

# Integration of Cisco certification programs on Computer Networks subjects

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**Abstract.** In today's labour market, companies greatly appreciate the possession of a certificate that validates the knowledge acquired during the university period. The Informatics department at the University of Almería has opted for the implementation of various certificates available for students in order to facilitate the employment of graduates. In this article, the positive developments in the implementation of Cisco certificates in subjects related to computer networks during the period between 2012 and 2014 is shown.

**Keywords:** Certificates · Cisco · Computer Networks · e-learning

## 1 Introduction

Electronic devices such as mobile phones, computers or last-generation televisions are interconnected through a network. Figure 1 shows the high number of transactions made on the Internet during sixty seconds.

In June 2014, Cisco released the complete VNI (Visual Networking Index) Global IP Traffic Forecast, 2013–2018. Global highlights from the updated study include the following projections:

- By 2018, there will be nearly four billion global Internet users (more than 51 percent of the world's population), up from 2.5 billion in 2013.
- By 2018, there will be 21 billion networked devices and connections globally, up from 12 billion in 2013.
- Globally, the average fixed broadband connection speed will increase 2.6-fold, from 16 Mbps in 2013 to 42 Mbps by 2018.
- Globally, IP video will represent 79 percent of all traffic by 2018, up from 66 percent in 2013

For more information, refer to the companion document “The Zettabyte Era – Trends and Analysis”. Cisco is a partner of the EU Grand Coalition for Digital Skills.

Installation and maintenance of such interconnection networks require knowledge that are highly valued by companies. One manner to demonstrate proficiency in this broad field of Information and Communications Technology (ICT)



Fig. 1. Things that happen on the Internet every 60 seconds

is through a document certifying the knowledge acquired during the university degree. In order to facilitate graduates of the University of Almería find a job, the institution has put the emphasis firmly on the introduction of certificates that provides an additional value to the university degree.

This work shows the experience of integrating the Cisco NetAcad training in subjects of different curricula at the University of Almería as supplementary and self-study material. The motivation is to reinforce the acquisition of competences in these study areas. A NetAcad local academy, called ATC-UAL (Arquitectura y Tecnología de Computadores - Universidad de Almería), has been established. For this purpose, several professors are training to become NetAcad instructors at the different levels that the academy offers. Professor and student training is not only a discipline with a high degree of renovation and adaptation of contents, but also concerned in the use of new teaching technologies used in e-learning of the new workspace provided by NetSpace.

This article follows the structure described next. In Section 2, the current state of the labour market with respect to the ICT will be presented. In Section 3, the certificate state in Spanish universities will be explained. Cisco certificate training will be introduced in Section 4. Section 5 will show the implementation of the Cisco certificate training at the University of Almería. The results and conclusions of this work will be provided in Sections 6 and 7 respectively.

## 2 Labour market from the ICT perspective

To show the current labour market situation, we will cite various reports in the press during 2014. On February 6th, *ABC* newspaper published that the profile most wanted by technology companies is the ICT engineer. Human Resources (HR) departments also put as an additional requirement the possession of an official certificate from entities such as Cisco, Microsoft or Adobe. ICT official certificate must be granted by any technology provider. The HR head of Hitic, Víctor Cruz, says that the most popular are those from Cisco, Microsoft, Adobe, VMware and Oracle as they are “companies that are providing network services and technology, providing security for the institutions which they collaborate with”. This title is gaining importance in recent times and there are HR departments that prioritize the possession of the official certificate of the manufacturer ahead even of the university career, as the study reveals. According to the *Adecco Professional* report related to 2013, the engineering, manufacturing and production area led the number of hirings in 2013, with 29 percent of hiring qualified profiles.

*Infoempleo* blog published on July 9th that ICT professionals are high demanded, even leading to a shortage of these according to European Commission reports. This demand is not limited to the European level, but occurs worldwide. According to a report on September 23rd in *El Economista* newspaper, a rise of 30 percent in demand for ICT professionals is predicted. This figure is part of the conclusions of the study by the AIEP Professional Institute, based on questions to executives from partner companies ACTI (Chilean Association of Information Technology), who revealed what the technology industry needs. One of the most demanded skills is the installation and maintenance of networks.

The rapid growth of networks has created a global shortage of people who are qualified to implement and maintain networking solutions, especially in places where networks are being built to foster economic development. At the same time, people need access to better training and career opportunities to successfully compete in the global economy [15]. Demand of qualified professionals in the ICT sector is getting larger in Europe due to the use in daily life of new technologies. The following quote is an extract of “A Digital Agenda for Europe”, a document written by the European Commission in 2010.

*Europe is suffering from a growing professional ICT skills shortage and a digital literacy deficit. These failings are excluding many citizens from the digital society and economy and are holding back the large multiplier effect of ICT take-up to productivity growth. This requires a coordinated reaction, with Member States and other stakeholders at its centre.*

As a sector, ICT is growing rapidly and creating about 120,000 new jobs each year. But due to differences in demands and skills, and despite high unemployment (especially among the young) Europe could face a shortage of up to 900,000 skilled ICT workers by 2020.

A recent study conducted by IDC (International Data Corporation) shows that the gap between supply and demand of skilled ICT professionals in Latin

America will remain a challenge for the economic development of countries in the coming years. Internet use is growing exponentially. The study on networking skills by IDC shows that the adoption of ICT and broadband can promote further economic growth and employment generation in Latin America. A 10 percent increase in the penetration of broadband in Latin America and the Caribbean can generate on average an increase of 3.19 percent of GDP and a 2.61 percent increase in productivity. However, the acquisition of new technologies is not enough. Countries should encourage the growth of specialized human resources to maximize ICT. The growing use of communication networks makes the demand for trained professionals in ICT increases. Also, the current supply that generates these capabilities is not enough to prepare the number of professionals who are in demand.

### **3 Certificates at the Spanish University**

Certificates distinguish professional specialists in hardware and/or software as individuals whose knowledge has been checked, resulting in added value in the increasingly competitive labour market. There exists an interest to incorporate certificate mechanisms to the Spanish University. Specialized companies like CertiUni [11] and PUE [12] are working on this purpose.

#### **3.1 CertiUni**

CertiUni is a project promoted by the Conference of Rectors of Spanish Universities (CRUE) that allows universities offering accreditation systems in some of the most demanding competitions in the new European Higher Education.

The strategic value that represents Spanish universities evaluation and accreditation of skills of its students, has motivated the need for a specific study which concluded with the creation of the Platform of University certificate (CertiUni) as shared management model, which optimizes efforts and resources without losing the specific identity of each university.

CertiUni allows universities to use a common system for evaluating certain skills, thanks to the contribution of procedures developed by the universities with the collaboration of expert organizations in each of the evaluated areas.

#### **3.2 PUE**

“Proyecto Universidad Empresa” (PUE) is a private company founded in 1998 under a collaboration agreement with the Polytechnic University of Catalonia (UPC).

Currently, the PUE educational program is successfully and stably implemented in all regions of Spain, having centres in almost all cities of the country that applies projects on official certificates.

The project stems from the concerns of different instructors, from public and private training centres, and ICT professionals, mainly concerned about faculty

quality and the affinity of the curriculum taught at universities to the reality in terms of knowledge required by the labour market.

Since its creation, PUE has in its business vision the innovative, valid and usable training and the certified and quality knowledge, in order to disseminate new technologies in education and alleviate lack of skilled technicians, according to the news presented in Section 2.

## 4 The Cisco Networking Academy Program

Cisco Networking Academy (NetAcad) offers online courses with certificates recognized around the world. From 1997, figures from world perspective are:

- 165 countries.
- 20,000 instructors.
- More than 4 millions of students.
- More than 100 millions of examinations.
- More than 10,000 academies.
- 19 languages.

In Spain, the figures are:

- 337 academies.
- 256 secondary schools.
- 49 universities.
- 11 military academies.
- 820 instructors.
- 20,153 active students.

Data has been extracted from NetAcad quarterly metrics as of February 2015.

Every year, hundreds of thousands of NetAcad students worldwide gain the skills needed to build, design, and maintain computer networks [4, 7, 10, 13]; improving their career prospects while filling the global demand for networking professionals.

NetAcad helps individuals prepare for industry-recognized certificates and entry-level ICT careers in virtually every type of industry [1, 3, 6]. Students develop foundational skills in ICT while acquiring vital 21st-century career skills in problem solving, collaboration, and critical thinking [14].

NetAcad helps to address the growing demand for ICT professionals while improving career prospects in communities around the world [15].

NetAcad delivers a comprehensive, 21st-century learning experience to help students develop the foundational ICT skills needed to design, build, and manage networks, along with career skills such as problem solving, collaboration, and critical thinking. Students complete hands-on learning activities and network simulations to develop practical skills that will help them fill a growing need for networking professionals around the world.

NetAcad courses are offered in multiple languages through a blended learning model that combines classroom instruction with online curricula, interactive

tools, hands-on activities, and online assessments that provide immediate feedback.

NetAcad has trained more than 5 million students to date. Many graduates have gone on to successful ICT careers in a variety of industries, while others have harnessed the entrepreneurial spirit and knowledge they acquired in NetAcad to start their own businesses and create new jobs [9].

Established in 1997, NetAcad is Cisco's largest and longest-running Corporate Social Responsibility program.

#### **4.1 CCNA Routing and Switching**

CCNA (Cisco Certified Network Associate) Routing and Switching curriculum teaches comprehensive networking concepts and skills, from network applications to the protocols and services provided to those applications by the lower layers of the network. Students progress from basic networking to more complex enterprise and theoretical networking models later in the curriculum. There are four courses in the recommended sequence:

1. Introduction to Networks.
2. Routing and Switching Essentials.
3. Scaling Networks.
4. Connecting Networks.

#### **4.2 CCNA Security**

CCNA Security validates associate-level knowledge and skills required to secure Cisco networks. With a CCNA Security certificate, a network professional demonstrates the skills required to develop a security infrastructure, recognize threats and vulnerabilities to networks, and mitigate security threats. The CCNA Security curriculum emphasizes core security technologies, the installation, troubleshooting and monitoring of network devices to maintain integrity, confidentiality and availability of data and devices, and competency in the technologies that Cisco uses in its security structure.

As a prerequisite, it is advisable to have done before the CCNA Routing and Switching.

#### **4.3 Cisco Packet Tracer**

Cisco Packet Tracer software was developed to help NetAcad students gain practical networking technology skills in a rapidly changing environment.

Cisco Packet Tracer is a powerful network simulation program that allows students to experiment with network behaviour and ask "what if" questions. As an integral part of the NetAcad comprehensive learning experience, Packet Tracer provides simulation, visualization, authoring, assessment, and collaboration capabilities and facilitates the teaching and learning of complex technology concepts [2].

Packet Tracer supplements physical equipment in the classroom by allowing students to create a network with an almost unlimited number of devices, encouraging practice, discovery, and troubleshooting [8]. The simulation-based learning environment helps students develop 21st-century skills such as decision making, creative and critical thinking, and problem solving.

## 5 Implementation at the University of Almería

The implementation started in 2011 thanks to a grant destined for educational innovation.

### 5.1 ATC-UAL

The local academy ATC-UAL is composed of six professors affiliated to the University of Almería. Three of them are instructors of the complete CCNA Routing and Switching, while the others can test the CCNA 1: Introduction to Networks.

### 5.2 Subjects involved in this methodology

Cisco curriculum has been offered as NetAcad supplementary material. Student access to the content of the curriculum of Cisco Netacad by the ATC-UAL academy is voluntary and free. Subjects where basic concepts are studied in order to achieve a Cisco certificate are the following:

- Foundations of computer networks.
- Data transmission and computer networks.
- Integration of information technologies in organizations.

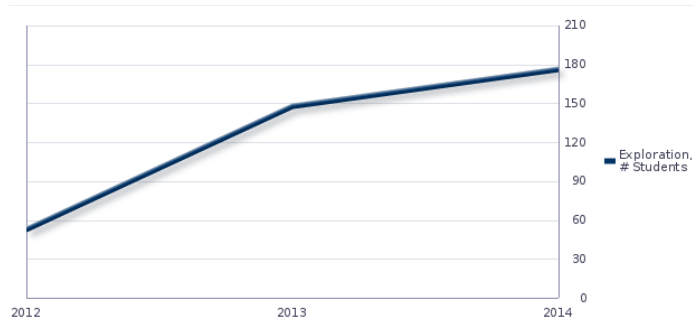
The above subjects belongs to the B.Sc. in Computer Engineering. Computer Networks subject from B.Sc. in Industrial Engineering is also valid to learn the necessary knowledge to pass the Cisco final exam. CCNA Security certificate is planned to introduce as novelty in the M.Sc. of Computer Engineering during academic year 2015-16.

Contents are available both in Spanish and English. This aspect facilitates the learning for international students. In addition, it allows to follow Content and Language Integrated Learning (CLIL) methodology in the class [5].

## 6 Results

The results from the interaction of students from the University of Almería with the ATC-UAL Academy is explained. Results are collected from 2012 to 2014.

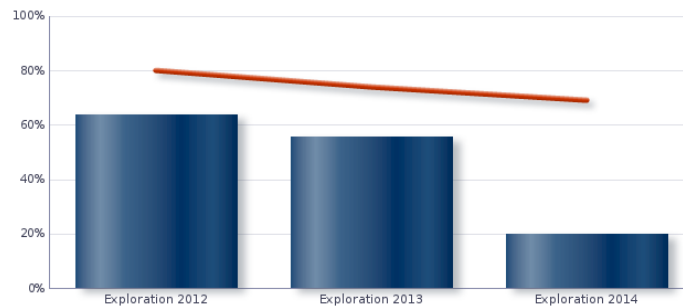
Figure 2 shows the number of students enrolled in the specified curriculum during the selected years. The number of enrolments has been incremented from



**Fig. 2.** Number of students per year

53 students in 2012 to 176 students in 2014. Last-year students tend to enrol for certificates of higher grades.

Figure 3 shows the Pass Rate. It is the percentage of all students at ATC-UAL academy who received a “Pass” in classes within the selected curriculum that ended in the selected time period, excluding inactive students who did not complete any Cisco-generated assignments. Bars represent the average for ATC-UAL academy. Line represents Spanish academies averages. Statistics from the local academy are in line with the Spanish academies average. A decrement on the pass rate can be observed. Third-year students enrol to certificates of higher grades, whose difficulty is higher than starting grades.

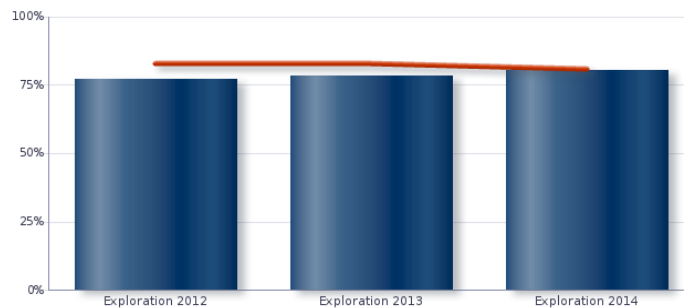


**Fig. 3.** Pass rate

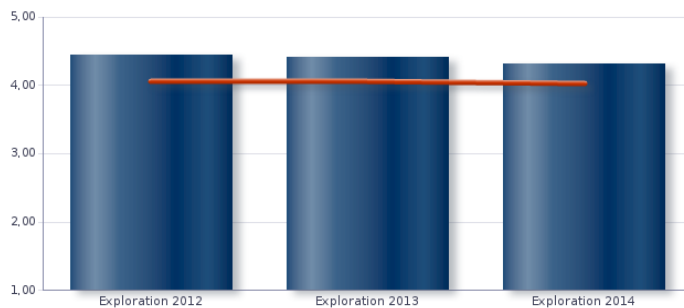
Figure 4 is the average of final exam scores for all students. The last attempt is counted. Changes made by instructors afterwards in the grade book are not taken into account. Scores are above 75 percent. A slight increment can be noticed from 2012 to 2014.

Figure 5 shows the student feedback. It is the average of ratings from the Course Feedback forms completed by students at the end of a course for a selected





**Fig. 4.** Final exam scores for all students



**Fig. 5.** Student feedback

curriculum and 12-month period. The Course Feedback form contains questions pertaining to Lab Effectiveness, Equipment Access, Instructor Rating, and Value to Students. Ratings for feedback items range from 1 (worst) to 5 (best). The average is above 4 out of 5. The local average is above the country average.

## 7 Conclusion

The conclusions about the experience of teaching innovation group are very positive as several objectives have been achieved. Student material needs to be updated constantly by expertise in both Computer Networks and new technologies. These material must be available online to allow e-learning. Students also have access to online educational materials and resources offered by Cisco NetAcad, such as Packet Tracer simulator that allows to address more complex and realistic practical cases than other simulators can address. Access to this supplementary official material is free for students. If the student pass the requested exam, he or she is awarded with a internationally-recognized certificate from the local academy ATC-UAL, increasing the teaching quality and facilitating the labour market insertion of young people.

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## References

1. Behrens, J.T., Mislevy, R.J., Bauer, M., Williamson, D.M., Levy, R.: Introduction to evidence centered design and lessons learned from its application in a global e-learning program. *International Journal of Testing* 4(4), 295–301 (2004)
2. Ben Othmane, L., Bhuse, V., Lilien, L.: Incorporating lab experience into computer security courses. In: *Computer and Information Technology (WCCIT), 2013 World Congress on*. pp. 1–4 (Jun 2013)
3. Villalba de Benito, M.T., Gaya López, M.C.: Diseño de contenidos online para la materia de tecnología de redes: una experiencia práctica. In: *Actas de las XX JENUI*. pp. 115–121. Universidad de Oviedo. Escuela de Ingeniería Informática, Oviedo, Spain (Jul 2014)
4. Bodnarova, A., Olsevicova, K., Sobeslav, V.: Collaborative resource sharing for computer networks education using learning objects. In: *Emerging eLearning Technologies and Applications (ICETA), 2011 9th International Conference on*. pp. 25–28 (Oct 2011)
5. Coyle, D., Hood, P., Marsh, D.: *Content and language integrated learning*. Ernst Klett Sprachen (2010)
6. Franco, E.A., Magaña, J.C.R., Mena, F.M., Ortiz, J.F.G.: Experiencia en la adaptación del modelo learning factory y uso de TIC en un curso de redes y seguridad de computadoras a nivel universitario. *Revista Iberoamericana de Educación en Tecnología y Tecnología en Educación* 13, 43–54 (Jun 2014)
7. Jakab, F., Janitor, J., Genci, J., Kniewald, K., Nagy, M., Sidimak, V.: Nctt 150; NetAcad curricula translation tool: Community based translation of e-learning materials. In: *Networking and Services, 2009. ICNS '09. Fifth International Conference on*. pp. 548–554 (Apr 2009)
8. Janitor, J., Jakab, F., Kniewald, K.: Visual learning tools for teaching/learning computer networks: Cisco Networking Academy and Packet Tracer. In: *Networking and Services (ICNS), 2010 Sixth International Conference on*. pp. 351–355 (Mar 2010)
9. Kleinová, K., Fecil'ak, P., Jakab, F.: Networking academy – innovation in education. In: *Emerging eLearning Technologies Applications (ICETA), 2012 IEEE 10th International Conference on*. pp. 163–166 (Nov 2012)
10. Logofatu, M., Logofatu, C.: Enhancing NetAcad by offering fully flexible student services on an integrated online learning platform. In: *Networking and Services, 2009. ICNS '09. Fifth International Conference on*. pp. 536–541 (Apr 2009)
11. Plataforma de Certificación Universitaria: <https://www.certuni-crue.org>
12. Proyecto Universidad Empresa: <https://www.pue.es/website>
13. Smith, A., Bluck, C.: Multiuser collaborative practical learning using Packet Tracer. In: *Networking and Services (ICNS), 2010 Sixth International Conference on*. pp. 356–362 (Mar 2010)
14. Soto-Ortiz, J.L., Torres-Gastelú, C.A.: Insights on collaborative network design data using ICT. *Eduotec-e. Revista Electrónica de Tecnología Educativa* 51, 1–15 (2015)
15. Tas, E.M.: ICT education for development – a case study. *Procedia Computer Science* 3(0), 507 – 512 (2011), world Conference on Information Technology