILAB**) is an Erasmus+ KA210-VET small-scale partnership focused on innovating the vocational education and training (VET) sector, with a specific emphasis on digital learning. Running from January to December 2025, the project brings together three partner organizations: Backslash (Spain) as applicant, Pannonia Consulting (Croatia), and Libero (Serbia).

Project Purpose and Motivation

The project's core aim is to respond to the growing demand for qualified professionals in the e-learning sector, a field that continues to expand globally and nationally.

Despite its growth, there is a noticeable lack of formal educational pathways to train eLearning Architects—professionals responsible for designing and delivering digital learning content. By filling this gap, the project supports the development of digital and non-formal VET programs that can empower both educators and learners with relevant skills for the labor market.

The project meets multiple Erasmus+ priorities: adapting VET to labor market needs, promoting digital transformation, and contributing to innovation. It proposes a realistic, sustainable, and inclusive solution to a pressing skills gap by creating a replicable model for vocational digital education. The strategic combination of experienced and less experienced organizations ensures both innovation and capacity building, while the focus on underrepresented groups guarantees added social value.



INTRODUCTION

As Europe advances toward a digitally empowered and inclusive labor market, vocational education and training (VET) systems across the continent must evolve to reflect the realities of emerging professions and technological change. The project **"eLearning Architects: Designing the Future of the Labor Market"** was conceived to address a shared challenge among Spain, Croatia, and Serbia: the urgent need to modernize VET offerings in digital education, particularly in the creation and delivery of distance learning content. Although each country operates within distinct educational frameworks and market conditions, they all face common pressures including a growing demand for digital competencies, rising youth unemployment, and a notable gap between VET curricula and labor market expectations.

This transnational report brings together national research conducted in the three partner countries to map the current state of digital transformation within VET, focusing specifically on the profession of eLearning Architect. The analyses explore how well current programs integrate tools such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and instructional design for digital environments. Furthermore, the studies examine national and regional disparities, teacher preparedness, and the alignment of training outcomes with labor market demands. By comparing findings from Spain, Croatia, and Serbia, this report highlights systemic gaps, innovative practices, and key opportunities for intervention. It provides an evidence base for the development of a non-formal curriculum tailored to the eLearning sector and supports the broader goals of the Erasmus+ program—namely, fostering innovation, inclusion, and digital resilience in vocational education. This joint effort underscores the value of international collaboration in tackling shared educational challenges and shaping future-ready learning pathways across Europe.





Croatia



**Advancing Digital
Transformation in Croatian VET:
Bridging Gaps in ICT Education
through Innovation and Labor
Market Alignment**

Abstract

As Croatia positions itself within the broader EU digital transition framework, its Vocational Education and Training (VET) system stands at a critical crossroads. This research investigates the extent to which digital technologies particularly artificial intelligence (AI), virtual and augmented reality (VR/AR) and sustainability principles are embedded in Croatian VET, with a particular emphasis on information and communication technology (ICT) programs. Drawing on data from 2020 to 2025, the study reveals a considerable disconnect between curricular offerings and labor market needs. Although national initiatives have promoted digital infrastructure, progress in pedagogical innovation and content modernization remains limited. This paper recommends targeted reforms, including curriculum redesign, stronger industry collaboration, and the introduction of micro-credentials to equip learners with labor-market-relevant competencies.

Keywords: Digital Education, VET, Croatia, AI, Labor Market, Sustainability

Introduction

Vocational education in Croatia plays a central role in equipping young people with employable skills, particularly in fast-evolving sectors like ICT. However, despite notable efforts to modernize the sector, such as those led by the Croatian Qualifications Framework (CROQF) and EU-backed initiatives like the e-Schools program, Croatia still faces substantial challenges.

The ICT sector contributed 6.2% to the national GDP in 2022, yet struggles to fill thousands of technical positions, largely due to outdated curricula and skills mismatches. This research explores the integration of emerging digital technologies and sustainability education into Croatian ICT-focused VET programs. By examining structural gaps in curriculum development and labor market alignment, we aim to identify pathways for systemic transformation in line with EU goals for a digital and green economy.



Croatia



METHODOLOGY



This study employed a mixed-methods approach to triangulate evidence from multiple sources:

- **Desk Research:** We analyzed fifteen ICT-related VET programs listed in the Agency for Vocational and Adult Education's 2023 catalogue, along with relevant European policy documents (e.g., CEDEFOP's 2022 skills forecasts).
- **Labor Market Analysis:** National employment trends and vacancy reports were drawn from the Croatian Bureau of Statistics (DZS) and the Croatian Chamber of Economy. The focus was placed on employment data relevant to young people and digital professions.
- **Policy Review:** Key EU and national digital education initiatives were reviewed, including the e-Schools program (CARNET, 2022) and the Digital Education Action Plan (European Commission, 2021), to assess the systemic efforts being made in this field.

Market Analysis: Trends in Digital Education in Croatia's VET Sector



In the context of Croatia's integration into the EU's broader digital education and sustainability objectives, the national VET system is undergoing gradual yet uneven transformation. Key technological trends shaping the future of education namely artificial intelligence (AI), virtual and augmented reality (VR/AR), and green digital skills are beginning to surface but are far from fully embedded in curricula.

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National initiatives such as the e-Schools program, coordinated by CARNET, have significantly improved digital infrastructure across secondary education institutions, including VET schools. Some vocational schools, like the Špansko Technical School, have begun to use VR for mechatronics training. However, these examples remain isolated and unstandardized. AI integration is still in a nascent stage, often limited to partnerships with industry leaders like Infobip and Rimac Automobili.

Regarding sustainability, its integration into VET especially ICT-related programs remains superficial. Only 2 of the 15 analyzed ICT programs incorporated any content related to green digital practices. This highlights a missed opportunity to position VET at the forefront of climate-smart technological development.

While digital authoring tools such as Articulate 360 or SCORM-based systems are acknowledged in some programs (e.g., Multimedia Technician), overall pedagogical innovation lags. Teachers' digital readiness is another challenge; many lack exposure to adaptive platforms like Moodle or interactive digital teaching tools, impeding scalable eLearning adoption.

ICT VET Programs and Gaps in eLearning Development



Desk research, based on the 2023 Catalogue of Vocational Programs published by Croatia's Agency for Vocational and Adult Education, revealed 15 nationally recognized ICT VET programs. These include courses in multimedia, IT systems, software development, and telecommunications. However, only 4 out of 15 programs explicitly integrate eLearning design and development into their curricula. Most programs still rely heavily on traditional software training (C#, Java) without preparing students for the dynamics of digital content creation or interactive learning design.

Notable gaps include:

- Minimal focus on VR/AR, AI, or machine learning.
- Absence of structured digital pedagogical frameworks in most curricula.
- Lack of teacher training on modern instructional design methodologies.

This reflects a broader challenge: Croatia's digital VET reforms have focused more on infrastructure than on competency-based content, leaving a mismatch between what students learn and what employers demand particularly in ICT domains involving digital transformation, ethical AI, and virtual simulations.

Labor Market Dynamics and Youth Employment Trends



Croatia's ICT labor market is rapidly expanding, yet it faces significant bottlenecks in talent supply. According to the Croatian Bureau of Statistics and Eurostat (2025), youth unemployment remains high at 16.2%, exceeding the EU average of 14.5%. This disproportionately affects coastal regions such as Split and Rijeka, where digital job demand surpasses the capital by up to 22%. Over 9,000 ICT-related vacancies remain unfilled, with 45% of ICT graduates lacking job-relevant competencies particularly in AI, cloud computing, and cybersecurity. Employers frequently report that recent graduates lack hands-on skills, creative problem-solving ability, and familiarity with collaborative digital environments.

Demographically, young people from rural or disadvantaged regions face greater barriers due to limited access to advanced educational technology and training programs. Gender gaps also persist in STEM-related VET education, reflecting a structural need for inclusive outreach and re-skilling initiatives.



Conclusion: Competencies, Validation, and Recommendations



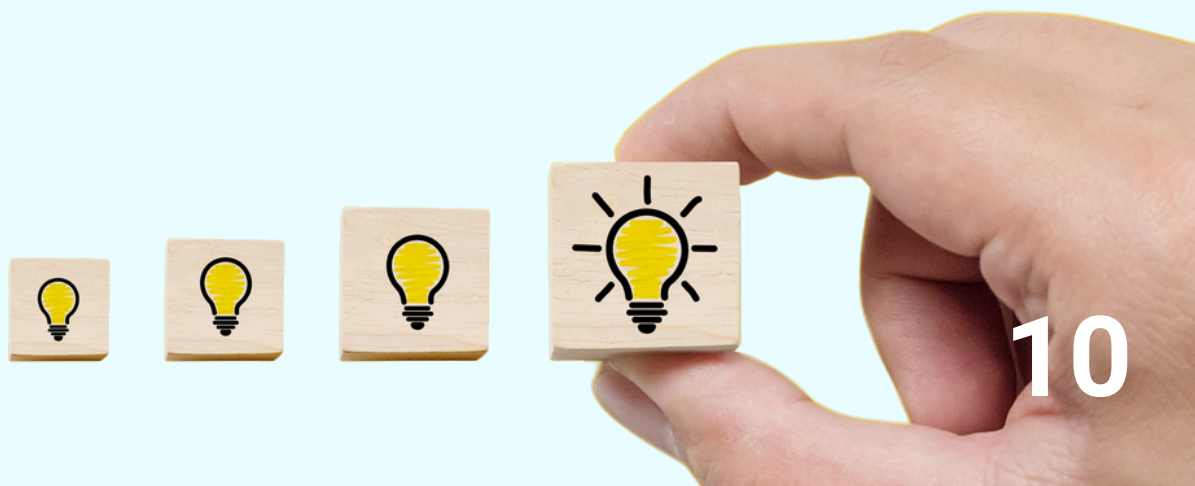
The research clearly identifies that Croatia's VET system is not yet adequately aligned with the evolving demands of the ICT labor market. While foundational progress has been made through programs like e-Schools, there is a pressing need to move from infrastructure development to pedagogical innovation and skills validation.

Recommendations:

1. Curriculum modernization: Introduce modules on AI, VR/AR, cybersecurity, and sustainability across all ICT VET programs.
2. Micro-credentialing: Establish flexible certification systems to validate skills in areas such as green IT and digital pedagogy.
3. Teacher upskilling: Implement targeted, EU-funded training for educators on using immersive and adaptive learning technologies.
4. Industry-driven alignment: Create formal partnerships with leading tech firms to co-design curricula and offer real-world learning pathways.
5. Inclusive strategies: Develop region-specific initiatives to address disparities and improve participation from underrepresented groups, especially in rural and coastal areas.

By implementing these reforms, Croatia can strengthen the role of VET in building a future-ready workforce that contributes meaningfully to the country's digital and green transitions.

Digital transformation within Croatia's VET system remains uneven, with infrastructure outpacing curricular innovation and pedagogical preparedness. To realize the full economic and social potential of the ICT sector, systemic reforms are urgently needed. By aligning education with labor market needs and embedding both digital and green competencies into vocational curricula, Croatia can not only reduce youth unemployment but also build a sustainable and inclusive digital economy.



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Serbia



**Adapting Serbian VET for the
Digital Era:
Innovations in ICT Education and
Labor Market Synergy**

Abstract

As Serbia progresses within the EU digital transition framework, its Vocational Education and Training (VET) system faces both challenges and opportunities. This research examines the integration of digital technologies—such as artificial intelligence (AI), virtual and augmented reality (VR/AR)—and sustainability principles within Serbian VET, with a focus on information and communication technology (ICT) programs. Reports from the European Training Foundation highlight Serbia's efforts to align VET with labor market needs through initiatives like the dual training model and work-based learning. The Vojvodina ICT Cluster emphasizes the importance of fostering digital skills and entrepreneurship to meet the demands of Industry 4.0. Additionally, government strategies, such as the Digital Skills Development Strategy, underscore the need for curriculum modernization and stronger collaboration between educational institutions and industry. Despite these advancements, gaps remain in aligning educational offerings with labor market demands. This paper advocates for targeted reforms, including curriculum redesign, enhanced industry partnerships, and the adoption of micro-credentials to equip learners with competencies relevant to the evolving digital economy.

Keywords: Digital Education, VET, Serbia, AI, Labor Market, Sustainability

Introduction

Vocational education in Serbia serves as a cornerstone for preparing young individuals with practical skills, particularly in rapidly advancing fields like ICT. Despite many efforts in modernizing the sector, such as initiatives supported by the European Training Foundation and national strategies like the Digital Skills Development Strategy, Serbia continues to face significant challenges. The ICT sector has emerged as a vital contributor to economic growth.



Serbia



On the other hand there are many struggles with a persistent gap between educational programs and labor market requirements. This disconnect is followed by outdated curricula and insufficient alignment with industry demands.

Here we present the cutting-edge digital technologies and sustainability principles within Serbian ICT-focused VET programs. Looking into structural deficiencies in curriculum design and industry collaboration, we aim to propose actionable solutions that align with Serbia's aspirations for a digitally-driven and environmentally sustainable economy.



METHODOLOGY



This research utilized a mixed-methods approach to gather and analyze data from diverse sources:

- **Desk research:** A comprehensive review was conducted on ICT-related VET programs listed in the Serbian Ministry of Education's catalogues, alongside relevant European policy documents, such as CEDEFOP's skills forecasts and ETF reports.
- **Labor market analysis:** Employment trends and vacancy statistics were examined using data from the Statistical Office of the Republic of Serbia and insights from the Serbian Chamber of Commerce. Special attention was given to youth employment and the demand for digital professions.
- **Policy review:** Key national and EU initiatives were analyzed, including Serbia's Digital Skills Development Strategy and the European Commission's Digital Education Action Plan, to evaluate systemic efforts in modernizing VET and aligning it with labor market needs.

Market Analysis: Trends in Digital Education in Serbia's VET Sector



In the context of Serbia's alignment with EU digital education and sustainability objectives, the national VET system is undergoing gradual but uneven transformation. Emerging technological trends, such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and green digital skills, are beginning to gain traction but remain inconsistently integrated into curricula.

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National initiatives, including Serbia's Digital Skills Development Strategy, have significantly enhanced digital infrastructure across educational institutions, including VET schools. Some vocational schools have started experimenting with immersive technologies like VR for technical training, though these efforts are isolated and lack standardization. AI integration is still in its infancy, primarily limited to pilot projects and collaborations with industry leaders.

Regarding sustainability, its incorporation into VET programs particularly ICT-related ones remains superficial. Few programs include content on green digital practices, highlighting a missed opportunity to position VET as a leader in climate-smart technological development.

Initiatives supported by the European Training Foundation have introduced workshops for VET educators to develop digital competencies, enabling them to create interactive learning experiences and adapt to modern teaching methodologies. These efforts, though impactful, require broader implementation to achieve scalable eLearning adoption across Serbia's VET sector.

ICT VET Programs and Gaps in eLearning Development



Based on reports from the Serbian Ministry of Education and the European Training Foundation (ETF), identified 12 nationally recognized ICT VET programs in Serbia. These programs include courses in software development, IT systems, telecommunications, and multimedia. Only a small fraction of these programs explicitly integrate eLearning design and development into their curricula. The majority continue to focus on traditional software training (e.g., Python, Java), with limited emphasis on preparing students for the demands of interactive learning design or digital content creation.

These gaps include:

- Minimal focus on emerging technologies: While some pilot projects have introduced VR/AR and AI, these technologies are not systematically embedded in VET curricula.
- Lack of structured digital pedagogical frameworks: Most programs lack comprehensive frameworks for integrating digital teaching methodologies.
- Teacher training challenges: Initiatives like Pro-VET have made strides in enhancing teacher competencies, but many educators still lack exposure to modern instructional design methodologies and adaptive eLearning tools.

Serbia's digital VET reforms have primarily focused on improving infrastructure, such as providing ICT equipment and internet access to schools. There remains a significant gap in aligning educational content with labor market demands, particularly in ICT domains requiring expertise in digital transformation, ethical AI, and immersive technologies

Labor Market Dynamics and Youth Employment Trends



According to the Statistical Office of the Republic of Serbia and the Regional Cooperation Council, youth unemployment remains high at 21.5%, significantly exceeding the EU average. Regional disparities are evident, with urban centers like Belgrade showing higher employment rates compared to rural areas, where access to advanced educational technology and training programs is limited.

Over 7,000 ICT-related vacancies remain unfilled, with employers frequently citing a lack of practical skills, innovative problem-solving abilities, and familiarity with collaborative digital tools among recent graduates. Key competencies in areas such as AI, cloud computing, and cybersecurity are particularly scarce, reflecting a mismatch between educational offerings and labor market needs.

Demographically, young people from disadvantaged regions face greater barriers to entry into the ICT sector due to limited resources and infrastructure. Gender gaps also persist in STEM-related VET education, with women underrepresented in ICT programs, highlighting the need for targeted outreach and re-skilling initiatives.



Conclusion: Competencies, Validation, and Recommendations



The research highlights that Serbia's VET system is not yet fully aligned with the dynamic needs of the ICT labor market. While progress has been made through initiatives such as the Digital Skills Development Strategy and Pro-VET, there is an urgent need to shift focus from infrastructure improvements to pedagogical innovation and skills validation.

Recommendations:

1. Develop ICT VET programs to prioritize practical skills in AI, VR/AR, and cybersecurity while integrating green technology applications relevant to Serbia's economic landscape, such as sustainable energy systems and digital agriculture.
2. Create modular training opportunities with stackable certifications, allowing students to progressively build expertise in areas like cloud computing, ethical AI, and digital media design.
3. Establish peer mentorship networks and workshops where teachers can share expertise and experiment with tools like VR labs, gamified learning, and blended teaching methodologies.
4. Partner with Serbian tech hubs and global IT companies to co-host innovation challenges and provide internships that immerse students in solving real-world digital problems.
5. Launch specialized ICT education programs tailored to the needs of rural areas, equipping these communities with the technology and skills to participate in Serbia's growing digital economy.
6. Develop mentorship programs for young women in STEM, paired with scholarships or grants for ICT education, to address systemic underrepresentation in the sector.

Serbia's VET system has made progress in improving infrastructure, but there's still a need to focus more on updating teaching methods and course content. By working closely with businesses, improving access to education in all regions, and offering practical training in important areas like digital skills and green technologies, Serbia can better prepare its youth for jobs in the modern economy. These changes will help reduce unemployment and build a stronger and more inclusive future for everyone



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Spain



Digital Education Trends in Spain's Vocational Education and Training (VET) Sector

Abstract



SPAIN



This report examines the main trends shaping digital education within Spain's Vocational Education and Training (VET) sector, with a focus on technological innovation, sustainability, and youth employment. The analysis is based on a mixed-methods approach combining desk research, labor market data, and policy review. It investigates the integration of digital tools—such as Artificial Intelligence (AI), Virtual and Augmented Reality (VR/AR)—into VET curricula, alongside the institutional expansion of specialized programs and infrastructure, like Aulas ATECA.

The study identifies a growing alignment between VET and labor market demands, as well as significant advances in digital pedagogy and program diversification. However, it also reveals persistent gaps, particularly in teacher training and the development of dedicated e-learning creation programs. While youth unemployment shows a declining trend, it remains one of the highest in the EU, especially among young women, underscoring the need for inclusive policy interventions.

The report concludes with a set of targeted recommendations aimed at strengthening the digital capacity of Spain's VET system. These include expanding modular and flexible learning formats, fostering public-private collaboration, and enhancing gender equity in digital education. The findings contribute to the broader debate on how vocational training can drive sustainable and inclusive economic transformation.



Keywords: Vocational Education and Training (VET), digital education, Artificial Intelligence, sustainability, labor market, Spain, youth employment, ICT, eLearning, educational innovation

Introduction

Spain's Vocational Education and Training (VET) sector is undergoing significant transformation, shaped by rapid digitalization, sustainability imperatives, and evolving labor market demands. In the 2023–2024 academic year, over 1.13 million students enrolled in VET programs, reflecting a 35.3% increase over five years. This growth signals not only increased student interest, but also a wider institutional and political effort to modernize vocational education.

Digital technologies - particularly Artificial Intelligence (AI), Virtual and Augmented Reality (VR/AR), and digital learning platforms - are being integrated into VET as part of broader reforms linked to Spain's Digital Agenda and the Recovery, Transformation and Resilience Plan. Simultaneously, VET is being positioned as a key driver for a more sustainable and inclusive economy, aligning training programs with environmental and social priorities.

This report examines these intersecting trends through desk research, labor market data, and a policy review. It explores how digital innovation is reshaping VET, identifies structural gaps - especially in teacher training and e-learning content creation - and assesses how well the system prepares young people for employment in a changing economy.



METHODOLOGY



The report is based on a three-pronged methodology:

- **Desk Research:** Reviewed national education portals and statistical bulletins to assess ICT-related VET programs.
- **Labor Market Analysis:** Used national data (INE, EPA) and sector-specific studies to identify employment trends for VET graduates.
- **Policy Review:** Evaluated initiatives such as the Digital FP Plan and the Modernization Plan of VET aligned with the EU Recovery and Resilience Facility (RRF).

Market Analysis: Trends in Digital Education in Spain VET Sector



Digital transformation is reshaping vocational education in Spain. In the 2023–2024 academic year, more than 1.13 million students enrolled in VET programs—a 35.3% increase over five years. Growth has been especially strong in private and online education, with non-subsidized private VET expanding by 468% and distance learning by nearly 3,000%. These figures point to rising demand for more flexible and technologically integrated training pathways.

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Emerging technologies such as Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) are increasingly being incorporated into VET programs. AI facilitates personalized learning through adaptive systems and automated feedback, while the growing relevance of prompt engineering highlights the importance of digital interaction skills in the labor market. These tools are not only changing what students learn, but also how they learn.

To support this integration, the Spanish government has introduced over 1,200 Aulas ATECA—advanced classrooms equipped with 3D printers, VR/AR devices, and industry-standard software. These spaces enable students to gain hands-on experience with cutting-edge technologies in simulated work environments. Aulas ATECA are funded by the Ministry of Education and Vocational Training and co-financed by the European Union through the NextGenerationEU fund, within the national Recovery, Transformation and Resilience Plan.

Sustainability is also being integrated as a core element of VET reform. Publicly funded innovation projects are promoting the development of green skills and digital responsibility. However, challenges remain. Many VET teachers lack sufficient training in the use of new technologies, and there is still no formal program dedicated specifically to the development of e-learning content. Addressing these gaps will be essential to ensuring that digital education in VET is both inclusive and future-oriented.

ICT VET Programs and Gaps in eLearning Development



Spain's VET system offers a wide and growing range of ICT-focused programs across different educational levels. At the basic level, students can begin with introductory training in computer systems and communications. Intermediate programs offer technical skills in microcomputer systems, networks, and IT support. At the advanced level, students specialize in software development, network administration, and telecommunications.

In recent years, new short-term specializations have emerged in cutting-edge areas such as Artificial Intelligence, Cybersecurity, Big Data, and Game Development, providing a more tailored response to evolving labor market needs. However, several important gaps have been identified in relation to digital learning content and pedagogy, which limit the full potential of these programs. These gaps reflect structural challenges in aligning educational content with current digital demands, particularly in the context of online and blended learning.

Identified Gaps:

- No dedicated VET program for e-learning content creation: Existing curricula do not cover the design and development of digital training materials in a comprehensive or structured way.
- Limited and uneven integration of digital pedagogy modules: Digital resource creation is included sporadically, with major differences between programs and regions.
- Insufficient teacher training in immersive and digital tools: Many instructors lack the practical and pedagogical skills to use AR/VR and digital platforms effectively in the classroom.
- Lack of standardized national guidance for digital instruction in VET: There is no coordinated framework to ensure digital competencies are systematically taught or assessed.

Closing these gaps will be crucial to improving the digital maturity of Spain's VET system. Investing in both program development and teacher training will help create a more adaptable, innovative, and resilient education model aligned with today's learning and employment environments.



Labor Market Dynamics and Youth Employment Trends



The relationship between vocational education and labor market integration in Spain is becoming increasingly relevant, particularly for young people. In 2023, 41.9% of job offers in Spain targeted candidates with VET qualifications, surpassing demand for university degrees (27.5%). Sectors such as services, IT, manufacturing, and automotive show especially high demand for VET graduates. This trend reflects a clear alignment between vocational training and the evolving structure of employment opportunities.

At the same time, the youth unemployment rate, though improving, remains a significant concern. By the end of 2024, unemployment among individuals aged 16 to 24 had dropped to 24.9%—the lowest level since 2008. This decline represents notable progress compared to 28.7% in 2023, driven in part by the creation of over 104,000 new youth jobs. However, despite these positive developments, Spain still ranks among the EU countries with the highest youth unemployment.

A closer look at employment dynamics reveals structural inequalities. While employment rose among young people in general, gains were unequally distributed. For example, 80% of new jobs for people under 25 were taken by men, while women represented only 37.6% of employed individuals aged 16–19 and 45% among those aged 20–24. In addition, more than 45% of new positions were occupied by young people with dual or foreign nationality, indicating a diverse but segmented youth labor force.

These patterns suggest the need for more targeted policies to ensure equitable access to employment and training opportunities. VET programs must not only reflect labor market demands but also actively address gender and social inclusion gaps. Future research should focus on how digital and sustainable competencies can enhance employability and how modular, work-based learning can support the integration of underrepresented groups into the workforce.



Conclusion: Competencies, Validation, and Recommendations



Spain's VET system is evolving in response to growing demands for digital and sustainable skills, as well as the need to improve youth employability. This report has highlighted the expansion of ICT programs, the integration of advanced technologies such as AI and VR, and the emergence of infrastructure like Aulas ATECA. However, it has also revealed structural gaps in teacher training, digital pedagogy, and e-learning content development. These limitations, combined with persistent inequalities in labor market access, underscore the need for coordinated action.

To strengthen the impact and relevance of VET, it is essential to ensure that digital and green competencies are not only taught but also validated through flexible, inclusive, and up-to-date learning pathways. This includes enhancing the quality of teaching, expanding practical learning opportunities, and aligning educational content with real labor market needs-especially in sectors driving Spain's digital and ecological transitions.

Recommendations:

1. Create specialized VET programs focused on e-learning content development, covering instructional design, multimedia production, and digital pedagogy.
2. Enhance teacher training in digital and immersive technologies, particularly in AR/VR integration and adaptive learning platforms.
3. Expand and update Aulas ATECA, ensuring their access in underserved regions and aligning their equipment with the latest industry standards.
4. Develop national guidelines for digital pedagogy in VET, to ensure consistency and quality in online and hybrid learning.
5. Promote gender equity in digital and technical fields, through targeted outreach, scholarships, and mentorship programs.
6. Strengthen public-private partnerships to co-develop training content, offer internships, and support innovation in VET curricula.
7. Introduce modular learning options and micro-credentials, making it easier for learners to upskill and reskill in line with labor market demands.

By addressing these areas, Spain's VET system can play a key role in building a workforce that is more inclusive, innovative, and resilient in the face of technological and economic change.



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CONCLUSION

**Comparative Analysis of Digital VET in
Croatia, Spain, and Serbia**

Introduction



Digital transformation and evolving labor market needs are driving reforms in Vocational Education and Training (VET) across Europe. This analysis compares three national VET contexts, Croatia, Spain, and Serbia, focusing on youth employment trends, ICT sector demand, the state of digital curricula in VET, gaps between skills supply and demand, and the need for innovative new programs. All three countries recognize that aligning VET with the digital economy is crucial for reducing youth unemployment and filling ICT skill shortages. However, each country's VET system is at a different stage of this transition, with Spain demonstrating significant advances in digital integration, and Croatia and Serbia working to close persistent gaps. The following sections examine these dimensions in each country and draw out comparative insights.

Labor Market Situation: Youth Employment and ICT Demand



Youth Unemployment: All three countries face challenges with youth unemployment, though severity varies. Spain continues to have one of the highest youth unemployment rates in the EU, despite recent improvements. By the end of 2024, Spain's youth unemployment rate fell to 24.9% (down from 28.7% in 2023) the lowest since 2008 yet it remains among the highest in Europe. Croatia's youth unemployment, at around 16.2%, also exceeds the EU average of ~14.5%. Serbia (an EU candidate country) similarly has high youth joblessness, about 21.5%, reflecting continuing difficulties for young people entering the workforce. Each country also exhibits internal disparities: for example, in Spain recent job gains for youth have primarily benefited young men (80% of new jobs for under-25s), and in Croatia and Serbia youth in rural or disadvantaged regions face higher unemployment due to limited access to quality training.

ICT Sector Demand: In all three economies, the ICT sector is growing rapidly and struggling to find enough skilled workers, indicating strong demand for VET graduates with digital skills. In Croatia, the ICT sector contributed 6.2% to GDP in 2022 and had over 9,000 ICT-related vacancies unfilled, as employers report that many graduates lack job-relevant competencies in areas like artificial intelligence (AI), cloud computing, and cybersecurity. Serbia's tech industry similarly reports 7,000+ unfilled ICT positions, pointing to a shortage of practical skills in emerging technologies among graduates.

Spain shows a somewhat different dynamic: thanks to an expanding VET system, 41.9% of all job offers in 2023 targeted candidates with VET qualifications, surpassing the share requiring university degrees. High-demand sectors include services, IT, manufacturing, and automotive, suggesting that Spain's labor market increasingly values vocationally trained talent for ICT and technical roles. Nevertheless, even in Spain the fast-paced growth of the digital economy (e.g. in AI and big data roles) creates continuous pressure to update skills supply. While Spain's labor market signals better alignment with VET output than Croatia's or Serbia's, all three countries experience a skills gap in ICT a simultaneous surplus of unemployed youth and a shortage of qualified tech workers underscoring the importance of modernizing VET programs to meet ICT sector needs.

State of Digital Curricula in VET



Curriculum Availability and Integration of Digital Skills: The extent and quality of digital content in VET curricula differ markedly across the three countries. Spain's VET system has undergone a substantial digital expansion in recent years. Enrollments have surged (over 1.13 million VET students in 2023–24, a 35% increase in five years), including rapid growth in online and private VET offerings, indicating demand for flexible, tech-oriented training. Spain has introduced new specialized programs at various levels from basic IT systems to advanced tracks in software development, AI, cybersecurity, big data, and game development to keep pace with industry trends. It has also invested heavily in digital infrastructure for VET schools through initiatives like Aulas ATECA, creating over 1,200 advanced classrooms equipped with 3D printers, VR/AR devices, and other industry-grade technologies. These “smart classrooms,” funded via the EU Recovery Plan, give Spanish VET students hands-on experience with emerging tech in simulated work environments. By contrast, Croatia and Serbia have more limited integration of cutting-edge digital skills in their VET curricula. In Croatia, a review of ICT-related VET programs (2023) found 15 nationally recognized ICT programs (e.g. in multimedia, IT, software, telecom), but only 4 out of 15 explicitly include e-learning design or development content. Most courses still emphasize traditional programming and IT skills without covering modern digital content creation or interactive learning design. Likewise, Serbia identified 12 ICT VET programs, of which only a small fraction incorporate any training in e-learning development; the majority remain focused on conventional software and networking skills. Both Croatia and Serbia also show minimal coverage of emerging technologies (AI, VR/AR, machine learning) in standard VET curricula, aside from a few isolated pilot projects or partnerships.

Curriculum Quality and Relevance: All three countries face the challenge of ensuring that digital curricula remain relevant to fast-evolving industry needs. Spain’s approach has been proactive: aligning many of its new VET programs with labor market demand (e.g. specialized short courses in AI or cybersecurity) and upgrading teaching facilities. This has improved the overall relevance of Spanish VET content to real-world jobs. However, even in Spain, gaps in digital pedagogy persist. Notably, there is no dedicated VET program for e-learning content creation skills in instructional design and online course development are not systematically taught. Integration of digital teaching modules varies by region and program, and many teachers have insufficient training in using new technologies like AR/VR or adaptive learning platforms. In Croatia and Serbia, the quality of digital training is hampered by similar issues. Both countries have made strides in providing hardware and connectivity to schools (e.g., Croatia’s e-Schools initiative modernized IT infrastructure nationwide, and Serbia’s Digital Skills Development Strategy equipped many schools with ICT tools). Yet pedagogical innovation lags behind infrastructure. Croatian teachers often lack exposure to advanced e-learning tools (e.g. learning management systems or content authoring software), which “imped[es] scalable eLearning adoption. In Serbia, teacher upskilling programs (such as the EU-supported Pro-VET project) have begun addressing this, but many educators still lack familiarity with modern instructional design and digital pedagogy methods. The relevance of curricula is therefore uneven: traditional IT skills are taught, but training in how to apply these skills in new digital workplaces (collaborative online environments, virtual simulations, etc.) is limited. Spain’s VET curriculum is the most diversified and digitally enriched of the three, while Croatia and Serbia are still in earlier stages of incorporating advanced digital content. However, all three need to improve certain qualitative aspects especially teacher training and inclusion of e-learning design to ensure VET programs fully reflect the competencies demanded by today’s digital economy.

Gaps Between VET Offerings and Labor Market Demands



Each country’s analysis points to a skills mismatch between VET education and labor market needs in the ICT and digital domains. Despite progress, none of the three VET systems is fully aligned with industry requirements. A common gap is the lack of training for emerging digital roles. For example, e-learning content developers or “eLearning Architects” specialists who design and produce online learning materials – are increasingly needed as education and corporate training go digital. Yet, as noted, Spain, Croatia, and Serbia do not currently offer dedicated VET programs for e-learning design. This is symptomatic of a broader lag in curriculum renewal.

Skill Mismatches: In Croatia, emphasis in VET reform has been on digital infrastructure rather than updating curricula, resulting in a mismatch between what students learn and what employers need. Employers report new graduates often lack hands-on experience with current technologies and creative problem-solving skills for the ICT workplace. The data show that 45% of ICT graduates lack job-relevant competencies, particularly in areas like AI, cloud computing, and cybersecurity. Similarly, Serbia's VET graduates often fall short of industry expectations: companies note deficits in practical skills and familiarity with collaborative digital tools. Key fields such as AI and cybersecurity are underrepresented in course offerings, contributing to scarcity of those skills in the labor pool. Spain appears to have the narrowest skills gap, thanks to recent reforms – the high share of job postings seeking VET graduates suggests many VET alumni do meet labor needs. Still, Spain's report uncovered structural gaps in teacher training and digital pedagogy that can limit the effectiveness of otherwise strong programs. Without sufficient teacher expertise in new technologies, even well-designed curricula may not translate into skilled graduates. Another issue in Spain is ensuring inclusivity: with women and certain socio-demographic groups underrepresented in tech-related VET jobs, there is an untapped supply of talent. Thus, across all three countries, VET systems need to better anticipate and respond to the digital skill demands of employers. Common areas for improvement include integrating cutting-edge tech topics (AI, VR/AR, machine learning) into curricula, strengthening practical training (through labs or work-based learning), and improving teachers' capacity to deliver modern digital content.

Systemic and Structural Gaps: The misalignment also has systemic roots. Each country's reports highlight that coordination between VET institutions and industry can be improved. Spain has made headway via public-private collaborations (e.g. involving companies in Aulas ATECA and curriculum design), but Croatia and Serbia particularly note the need for stronger industry partnerships. Additionally, none of the countries yet has a standardized national framework for digital competencies in VET, which leads to uneven coverage of essential skills. Spain's report suggests establishing national guidelines to ensure consistency in teaching digital and sustainable competences across programs a recommendation that could well apply to Croatia and Serbia as well. Lastly, social inclusion gaps (gender, regional disparities) indicate that VET offerings are not fully reaching or benefiting all segments of youth. In Serbia and Croatia, rural students have less access to advanced VET options, while in Spain and Serbia women remain underrepresented in ICT VET fields. These gaps between VET systems and labor market needs, whether in specific skills or in equitable access, highlight areas where innovative solutions are required.

Need for New and Innovative VET Programs



All three reports converge on the imperative to develop new, forward-looking VET programs to address emerging skill needs. This includes updating existing curricula and introducing entirely new training pathways. A prominent example is the call for VET programs specializing in digital instructional design and e-learning development essentially creating “**eLearning Architect**” roles. Spain’s recommendations explicitly propose establishing a specialized VET program in e-learning content development, covering instructional design, multimedia production, and digital pedagogy. Such a program would directly target the current void in training for those who create online education/training resources. Croatia’s recommendations similarly emphasize curriculum modernization by adding modules on AI, VR/AR, cybersecurity, and sustainability across ICT programs as well as implementing micro-credentials to certify skills in niche areas like green IT and digital teaching methods. This micro-credentialing approach would allow learners (and workers needing upskilling) to acquire specific digital competencies more flexibly, reflecting a trend toward modular learning also noted in Spain. Serbia advocates for modular training with stackable certifications to build expertise incrementally in cloud computing, ethical AI, digital media, etc., which would make the VET system more responsive to fast-changing technology trends. Additionally, Serbia highlights the need for special programs tailored to under-served groups and regions for instance, bringing ICT education to rural communities (through targeted initiatives and investment in local training centers), and mentorship programs for young women in STEM to boost female participation.

Innovative pedagogy and partnerships are also part of the solution space. All three countries see value in strengthening public-private partnerships to keep curricula relevant and provide work-based learning. For example, working with tech companies to co-design courses, offer internships, or set up innovation challenges for students is recommended for bridging the education-employment gap. Upgrading teacher skills is another universal priority: proposals include intensive training in AR/VR and adaptive learning platforms (**Spain**), peer-led teacher workshops and exchanges (**Serbia**), and EU-funded professional development in digital pedagogy (**Croatia**). These measures aim to ensure that new VET programs are delivered effectively by instructors who are comfortable with innovative tools and methods. In sum, the future direction for VET in Croatia, Spain, and Serbia involves creating flexible, technology-rich learning pathways aligned with new job roles. Whether through an “eLearning Architect” program or other emerging specializations, the focus is on anticipating the next generation of skills (like designing virtual training experiences, managing AI tools ethically, or implementing green tech solutions) and embedding them into the VET ecosystem.

Comparative Conclusion



Croatia, Spain, and Serbia are all striving to adapt their **VET systems to the digital era**, with the twin goals of boosting youth employment and satisfying ICT sector demand. Spain has achieved notable progress with broad VET expansion, advanced tech integration (e.g. Aulas ATECA), and closer alignment to labor market needs reflected in high employer demand for VET graduates. However, Spain still contends with structural issues such as exceptionally high youth unemployment and gaps in training for digital pedagogy and content creation. Croatia and Serbia, while smaller in scale, face similar challenges: their VET curricula have not kept fully up-to-date with rapid technological change, contributing to persistent skill mismatches (e.g. shortages in AI, cybersecurity, and practical e-learning skills) and continued youth joblessness above the European average. All three countries recognize that innovative reforms are needed to bridge these gaps. This includes revising curricula to incorporate emerging digital and green skills, improving the quality of teaching through targeted upskilling, and fostering partnerships with industry to ensure training content remains relevant. Crucially, the introduction of new **VET programs** for emerging roles such as e-learning developers, digital transformation specialists, or other ICT niche experts is seen as a way to future-proof the workforce. By developing such programs (along with modular credentials for lifelong learning), VET systems can more quickly adapt to evolving labor market demands.

Comparatively, Spain's VET system currently leads in modernization and labor market alignment, whereas Croatia and Serbia are in earlier phases of transformation. Nonetheless, the direction of change is common: all three are moving toward VET models that emphasize digital competencies, flexibility, and inclusivity. If these reforms are effectively implemented, the impact could be significant. Better-aligned VET programs would help reduce youth unemployment by equipping young people with in-demand digital skills and making them immediately productive in the workplace. In the long term, such alignment contributes to economic growth and innovation. Spain's case already shows how investment in VET can support broader economic resilience. For Croatia and Serbia, accelerating VET innovation is also key to meeting EU expectations and ensuring their youth are not left behind in the digital economy. In conclusion, while challenges remain, the concerted focus on bridging the gap between education and employment in the ICT domain positions these countries to cultivate a skilled, adaptable, and competitive workforce for the future. Achieving this will require sustained commitment to curriculum innovation, teacher development, and partnership with the tech industry, thereby turning VET into a driver of sustainable and inclusive growth across all three societies.



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