

# Integrate Technologies for the Teaching and Learning Model

Subjects: Computer Science, Hardware & Architecture

Contributor: Santiago Criollo-C, Jaime Govea, Washington Játiva, Jose Pierrottet, Andrea Guerrero-Arias, Ángel Jaramillo-Alcázar, Sergio Luján-Mora

Online, distance, and hybrid study modalities, due to the isolation caused by the pandemic, had an incredible surge. It has been a challenge for higher education institutions to adapt to these changes due to the new educational needs and the digital culture of the new generation of students.

Keywords: education ; innovative learning ; learning models ; automation ; Phyton ; web application

---

## 1. Introduction

During the last decade, higher education has undergone significant changes marked by the development of technology and its influence on the new generation of students <sup>[1][2]</sup>. Current educational models have introduced innovative practices using digital technologies to enhance traditional education methodologies <sup>[3]</sup>. An example of this are the academic models that use blended learning, e-Learning, and mobile learning, as well as continuous and ubiquitous education initiatives and programs such as MOOCs, online classes, the use of mobile educational applications, augmented reality, virtual reality, web applications, etc. <sup>[4]</sup>. These models, being new and innovative, reveal a deficiency in learning; the causes of this deficiency can be associated with factors such as educational modality, educational materials and resources, learning challenges, and assessment methods <sup>[5]</sup>. In a traditional modality, the teacher becomes the main actor of learning; they are the one who defines what and how students learn in the classroom, which is a controlled environment <sup>[6]</sup>. By eliminating the environment and the control that the teacher exercises over the group, problems increase, especially when the resources, activities, and methods of the face-to-face model are not adapted to the new modality <sup>[7]</sup>. These factors cause a lack of interest in the student, who by not having the physical presence of the teacher, avoids their participation, which can create gaps in learning that are difficult to identify until they become problems such as academic dropout <sup>[8]</sup>.

Online, distance, and hybrid study modalities, due to the isolation caused by the pandemic, had an incredible surge <sup>[9]</sup>. It has been a challenge for higher education institutions to adapt to these changes due to the new educational needs and the digital culture of the new generation of students <sup>[10]</sup>. This adaptation can generate indicators, which must be properly addressed for a correct deployment in the implementation of new strategies and methodologies that use digital technologies in the educational context <sup>[11]</sup>. In addition, this need for the use of digital technologies in education arises from the new educational modalities and technological contexts in which students and their new learning needs are included <sup>[12]</sup>. Nowadays, the use of technology plays an important role in education, and an educational model that is shaped using digital technologies and emphasizes student-centered learning activities is possible <sup>[4][13]</sup>. The learning process using digital technologies can provide students with a self-paced learning environment <sup>[14]</sup>. In this way, students can learn according to their learning ability. In addition, it has been shown in several empirical studies that the use of technology can improve academic performance in students <sup>[15]</sup>.

Nowadays, the development of technological skills in the educational context is a priority in formal education from early learning to higher education <sup>[16]</sup>. All this must go hand in hand with teacher training and professional development, which involves identifying the role of the teacher and the student to transform the learning environment <sup>[17]</sup>. These skills and innovative educational models supported by emerging technologies contribute directly to the fourth Sustainable Development Goal (SDG) <sup>[18]</sup>. This goal seeks to improve access to quality education and thus ensure the sustainable development of countries <sup>[19]</sup>.

## 2. Emerging Digital Technologies in Education

Today's education has become one of the biggest challenges; in many countries, teachers face material shortages, lack of content, lack of equipment, and lack of opportunities for self-directed learning <sup>[20]</sup>. To address these challenges, educators are turning to the use of digital technologies to help improve the quality of teaching and learning <sup>[21]</sup>. The integration of technology in education can give way to the creation of educational models in online, face-to-face, blended, and hybrid modalities <sup>[7]</sup>. It is for this reason that the use of technology in education has the potential to reach people living in remote places, in conditions of vulnerability, and where there are no educational institutions, teachers, or libraries <sup>[22]</sup>. Therefore, it is expected that in the future, the use of digital tools will become the basis for the creation of new and innovative learning environments <sup>[23]</sup>.

Higher educational institutions have several challenges to address for the deployment of digital technologies in education, but undoubtedly, a point in favor is the new generations of students <sup>[12]</sup>. Digital natives have a new way of accessing knowledge; they are technologically advanced, and this contributes to the use of technologies in the educational model <sup>[10]</sup>. In recent years, initiatives have been developed using digital technologies as a support in the educational model <sup>[15]</sup> <sup>[24]</sup>. Some works use mobile applications for learning indigenous languages to preserve the culture of a country <sup>[25]</sup>. Another example is the use of augmented reality (AR) for learning enhancement in higher education <sup>[15]</sup> <sup>[26]</sup> <sup>[27]</sup>. Virtual reality has also been used in the educational context to create immersive educational environments so that students can observe how knowledge can be applied <sup>[28]</sup> <sup>[29]</sup> <sup>[30]</sup>. In recent years, the concept of gamification has become relevant in education through gamification <sup>[1]</sup>. Motivation, entertainment, and competition mean that this digital technology is being used in the educational environment with very encouraging results regarding learning <sup>[1]</sup> <sup>[31]</sup> <sup>[32]</sup>.

Whether a technology is considered emergent depends on where it is being used, the domain and knowledge of its operation, and the application given to it <sup>[33]</sup>. An important characteristic of these technologies is that they do not need to have a limited life, even when they have been used for a long period of time. They can begin to become emerging when they are used in innovative ways in the service of people to achieve their objectives <sup>[34]</sup> <sup>[35]</sup>. Emerging technologies for education (ELTs) are those that are being incorporated into education, which favor communication and allow easy access to educational information <sup>[36]</sup>. Some of the ELTs that contribute to an innovation system in higher education are mobile learning, MOOCs, social networks, gamification, augmented reality, virtual reality, and web applications <sup>[14]</sup> <sup>[33]</sup>. The use of ELTs is quite diverse, for example, one research proposes the use of smartphones to run educational applications and contribute to improving the quality of teaching and learning. In addition, the author indicates that the use of mobile learning helps to compensate for the lack of infrastructure and the scarcity of school supplies and books in the place where the research was conducted <sup>[37]</sup>. They are also used for learning English as a second language for native speakers of Chinese <sup>[38]</sup>. One of the most widely used digital technologies is web pages which, depending on their design, can store information, generate educational games, serious games, manage learning resources, and automate processes, etc. <sup>[39]</sup> <sup>[40]</sup> <sup>[41]</sup>.

### **3. Literature Review on Network Automation**

Network automation is performed using software, which automatically performs the configuration, provisioning, management, and testing of data network devices <sup>[42]</sup>. This technology is used by organizations and service providers seeking to improve the efficiency of their network management and administration processes <sup>[43]</sup>. In addition, using network automation can reduce human errors and operational expenses involved in existing manual configuration <sup>[42]</sup> <sup>[44]</sup> <sup>[45]</sup>. Network automation tools can perform simple jobs such as basic network mapping or much more complex jobs such as managing and evaluating the configuration of a technology infrastructure and provisioning resources needed for a virtual network <sup>[44]</sup>. Automation can be used in any type of network—for example, a local area network (LAN)—and even encompasses a wide area network (WAN). In addition, it can be used in data centers, in the cloud, and in wireless networks; that is, any network equipment that uses the command line interface (CLI) or an application programming interface (API) can be automated <sup>[42]</sup>. In recent years, as organizations have begun to digitally transform, their technology infrastructure has become much more complex, which has made way for new open-source programming languages, such as Python and Ruby, which have gained popularity for their ease of use and flexibility of work <sup>[42]</sup> <sup>[46]</sup> <sup>[47]</sup>.

#### **3.1. Network Automation Benefits**

Some of the benefits associated with network automation are as follows:

- Reduce operational expenses. By eliminating manual tasks, network equipment provisioning, and management can be improved, allowing organizations to operate in an agile and efficient manner <sup>[44]</sup>.
- Low probability of human error. Manual configurations bring with them errors, which can be quickly propagated in the network, and this can have significant consequences. This can be avoided if the task is automatically configured properly only once <sup>[42]</sup> <sup>[44]</sup>.
- Improves network efficiency. Automating the configuration processes in a technological infrastructure immediately improves network efficiency, as there is no need to perform time-consuming manual tasks <sup>[44]</sup>.
- Improves network performance. Without the need for disruption from manual network configuration, organizations can offer and deliver a higher level of services consistently <sup>[46]</sup>.
- Improves monitoring. Automation allows better control of the network, making it adaptable to specific needs. In addition, it allows for greater capacity and response to changes and better resolution of incidents and problems <sup>[44]</sup>.

#### **3.2. Network Automation Tools**

For configuration automation in data network equipment, there are several platforms and protocols, based on scripts and software. These tools are open source, and examples of them are Ansible, Chef, and Puppet <sup>[48]</sup>. These tools offer an automation model and provide a library of common commands or workflows that can be easily used <sup>[45]</sup>.

In recent years, automation has been used in the configuration of networking equipment. Software-based platforms have been developed that offer automation capabilities that work only with specific brands of networking equipment and use a specialized API [42][44][49]. All these tools simplify the amount of work and eliminate repetitive processes in the configuration of IT infrastructure equipment [50]. Some initiatives use Python libraries to perform data network automation, but these automation tools were not created for educational environments [44][46][51]. Examples include the web tool called Network Configuration Manager, which automates backups, monitoring, and change management, thus improving the productivity and reliability of the enterprise data network [52]. Another available web tool is Ansible Automation, which is used to install system software, automate daily tasks, prepare internal infrastructure, and improve data network security [45]. Mazin, et al. [51] in their research shows positive results regarding the efficiency of using automation in network equipment configuration versus using CLI, but their results were not analyzed in an educational environment with students.

Other network automation initiatives using emerging technologies include “Implementación de un sistema para la administración de las funciones básicas de un Cisco Meraki MR33 mediante Cisco Devnet y Amazon Alexa en el Data Center académico de la Universidad de las Américas”. Its objective was to implement a system for the administration and management of the functionalities of Cisco Meraki equipment through Cisco DevNet Sandbox and Amazon Alexa, using Python as a tool for the migration of the UCS admin system [53]. In “Network Automation and Abstraction using Python Programming Methods”, a network was simulated in the GNS3 simulator with an Ubuntu container in Docker to run the Python scripts. Netmiko and Paramiko libraries were used to perform virtual network configuration, routing protocols, and backup configuration independently of the network equipment vendor [46]. The goal of “Diseño e implementación de un agente de administración, configuración y monitoreo para dispositivos de red Cisco” was achieved by using functions that enable serial communication between the computer running the program and the network equipment to which it is connected [54].

## 4. Web Application to Automate the Configuration of Networking Equipment

To achieve the objectives of this research, an educational web application was designed and built, which contains a GUI for the automated configuration of equipment in a data network or technological infrastructure.

### 4.1. Programming Languages and Frameworks

The tools listed in **Table 1** were used to develop the web application.

**Table 1.** Tools used to develop the web application.

Programming Language/Framework	Definition
Python	It is a computer programming language that is often used to create websites and software, automate tasks, and perform data analysis. Python is a general-purpose language, which means that it can be used to create a variety of programs for different purposes [42][55].
WTForms	It is a flexible form validation and rendering library for web development in the Python programming language. This library can work with any web framework and any template engine of choice [56].
Netmiko	It is a multivendor Python library that facilitates the process of connecting to network devices through the SSH protocol, allowing better management and administration of network equipment through programs or scripts. In addition, it works with a variety of equipment—for example, Arista vEOS, Cisco ASA, Cisco IOS, Cisco IOS-XR, Cisco SG300, HP Comware7, HP ProCurve, Juniper Junos, and Linux Servers [57].
Flask	It is a framework for a lightweight web application that is developed for easy deployment. Moreover, it is scalable for complex applications, making it one of the most popular Python web application frameworks. Flask makes it easy for the developer to freely choose the tools and libraries he needs [58].
Jinja	It is a modern templating language for Python developers. It is used to create HTML, XML, or other markup formats that are returned to the user via an HTTP request [59].
Bootstrap	It is a giant collection of practical and reusable bits of code written in HTML, CSS, and JavaScript. Additionally, it is a front-end development framework that allows developers and designers to quickly create fully responsive websites [60].

### 4.2. Configuration Modes in Network Equipment

The executable file Putty with an SSH client is used for secure access to communication equipment and input and output peripherals (monitor and keyboard). This tool allows securely connecting to remote servers and communication equipment through a serial session allowing remote administration of equipment within a data network [61].

The Internetwork Operating System (IOS) is the software used by most Cisco-branded equipment [62]. It is responsible for the management of interfaces, resources, routing, routing, quality of service (QoS), security, etc. There are several modes

of operation for configuration through the CLI, which are hierarchically structured, and each of them allows specific tasks. The IOS configuration modes are hierarchically defined as follows:

- User mode (User EXEC)
- Privileged execution mode (Privileged EXEC)
- Global configuration mode
- Specific configuration modes

To automate the network configurations, Cisco IOS commands were used to manually configure the protocols and services.

**Table 2** shows the commands that should be configured manually through the CLI and which were automated to be configured more easily through the graphical interface of the designed application.

**Table 2.** Commands used for configuration using the CLI.

Basic Commands to Monitor the Initial Configuration of the Equipment		
Equipment Configuration Mode	Command for the CLI	Command for the CLI
router#	show running-config	These commands are used to display data related to the current configuration of the equipment, such as protocols and VLANs, among others.
	show versión	
	show protocols	
	show vlan	
	show ip interface brief	
	show ip route	
	show access-list	
router(config)#	IPv4 addressing configuration	
	interface type number	These commands are used to assign an IP address to the interface of a network computer.
	ip address ip address mask	
	no shutdown	
	DHCP protocol configuration for dynamic IPv4 address allocation	
router(config)#	ip dhcp pool pool name	With these commands you can configure a network computer as a DHCP server.
	network ip mask	
	domain-name domain name	
	dns-server server ip	
router(config)#	Configuration of dynamic routing protocols, RIP, RIPv2 and OSPF	
	router ospf ospf id	These commands can be used to configure the OSPF protocol on the routers.
	router-id router id	
	network ip wildcard area	
	router(config)#	router rip
versión 2		
network ip address		
no auto-summary		
switch(config)#	Creating and configuring a virtual LAN (VLAN)	
	vlan vlan id	These commands are used to create VLANs with their respective names on the computers.
	name vlan name	
Configuring security on layer two communication equipment ports on the switch		

Basic Commands to Monitor the Initial Configuration of the Equipment			
Equipment Configuration Mode	Command for the CLI	Command for the CLI	
switch(config)#	interface type number	These commands are used to configure layer two port security on network equipment.	
	switchport mode access		
	switchport port-security		
	switchport port-security maximum MAC address number		
	switchport port-security mac-address sticky		
router(config)#	switchport port-security violation shutdown   restrict   protect	With these commands you can create a new user on a network computer.	
	Initial configuration of a layer three equipment, the router		
	username username password password		
	Username username privilege level		
Static routing configuration for communication between different data networks			
router(config)#	ip route network-ip network mask next hop ip	These commands are used to create a static route to another network.	

**Figure 1** shows the Python code of the application designed for configuring virtual local area networks (VLANs). A VLAN is a collection of network devices or nodes that communicate with each other as if they form a single local area network, but each VLAN is a different network <sup>[44]</sup>. VLANs are used to segment enterprise networks and divide broadcast domains. To configure VLANs, communication equipment must support the IEEE8202.1Q standard.

```
@app.route('/vlan', methods = ['GET', 'POST'])
@login_required
def vlanPage():
    output = ''
    vlan_form = VlanForm()
    if vlan_form.validate_on_submit():
        try:
            output = createVlans(ip_address=vlan_form.ip_address.data,
                                username=vlan_form.username.data,
                                password=vlan_form.password.data,
                                vlan_numbers=vlan_form.vlan_numbers.data,
                                vlan_names=vlan_form.vlan_names.data)
            flash('Successful configuration!', category='success')
        except ssh_exception.NetmikoTimeoutException:
            flash('Can not connect to the specified device', category='danger')
        except ssh_exception.NetMikoAuthenticationException:
            flash('Incorrect username/s or password/s', category='danger')
    if vlan_form.errors != {}:
        for errorMsg in vlan_form.errors.values():
            flash(f'There is an error within the configuration data: {errorMsg}', category='danger')
    return render_template('vlan.html', form=vlan_form, config_output=output)
```

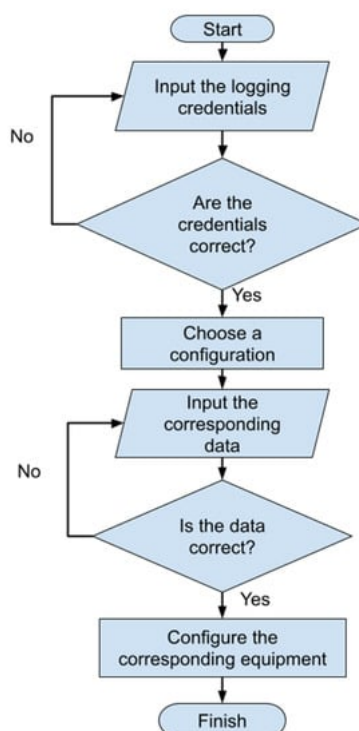
**Figure 1.** Path code for VLAN creation.

**Figure 2** shows the GUI presented to the user to enter the data required to create a VLAN using the developed web tool. The first field to fill in is the IP address of the computer where the VLAN is to be created. Next, a username and password are entered for the SSH connection to the computer. Next, you add the ID number corresponding to the number of VLANs you want to create. In addition, you add the name corresponding to each VLAN separated by a comma. Finally, to execute the configuration, click on “Submit” and verify that the execution was successful by checking the output screen. As shown in **Figure 2**, the GUI is user-friendly and very easy to use to achieve the necessary configurations in the proposed network. It is important to note that users need some knowledge of data networks and IP addresses to access the computers involved through SSH.

VLAN Configuration	
Device IP Address	192.168.10.40
Username	jaime
Password	•••••
VLAN numbers	10, 20, 30
VLAN names	soporte, finanzas, marketing
<input type="button" value="Submit"/>	

**Figure 2.** Configuration and testing for VLAN creation.

The operation of the web application can be summarized in the flow diagram presented in **Figure 3**. This diagram shows the functionality of the application and the steps required for the correct configuration of the network devices. It is important to note that the application ensures a level of security by requesting authentication for access to the configuration.



**Figure 3.** Application flowchart.

## References

1. Criollo-C, S.; Luján-Mora, S. Encouraging Student Motivation Through Gamification in Engineering Education. In *Mobile Technologies and Applications for the Internet of Things; Advances in Intelligent Systems and Computing*; Springer: Berlin/Heidelberg, Germany, 2019; Volume 909, pp. 204–211.
2. Traxler, J. Inclusion in an age of mobility. *Res. Learn. Technol.* 2016, 24, 18.
3. Cabero-Almenara, J.; Barroso-Osuna, J.; Llorente-Cejudo, C.; del Mar Fernández Martínez, M. Educational Uses of Augmented Reality (AR): Experiences in Educational Science. *Sustainability* 2019, 11, 4990.
4. Cantero, C.L.; Oviedo, G.B.; Balboza, W.F.; Fera, M.V. Tecnologías emergentes en el proceso de enseñanza-aprendizaje: Hacia el desarrollo del pensamiento crítico. *Rev. Electrónica Interuniv. De Form. Del Profr.* 2020, 23, 83–98.
5. Kassim, M.H.; Abdullah, F.; Sanusi, A.N.Z. Mobile Augmented Reality Learning: Design Exploration Toward Student Learning Trends. *Adv. Sci. Lett.* 2018, 24, 7890–7894.

6. Stroeve, O.A.; Zviagintceva, Y.; Tokmakova, E.; Petrukhnina, E.; Polyakova, O. Application of remote technologies in education. *Int. J. Educ. Manag.* 2019, 33, 503–510.
7. Oliveira, A.; Behnagh, R.F.; Ni, L.; Mohsinah, A.A.; Burgess, K.J.; Guo, L. Emerging technologies as pedagogical tools for teaching and learning science: A literature review. *Hum. Behav. Emerg. Technol.* 2019, 1, 149–160.
8. Drachsler, H.; Kirschner, P.A. Learner Characteristics. In *Encyclopedia of the Sciences of Learning*; Seel, N.M., Ed.; Springer: Boston, MA, USA, 2012; pp. 1743–1745.
9. Cortez, C.P. Blended, Distance, Electronic and Virtual-Learning for the New Normal of Mathematics Education: A Senior High School Student's Perception. *Eur. J. Interact. Multimedia Educ.* 2020, 1, e02001.
10. Dingli, A.; Seychell, D. *The New Digital Natives*; Springer: Berlin/Heidelberg, Germany, 2015.
11. Oyetade, K.E.; Zuva, T.; Harmse, A. Technology Adoption in Education: A Systematic Literature Review. *Adv. Sci. Technol. Eng. Syst. J.* 2020, 5, 108–112.
12. Prensky, M. Digital Natives, Digital Immigrants. In *On the Horizon*; MCB University Press: Bingley, UK, 2001; Volume 9, pp. 1–6.
13. Criollo-C, S.; Lujan-Mora, S. M-Learning and Their Potential use in the Higher Education: A Literature Review. In *Proceedings of the 2017 International Conference on Information Systems and Computer Science (INCISCOS)*, Quito, Ecuador, 23–25 November 2017; pp. 268–273.
14. Martin, F.; Dennen, V.P.; Bonk, C.J. A synthesis of systematic review research on emerging learning environments and technologies. *Educ. Technol. Res. Dev.* 2020, 68, 1613–1633.
15. Criollo-C, S.; Abad-Vásquez, D.; Martic-Nieto, M.; Velásquez-G, F.; Pérez-Medina, J.-L.; Luján-Mora, S. Towards a New Learning Experience through a Mobile Application with Augmented Reality in Engineering Education. *Appl. Sci.* 2021, 11, 4921.
16. Kozma, R.B. A Framework for ICT Policies to Transform Education. In *Transforming Education: The Power of ICT Policies*; UNESCO, the United Nations Educational, Scientific and Cultural Organization: Paris, France, 2003.
17. Gashi-Berisha, V.; Kamberi, N. Methodology of teaching literature with digital means. *Xlinguae* 2019, 12, 145–160.
18. United Nations. Sustainable Development Goals. 2015. Available online: <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> (accessed on 13 March 2023).
19. United Nations. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Available online: <https://sdgs.un.org/goals/goal4> (accessed on 25 November 2021).
20. Aseey, A.A.; Andollo, A.A. Electronic Mobile Devices, Transformative Pedagogy and Learning: Higher Education and Changing Times in Kenya. *J. Educ. Soc. Res.* 2019, 9, 54–61.
21. UNESCO. World Higher Education Conference. 2022. Available online: <https://www.unesco.org/en/higher-education/2022-world-conference> (accessed on 9 August 2022).
22. Godwin-Jones, R. Emerging Technologies: Autonomous language learning. *Lang. Learn. Technol.* 2011, 15, 4–11. Available online: <https://www.scopus.com/record/display.uri?eid=2-s2.0-80053537430&origin=inward&txGid=42a06e8a73d82f0615ce292cef0c3a6c> (accessed on 10 January 2023).
23. Kiadi, M.; Tan, Q. *Machine Learning: A Convergence of Emerging Technologies in Computing*; Springer, Faculty of Continuing Education and Training, Seneca College: Toronto, ON, Canada, 2018; Volume 723, pp. 181–192.
24. Tomaschko, M.; Hohenwarter, M. Augmented Reality in Mathematics Education: The Case of GeoGebra AR. In *Augmented Reality in Educational Setting*; Brill (NL): Leiden, The Netherlands, 2019; pp. 325–346.
25. Criollo-C, S.; Lema, M.; Gonzalez, M.S.; Jaramillo-Alcázar, A.; Guerrero-Arias, A.; Luján-Mora, S. Exploring the technological acceptance of a mobile learning tool used in the teaching of an indigenous language. *PeerJ Comput. Sci.* 2021, 7, e550.
26. Vargas, H.; Farias, G.; Sanchez, J.; Dormido, S.; Esquembre, F. Using Augmented Reality in Remote Laboratories. *Int. J. Comput. Commun. Control* 2013, 8, 622.
27. Lee, K. Augmented Reality in Education and Training. *Tech Trends* 2012, 56, 13–21.
28. Bekele, M.K.; Town, C.; Pierdicca, R.; Frontoni, E.; Malinverni, E.V.A.S. A Survey of Augmented, Virtual, and Mixed Reality. *J. Comput. Cult. Herit.* 2018, 11, 36.
29. *Virtual Immersive and 3D Learning Spaces: Emerging Technologies and Trends*; Kansas State University, United States, IGI Global: Hershey, PA, USA, 2010.
30. Craig Tranter. Virtual and Augmented Reality in Education-Cisco Blogs. 2017. Available online: <https://blogs.cisco.com/education/virtual-and-augmented-reality-in-education> (accessed on 20 January 2023).
31. Moreira, F.; Durão, N.; Pereira, C.S.; Ferreira, M.J. Mobile Learning with Gamification and Augmented Reality in Portuguese High Education. In *Proceedings of the 9th International Conference on Education and New Learning Technologies*, Barcelona, Spain, 3–5 July 2017; pp. 4263–4273.
32. Jaramillo-Alcázar, A.; Venegas, E.; Criollo-C, S.; Luján-Mora, S. An Approach to Accessible Serious Games for People with Dyslexia. *Sustainability* 2021, 13, 2507.

33. Bacos, C.A. Machine Learning and Education in the Human Age: A Review of Emerging Technologies; Springer, University of Nevada, Las Vegas: Las Vegas, NV, USA, 2019; pp. 536–543.
34. Halaweh, M. Emerging Technology: What is it? 2013. Available online: <http://www.jotmi.org> (accessed on 15 January 2023).
35. Rotolo, D.; Hicks, D.; Martin, B.R. What is an emerging technology? *Res. Policy* 2015, 44, 1827–1843.
36. Ley, D. Emerging technologies for learning. In *Web 2.0 and Libraries: Impacts, Technologies and Trends*; Elsevier Inc.: Becta, UK, 2010; pp. 123–168.
37. Zongo, R. Integration of emerging learning technologies in secondary school: A Burkina Faso case study. In *Proceedings of the 2014 International Conference on Collaboration Technologies and Systems (CTS)*, Minneapolis, MN, USA, 19–23 May 2014; pp. 639–640.
38. Gao, C.; Shen, H.-Z. Mobile-technology-induced learning strategies: Chinese university EFL students learning English in an emerging context. *Recall* 2020, 33, 88–105.
39. Luna, F. *Desarrollo Web Para Dispositivos Móviles: Herramientas Para Diseñar y Programar WebApps*; RedUsers: Buenos Aires, Argentina, 2016.
40. Olla, P.; Choudrie, J. Emerging Learning Technologies: Integrating Web2.0, Tablet PCs and Social Learning into Pedagogy. In *Proceedings of the 15th Americas Conference on Information Systems, AMCIS 2009*, San Francisco, CA, USA, 6–9 August 2009; Volume 1, pp. 311–314. Available online: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84870283683&partnerID=40&md5=bdf2cb87e2b7b07e1e0998a9250e117f> (accessed on 15 January 2023).
41. Saeed, N.; Yang, Y.; Sinnappan, S. Emerging Web Technologies in Higher Education: A Case of Incorporating Blogs, Podcasts and Social Bookmarks in a Web Programming Course Based on Students' Learning Styles and Technology Preferences. *Educ. Technol. Soc.* 2009, 12, 98–109. Available online: [https://www.researchgate.net/publication/211906563\\_Emerging\\_Web\\_Technologies\\_in\\_Higher\\_Education\\_A\\_Case\\_of\\_Incorporating\\_Blog](https://www.researchgate.net/publication/211906563_Emerging_Web_Technologies_in_Higher_Education_A_Case_of_Incorporating_Blog) (accessed on 15 January 2023).
42. Jambunatha, K. Design and implement Automated Procedure to upgrade remote network devices using Python. In *Proceedings of the 2015 IEEE International Advance Computing Conference (IACC)*, Bangalore, India, 12–13 June 2015; pp. 217–221.
43. Altalebi, O.W.J.; Ibrahim, A.A. Optimization of Elapsed Time of Automation for Large-Scale Traditional Networks and Proposing New Automation Scripts. In *Proceedings of the 2022 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA)*, Istanbul, Turkey, 9–11 June 2022; pp. 1–10.
44. Emiliano, R.; Antunes, M. Automatic network configuration in virtualized environment using GNS3. In *Proceedings of the International Conference on Computer Science and Education*, Cambridge, UK, 22–24 July 2015; pp. 25–30.
45. RedHat. Ansible Automation Platform. Available online: <https://www.ansible.com/products/automation-hub> (accessed on 24 October 2022).
46. Mihăilă, P.; Bălan, T.; Curpen, R.; Sandu, F. Network Automation and Abstraction using Python Programming Methods. *Macro* 2015 2017, 2, 95–103.
47. Ortiz-Garcés, I.; Echeverría, A.; Andrade, R.O. Automation Tasks Model for Improving Hardening Levels on Campus Networks. In *Proceedings of the 5th World Conference on Smart Trends in Systems Security and Sustainability*, London, UK, 29–30 July 2021; IEEE: Piscataway, NJ, USA, 2021; pp. 30–35.
48. Singh, N.K.; Thakur, S.; Chaurasiya, H.; Nagdev, H. Automated provisioning of application in IAAS cloud using Ansible configuration management. In *Proceedings of the 2015 1st International Conference on Next Generation Computing Technologies*, Dehradun, India, 4–5 September 2015; pp. 81–85.
49. Al-Mekhlal, M.; AlYahya, A.; Aldhamin, A.; Khan, A. Network Automation Python-based Application: The performance of a Multi-Layer Cloud Based Solution. In *Proceedings of the International Conference on Omni-Layer Intelligent Systems*, Barcelona, Spain, 1–3 August 2022; pp. 1–8.
50. Ji, Z. Engineering operation management technology based on network automation configuration visualization. *Int. J. Syst. Assur. Eng. Manag.* 2021, 12, 765–775.
51. Mazin, A.M.; Ab Rahman, R.; Kassim, M.; Mahmud, A.R. Performance Analysis on Network Automation Interaction with Network Devices Using Python. In *Proceedings of the 2021 IEEE 11th IEEE Symposium on Computer Applications & Industrial Electronics (ISCAIE)*, Penang, Malaysia, 3–4 April 2021; pp. 360–366.
52. ManageEngine. Network Configuration Manager. 2017. Available online: <https://www.manageengine.com/latam/network-configuration-manager/> (accessed on 24 October 2022).
53. Burgos, V.; Proaño, C. Implementación de un Sistema para la Administración de las Funciones Básicas de un Cisco Meraki mr33 Mediante Cisco Devnet y Amazon Alexa en el Data Center Académico de la Universidad de las Américas. 2020. Available online: <https://dspace.udla.edu.ec/handle/33000/13023> (accessed on 30 January 2020).
54. Vacas, C. Diseño e Implementación de un Agente de Administración, Configuración y Monitoreo para Dispositivos de Red Cisco. 2019. Available online: <https://dspace.udla.edu.ec/handle/33000/11555> (accessed on 5 January 2023).
55. Schwarz, J.S.; Chapman, C.; McDonnell Feit, E. Welcome to Python, Python for Marketing Research and Analytics. 2020. Available online: <https://www.python.org/> (accessed on 3 March 2022).



56. WTForms. Wtforms Documentation. 2019. Available online: <https://wtforms.readthedocs.io/en/stable/fields.html> (accessed on 31 March 2022).
57. What is Netmiko? Available online: <https://www.packetcoders.io/netmiko-the-what-and-the-why/> (accessed on 15 January 2023).
58. The Pallets Projects. Flask. 2010. Available online: <https://palletsprojects.com/p/flask/> (accessed on 15 January 2023).
59. Jinja. Documentation (3.0.x). 2007. Available online: <https://jinja.palletsprojects.com/en/3.0.x/> (accessed on 30 April 2022).
60. Ouellette, A. What is Bootstrap? An Awesome 2022 Beginner's Guide. 2021. Available online: <https://careerfoundry.com/en/blog/web-development/what-is-bootstrap-a-beginners-guide/> (accessed on 31 March 2022).
61. Sari, L.M.I.; Hatta, P.; Wihidayat, E.S.; Xiao, F. A Comparison between the Use of Cisco Packet Tracer and Graphical Network Simulator 3 as Learning Media on Students' Achievement. J. Pendidik. Teknol. dan Kejuru. 2018, 24, 132–136.
62. Carthern, C.; Wilson, W.; Rivera, N. Engineers' Handbook of Routing, Switching, and Security with IOS, NX-OS, and ASA; Springer: Berlin/Heidelberg, Germany, 2021.

---

Retrieved from <https://encyclopedia.pub/entry/history/show/120965>