ARIS PROJECT
AI SKILLS FOR ICT PROFESSIONALS

ARIS

VET Integration Guidelines

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Disclaimer

Abbreviations and Acronyms

Definitions	
ECVET	European Credit System for Vocation Education & Training
EU	European Union
ICT	Information Computer Technology
VET	Vocational Education & Training
CVET	Continuous Vocational Education & Training
ISCED	International Standard Classification of Education
IVET	Initial Vocational Education & Training
ECVET	European Credit system for Vocational Education & Training
EQF	European Qualification Framework
NQF	National Qualification Framework

ARIS Consortium	
BT	BUSINESS TRAINING SA
EXELIA	EXELIA E.E.
UPC	UNIVERSITAT POLITÈCNICA DE CATALUNYA
LIKS	LIETUVOS KOMPIUTERININKU SAJUNGA
CNR-ISTC	CONSIGLIO NAZIONALE DELLE RICERCHE

Table of Content

1. Introduction

The purpose of this report is to offer VET providers with detailed guidelines on how to facilitate the introduction and integration of the developed ARIS learning units into existing training courses for ICT Professionals.

The ARIS Project makes available an online course and Open Educational Resources (OERs) in the Artificial Intelligence (AI) field, which can be integrated into existing educational courses.

The aim of these additional resources is to support the up-skilling of ICT professionals in terms of new knowledge, skills and competences required to understand, work with and manage a first range of applications based on Artificial Intelligence technologies (machine learning and neural networks for computer vision, natural language processing and big data analysis).

Learners will have free access to all ARIS OERs; and they will also be able to attend the course at their own pace and convenience, choosing the modules that best suit their needs and training priorities.

These VET Integration Guidelines provide instructions on how to:

a) implement training making use of the ARIS learning units,

b) attribute the most appropriate reference levels to learning units according to the partnership countries' National Qualification Frameworks (NQFs) as detailed in CEDEFOP country reports for Vocational Education and Training (VET);

c) develop additional units fitted to their current training programmes.

Finally, the Guidelines present:

d) a practical example on how an existing VET programme could be modified to include the ARIS learning outcomes and units.

This document also provides information on the recommended background to access the ARIS learning units, and on the necessary equipment and software to

be installed in the work station (Libraries).

2. Learning units integration methodology

In line with CEDEFOP indications, organization and planning of a training or education action, the learning integration methodology is based on four distinct phases: prepare, design, run pilot & evaluate, and optimize For each phase, VET providers are guided through a sequence of processes in order to guarantee that their organization will get the best results from the use of the ARIS learning units.

The integration and the creation of new courses is a big challenge for VET providers, considering that the Covid-19 pandemic has emphasised the overall importance of VET to Europe's recovery and transformation and that AI represents a huge potential for economic and social development. It should be taken into account that even before the crisis, over 45% of the adult population in the EU had low or outdated skills and potentially needed upskilling or reskilling. In response, the European skills agenda, a five-year plan to improve skills and their use, aims to increase participation in adult learning and CVET to 32% by 2025.

2.1 Phase 1: Prepare

Identify an individual or team (change-team) that will be responsible for undertaking the integration process. Working in collaboration with peers/experts will ensure the adoption of the widest possible perspective, and will avoid the risk of adopting only a trainer's viewpoint.

Understand the factors that encourage change in the existing curriculum. Examine ARIS outputs, evaluating the different opportunities they offer to address effectively the new occupational skills needs emerging from the industry. It is particularly important to determine if there is a mismatch between

jobs demand and job offerings concerning the specific innovative skills ARIS project aims to develop, so to choose from the ARIS outputs those educational resources that fill the identified gap in existing curricula.

All outputs of the project are available online, published on the official ARIS website at http://ARIS-project.eu/. The contact details of ARIS partners are also available there, and can be used for establishing contact and discussing/clarifying terms and opportunities for using and promoting ARIS results.

In particular it can be useful to examine the results of skills intelligence gathering activities mostly focused on the investigation of a) practical AI applications in different industry settings, b) job vacancies descriptions and c) studies and experts' opinion on the issue (Data Analysis and reporting on learning outcomes), supplemented with an extensive consultation with stakeholders on AI skills needs and labor market realities.

Select the curriculum that is most suitable for integrating one or more ARIS learning units. Go through existing curriculum offered by the organization (VET provider) targeting topics related to Artificial Intelligence, taking into consideration:

b) the relevance of content and objectives between existing courses and ARIS learning units;

c) the demand for existing curricula, selecting the curriculum that could best integrate ARIS learning units and offer added value to the organization and the market.

Get feedback from industry stakeholders. Contact ICT companies, present ARIS learning outcomes and consult on which of them would best answer their demand of new Artificial Intelligence skills.

Define the revised learning objectives of the curriculum, based on the ARIS learning units to be integrated. Following feedback from local industry stakeholders, the **change-team** consults on how the ARIS and existing learning units could be combined, and decides on the main learning objectives of the new

curriculum, which will be the axes for the design phase.

2.2 Phase 2: Design

Define the main constraints for the design of the course. Consult with the **VET provider's management board/programme director** and identify constraints related to:

a) **Time available** in the programme of the organization (e.g. will the selected curriculum be extended or will one or more existing learning units be replaced?)

For example: There is usually a fixed number of hours available for the course's completion, therefore the number of hours devoted to each unit will have to be adjusted. In some cases it may be difficult to integrate a complete unit without adjusting the courses duration. There is therefore a risk that the content integrated may not be taught/explained thoroughly due to the limited time availability.

b) **Human resources available** to design, implement and run the new curriculum (e.g. is the teaching staff qualified and able to teach the material or is there a need to train or hire new people?);

With this respect it can be useful to take into account the entry ARIS LEARNING PREREQUISITES, detailed as follows: Basic Knowledge of programming with Python, Linear Algebra, Probability Theory.

c) **Time available** until the release of the new curriculum;

d) **Availability of teaching equipment** for hands-on lessons (e.g., is there a need to acquire related equipment?);

With this respect it can be useful to take into account the ARIS EQUIPMENT REQUIREMENTS, detailed as follows: Subscription to OpenLearning Platform to access the ARIS online VOOC (www.openlearning.com/aris); Supported Operating Systems: Desktop: Windows, Mac, and Linux; Mobile devices: Android 4.1, 4.4, 5.0 & iOS 8 and 9; Supported Browsers: Google Chrome (recommended), Firefox, Safari version 7.1 and 8+; Internet Requirements: minimum download speed of 1.5 Mbps (basic DSL connection).

e) **Any other conditions** that should be taken into consideration.

Decide on which of the existing learning units could be potentially replaced by the ARIS ones. If, based on constraints above, the course duration cannot be extended and one or more learning units from the existing curriculum have to be replaced by new ones, then break down the existing curriculum into its learning units and, after examining potential overlaps among them, decide on which of the existing learning units will be replaced.

Check prerequisites' consistency of the selected ARIS learning unit(s) to be integrated. Examine whether knowledge and experience required for a student to attend the course are covered by the prerequisites of the existing curriculum. If so, ARIS learning units can be used independently from the existing learning units. If not, learners should attend first the existing learning units that provide the knowledge required for attending the ARIS learning units. Ensure that the prerequisites of the ARIS learning units are added to the overall prerequisites of the curriculum.

Define the sequence of learning units based on the prerequisites described above, as well as on a teaching flow that suits the objectives of the course.

Adapt ECVET credits in the curriculum. As credit points are a numerical representation of the relative weight of units in relation to the qualification, the change-team should consult on the weight of the new learning units compared to the existing ones and allocate credits accordingly.

Calculate total duration of the curriculum, by aggregating contact, hands-on, self-study and assessment hours of new and existing learning units.

Assign the National Qualification Level of the curriculum, based on the Methodology described in section 3.

Train (if needed) the teaching staff. Assuming that the teaching staff have adequate teaching experience/qualifications, a study of the ARIS trainer

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handbook, which facilitates the integration of the ARIS training and assessment material with the existing curriculum should be sufficient. Additional assistance could be offered by ARIS project partners if requested and availability permits it.

Integrate learning materials. In collaboration with the teaching staff, integrate the ARIS's Open Educational Resources into the wide pool of resources already used in this curriculum The choice of approach and format for the existing curriculum depends on the overall strategy and common practices of the VET provider. Adopting those parts of the MOOC that are relevant to the learning units being integrated could be a choice for VET providers that are already experienced in using online tools for training. (No facilitator can be made available from the ARIS partners, unless otherwise agreed with them.)

Integrate assessment material. Modify the existing assessment procedures either by using the assessment material suggested by the ARIS partnership, or by developing new assessment materials, or both, in order to create a unified methodology that assesses the learning outcomes overall.

2.3 Phase 3: Run Pilot & Evaluate

Run a pilot course. The first step that a VET provider should do to run a pilot session is to form a group of students (at least 5) that meet the prerequisites. (Alternatively trainers can assume the role of students, and the teaching staff delivers a mini course with the new learning unit(s) combined with the learning and assessment materials. This could be useful to identify weaknesses and inconsistencies that may arise from the integration of new learning units

Evaluate the pilot course. Evaluate the learning process, based on feedback provided by the involved teaching staff and learners. The evaluation tools will include personal interviews and group discussions, focusing on the achievement of learning objectives and potential course improvements.

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2.4 Phase 4: Optimize & Run

Optimize the curriculum. Based on the evaluation process, make any necessary amendments to the structure, content and materials of the curriculum in order to best meet learning objectives.

Run the new curriculum. Proceed with any necessary promotional activities and run the course.

2.5 Development methodology of additional units

In case a VET provider needs to develop new, additional, units for the creation of new skills related to the rapidly advancing technologies of Artificial Intelligence skills, all the methodology followed by the ARIS partnership for the development of ARIS learning units is available through the deliverables of the ARIS project on the official project website (http://ARIS-project.eu/).

The methodology comprises the following reports, which outline the steps followed by ARIS partners, and could be similarly applied in extending the work of ARIS to fit the needs of different / specialised target groups:

- Definition of research tools for data collection (field and desk research)

- Data analysis and reporting on learning outcomes

- Grouping of learning outcomes into learning units

- Learning units' specifications

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3.0 Referencing National Qualifications Levels to the EQF

3.1 What is referencing to the EQF

Referencing is the process that results in the establishment of a relationship between the levels of national qualifications - usually defined in terms of a national qualifications framework - and the levels of theEuropean Qualification Network (EQF). Through this process, national authorities responsible for qualifications systems, in cooperation with stakeholders responsible for developing and using qualifications, define the correspondence between the national qualifications system and the eight levels of the EQF.

The EQF system does not replace the existing Nation Qualification Framework (NQF), nor does it describe any particular qualifications or individual competences, but it describes the EQF in terms of three broad categories "knowledge", "skills" and "competences".   Therefore, reference to the EQF relates to the process of linking the national qualification levels, commonly defined in the NQF with the EQF.

3.2 How referencing is applied in ARIS

Based on the European Qualification Framework descriptors and ARIS learning outcomes in terms of skills, competence and knowledge, **ARIS learning units have been attributed to the EQF level 4.** Level 4 EQF descriptors for skills, competence and knowledge define the following:

> ***Knowledge****: Learners should have a Factual and theoretical knowledge in broad contexts within a field of work or study*
> ***Skills:*** *Learners should have a a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study*

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Competence: *Learner should be able to exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities*

ARIS partners researched and consulted on how level 4 of the EQF can be translated to each partnership country's NQF, so that VET providers in each country (Belgium, Greece, Spain, Lithuania, and Italy) can attribute the most appropriate level to the new ARIS curriculum.

3.4 Belgium Qualification Framework

In Belgium full-time education is compulsory up to 15 years of age and part-time only education is obligatory thereafter. The Belgian government-regulated VET system includes: secondary compulsory and upper secondary education with technical and vocational programmes (full-time and part-time); apprenticeship and entrepreneurial training; vocational training for learners with special education needs, adult education; higher education with vocational bachelor programmes. VET provision systems are either government regulated or provided by public authorities (VET training at a regional level), both of which follow a common structure.

Throughout Belgium, higher vocational training is offered in the form of professionally oriented bachelor programmes in colleges, which last from two to three years depending on the field of education. Currently, 57 professional bachelor programmes are offered in 22 university colleges, which are divided into ten study areas in the Flemish speaking community (BEFL). In French speaking community (BEFR), those programmes, although they are available to learners, are not yet connected to the VET system. In the German speaking community (BEDG), a dual bachelor training was introduced in the study of financial services and accounting in the academic year 2011-12.

Level 4 of EQF corresponds to level 4 of Belgian Qualification framework of the

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Flemish-speaking community (FQF), which comprised Professional qualifications and the following educational qualifications: Upper secondary general education Technical secondary education (third stage) Artistic secondary education (third stage) Supplementary general adult education.

Table 1: Summary of government-regulated VET providers and programmes

VET-programmes	Organised/provided by
Vocational secondary education: from the 3rd year of secondary education to the 6th	Schools for secondary education (all Communities)
Vocational secondary education: 7th secondary school-year (one more school year)	Schools for secondary education (all Communities)
Vocational secondary education, complementary/ specific qualifications: nursing programme (1, 2 or 3 years) Associate degree: nursing	Schools for secondary education (BEFR and BEDG) Schools for secondary education (BEFL)
Technical secondary education: from the 3rd year of secondary education	Schools for secondary education (all Communities)
Secondary after secondary education, se-n-se (7th year for complementary qualification)	Schools for secondary education (BEFL)
Dual system: part-time education for 15-25 year-olds	Schools for part-time education: CEFA, CDO, TZU(23)
Dual system: apprenticeship (15-25 year olds)	SYNTRA Vlaanderen(24): in BEFL and Brussels SFPME/EFPME (Brussels)(25) IFAPME (Wallonia)(26) IAWM (BEDG)(27)
Secondary Adult Education: to obtain basic and secondary education certificate/diploma	Centres for adult education, (all Communities)
Associate degree Patent of higher education	Centres for adult education, university colleges (BEFL) Centres for adult education (BEFR)
Professional bachelor	Adult education (BEFR) University and colleges (BEFL)
Specific teacher training programme	Centres for adult education: all Communities University colleges and universities: BEFL/ BEDG

Vocational programmes focused on labour market: jobseekers, workers	Flemish Employment and Vocational Training Agency (VDAB, in Flanders and Brussels); Bruxelles Formation (Brussels); FOREM (Wallonia); Arbeitsamt (BEDG)
Entrepreneurial training course, lifelong learning for entrepreneurs and additional courses	SYNTRA Vlaanderen (BEFL + Brussels Flemish speaking) SFPME/EFPME (Brussels, French speaking) IFAPME (Wallonia) IAWM (BEDG)
Validation / recognition	Accredited centres (BEFL / BEFR)

Source: VET integration guidelines Belgium report, Cedefop, 2014

3.6 Greek Qualification Framework

In Greece, schooling is compulsory from the age of six to fifteen. Secondary education starts with the *Gymnasio* (lower secondary education), at the age of twelve. Students enter upper secondary school at the age of 15 and graduate at 18. Those who graduate from a general upper secondary school receive a school leaving certificate (qualifications at EQF/NQF level 4) and can sit the national examinations for admission to a higher education programme.

The Upper secondary VET level (EQF 4) includes:

● initial vocational education within the formal education system in the second cycle of secondary education (EPAL)
● initial vocational education at an apprenticeship school (EPAS) at upper secondary level
● initial vocational training (outside the formal education system, referred to as non-formal) in post-secondary vocational training institutes (IEK), centres for lifelong learning and colleges, and also the postsecondary apprenticeship year (or apprenticeship class) for EPAL graduates

Post-secondary, non-Tertiary Education is offered by the Vocational Training Institutes (IEK) operating in the non-formal education framework and leading

after two years of attendance to the acquisition of nationally recognized certificates (EQF Level 5). Providers of vocational training (public or private) outside the formal education system are supervised by the General Secretariat for Lifelong Learning (GSLL) of the Ministry of Education, as the responsible body for most VET provision education and training in the country.

Level 4 of EQF corresponds to Level 4 of the Greek Qualification Framework. This consists of: EPAL certificate; Vocational Upper secondary school and Vocational school EPAS certificate.

3.3 Spanish Qualification Framework

In Spain, schooling is compulsory up to the age of 16 years. There are three vET qualification levels.

Basic VET or FP Básica in Spanish, introduced in 2013, open to ESO students aged 15 years, who meet certain age and academic requirements. Students passing this basic VET programme are awarded a diploma with academic and professional validity (Título profesional básico). Basic VET cycles run in a 2-year programme of 2 000 hours of theoretical and practical training, of which a minimum of 240 hours are completed in workplaces. It gives direct access to intermediate VET cycles and the possibility of sitting the exam to obtain the ESO diploma, opening up access to upper secondary general education programmes. Students who finish basic VET will obtain the ESO diploma directly if the teaching staff considers they have achieved the objectives and necessary skills of ESO level. Education authorities, apart from compulsory education, can also offer basic VET to people who are over 17 and do not have a VET or a secondary qualification.

Intermediate VET (Upper secondary education as alternative to high school,the general academic route, bachillerato in Spanish). Intermediate VET programmes (ISCED 3) consist of 2 000 hours of training divided into two academic years. Students who successfully complete these programmes are awarded a Technician diploma (título de Técnico) in the relevant speciality. Since the 2016/17 academic year, this qualification gives students direct access to

higher level VET

Higher VET (Tertiary education includes vocational and academic programmes. The duration of Higher VET programmes is 2 000 hours over two academic years. These studies lead to a Higher Technician diploma (título de Técnico Superior) giving access to related university studies.

The flexibility of the system not only affects the vertical progression in VET, but also the horizontal flow between different educational programmes: students awarded a basic VET diploma may obtain the ESO diploma. Equally, students awarded Intermediate VET Diplomas may obtain the Bachillerato Diploma by passing the relevant Bachillerato core subjects.

In relation to VET, there are different levels of political and administrative responsibilities and activities within each territory level. The Ministry of Education, Culture and Sport (hereinafter Ministry of Education or MECD) is responsible for developing and implementing government policy in VET programmes in the education system whereas the Ministry of Employment and Social Security (hereinafter Ministry of Employment or MEYSS) is mainly concerned with VET programmes in the National Employment System and continuous vocational education and training (CVET).

The National Catalogue of Professional Qualifications (CNCP) is the instrument of the National System of Qualifications and Vocational Training (SNCFP) that orders the professional qualifications susceptible of recognition and accreditation, identified in the productive system, in function of the appropriate competences for the professional exercise.

Level 4 of EQF corresponds to Level 2 of the Spanish Qualifications Framework (Marco Español de Cualificaciones - MECU) and Catálogo Nacional de Cualificaciones Profesionales (CNCP). There are 26 professional families, and the qualifications relevant for Artificial Intelligence belong to Informàtica y Comunicaciones. The National Institute of Professional Qualifications (INCUAL) (44) is currently carrying out prospective studies to assess the needs of adaptation of existing occupational standards to the requirements derived from Industry 4.0. Work is also underway to update the professional certificates

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(CdPs) programmes, taking into account the progress made in each sector as well as the changes derived from the use of digital technologies.

The professional training offered by the Spanish National Public Employment Service (SEPE) (46) includes, in the Catalogue of Training Specialties (47), various training programmes related to new technologies such as robotics, analytics, Big Data, artificial intelligence, Machine Learning, cognitive technologies, nanotechnology and Internet of Things (IoT), among others, as well as training actions for the acquisition of basic and advanced digital skills and languages.

3.3 Lituanian Qualification Framework

In Lithuania education is compulsory until age 16 and it ends with the completion of lower secondary education (EQF 2).
VET programmes are designed for learners of different ages and educational backgrounds:

In IVET, VET programmes included in the 'study, training programmes and qualifications register' (Studijų, mokymo programų ir kvalifikacijų registras) are provided at:
• lower secondary education level not leading to a basic education certificate (ISCED 252);
• lower secondary education level leading to a basic education certificate (ISCED 254);
• upper secondary education level for learners having completed lower secondary education, not leading to upper secondary general education matura certificate (ISCED 352);
• upper secondary education level leading to upper secondary general education matura certificate (ISCED 354);
• post-secondary education level for learners who have completed upper secondary general education (ISCED 454). Average study duration, qualification certificates and further learning and career opportunities are summarised in the following Table 2.

Table 2.   **Formal IVET and CVET programmes**

	ISCED-P 2011 level	Average duration	Certificates awarded	EQF level	Further learning and career opportunities
Programmes at lower secondary education level	252	2-3 years(*)	VET diploma	2	Access to labour market
Programmes at lower secondary education level	254	3 years	VET diploma; basic school certificate	2	Further training in VET institution or general education school; Access to labour market
Programmes at upper secondary education level	352	2-3 years*	VET diploma	3	Access to labour market
Programmes at upper secondary education level	354	3 years	VET diploma; *matura* certificate	4	Access to higher education/college or university study programmes; Access to labour market
Programmes at post-secondary education level	454	1-2 years	VET diploma	4 (**)	Access to higher education/college or university study programmes; Access to labour market
CVET programmes	2-4	Up to 1 year	VET diploma	1-3	Access to labour market

NB.   (*) Programme duration depends on whether the programme is targeted at learners with special needs.
(**) a new 2-year pilot programme at EQF level 5 is also being piloted since 2016/17
Source: ReferNet Lithuania.

Higher VET is formally a part of higher education and includes three to three year and half college study programmes leading to a professional bachelor degree (corresponding to EQF level 6).

More Information about VET programmes and qualifications is available in the open information, counselling and guidance system (AIKOS, http://www.aikos.smm.lt) web portal

The Ministry of Education and Science is responsible for shaping and implementing vocational education and training (VET) policy. The Ministry of Economy participates in human resources development and VET policy, and organises research on future skill needs. Advisory institutions play an important role in designing and implementing VET policy and the qualifications system. Most important are the VET council and the central professional committee with its sectoral professional committees. Although VET in Lithuania is school-based,

practical training and training in enterprises are a major part.

3.5 Italian Qualification Framework

In Italy, the term vocational education and training tends to be 'reserved' for specific programmes primarily under the remit of the regions an autonomous provinces (such as IeFP). In Italy VET provision is planned and organized by a variety of different actors including the Ministry of Labour and Social Policies, regions and autonomous provinces, and social partners. However the Ministry of Education, University and Research set the framework for VET in national school programmes. Irrespective of the provider or governance scheme, VET can take place at secondary, post-secondary or tertiary level in formal education and training or non-formal settings including active labour market measures. VET addresses young people and adults and can be school-based, company-based or combine school- and company-based learning (apprenticeships). Therefore, the term VET also covers the technical and vocational schools.

According to the Italian legislation, all young people have the duty (Law 53/2007), to pursue education and training for at least 12 years before reaching the age of 18. After completing lower secondary education at the age of 14, in secondary upper education learners have the opportunity to choose between general education and VET.

At upper secondary level, the following VET programmes are offered:

1. **five-year programmes** (EQF level 4) at technical schools (istituti tecnici) leading to technical education diplomas or at vocational schools (istituti professionali) leading to professional education diplomas. Programmes combine general education and VET and can also be delivered in the form of alternance training. Graduates have access to higher education;
2. **three-year programmes** (Istruzione e Formazione Professionale, IeFP) leading to a vocational qualification (attestato di qualifica di operatore professionale, EQF level 3, ISCED level 353);

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3. **four-year programmes** leading to a technician professional diploma (diploma professionale di tecnico, EQF level 4, ISCED level 354).

Upper secondary school leaving diploma (allows to continue studies at tertiary education or higher technical education and training programmes) and is equivalent to EQF level 4, consisting of Upper secondary education diploma (*Diploma di istruzione tecnica and Diploma di istruzione professionale).*

At post-secondary level, VET is offered as higher technical education for graduates of five-year upper secondary programmes or of four-year IeFP programmes that pass entrance exams:

1. **higher technical education and training courses** (istruzione e formazione tecnica superiore, IFTS): one-year post-secondary non-academic programmes leading to a higher technical specialisation certificate (certificato di specializzazione tecnica superiore, EQF level 4);
2. **higher technical institute programmes** (istituti tecnici superiori, ITS): two- to three-year post- secondary non-academic programmes that lead to a higher level technical diploma (diploma di tecnico superiore, EQF level 5).

The Ministry of Education, Universities and Research (MIUR) defines the VET framework in national school pathways (technical and vocational institutes) for Higher Technical Education and Training pathways (IFTS) in agreement with the Ministry of Labour and Social Policies (MLPS). It has sole responsibility for Higher Technical Education (ITS) in terms of defining guidance documents and the monitoring and assessment of the training chain. The MIUR also deals with redefining the ITS National Index, with the introduction of new technical figures and the updating of those already on the index itself. The labour ministry defines the VET framework for interventions provided for within the scope of IeFP, (in agreement with the education ministry) for training interventions for apprenticeship and for continuing training provided within the scope of the public system. The regions and autonomous provinces are responsible for the planning, programming, organisation and implementation of interventions provided for within the scope of IeFP, ITS, IFTS, (in agreement with the social

partners). The Law 107/2015 and the Decree no. 61/2017 regarding the revision of the curricula of vocational education have introduced some important quality innovations (Inapp et al., 2016).

Italy is working on the creation of a complete framework, legally adopted in 2018: the Atlas of Labor and Qualifications, which constitutes a database of professions and qualifications able to reflect the large number and diversity of regional VET qualifications. Till now 4 000 regional qualifications have been entered into this database.

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4.0 Example of integrating learning units

The following example is based on a real curriculum that has been properly modified for demonstration purposes, in order to provide exemplary guidelines on how existing programmes could integrate ARIS learning outcomes and units.

The example shows how it is possible to integrate the 4 ARIS Learning Units within the last two years curriculum of INFORMATICS AND TELECOMMUNICATION (IT) offered by the Technological Institutes in Italy, with respect to the following n. 2 relevant complementary courses:

o   **Informatics**: 198 hours per year
o   **Technologies and design of informatics and telecommunication systems**: 132 hours per year

EXISTING CURRICULA DESCRIPTION

Informatics - 4th Year

NQF level 4

Contact hours: 200 approx.

Credits: 8 approx.

<table>
<tr><th colspan="2">Elective Course: Informatics</th></tr>
<tr><td>Total hours of study</td><td>1 scholastic year approximately 200 hours</td></tr>
<tr><td>NQF level</td><td>4</td></tr>
<tr><td>ECTS credits</td><td>8 approx</td></tr>
<tr><td>Target audience</td><td>ICT students (I-VET) ICT professionals (C-VET)</td></tr>
<tr><td>Course Objectives</td><td>The Course is focused on the following:
1. Introduction to Object Oriented Programming
2. Introduction to Java</td></tr>
</table>

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Learning outcomes	After completion of the course students are expected to be able to:
	1. Encode in Java from a diagram UML
	2. Know the advantages of object oriented programming
	3. Handle input e the output and the formatting of the output
	4. Encode inheritance, the polymorphism and the interfaces
	5. Use containers
	6. Manage events of a GUI
	7. Code a "event-driven" programming
	8. To develop a GUI based on some requests
Prerequisites	Know the concept of algorithm
	Know the concept of variable and constant
	Classify C / C ++ data structures
	Translate algorithms in a source program
	Define the constituent parts of a software module
	Know the mechanism of passing variables by Value, Reference and Address
	Knowing how to document a program
Learning Units	1. Introduction to Object-Oriented programming
	2. UML diagrams
	3. Inheritance e polymorphism
	4. Java language
	5. Data structures dynamics
	6. Use of derivation in Java
	7. Types of data "Generics"
	8. Abstract classes e interfaces
	9. Management of exceptions
	10. File management in Java
	11. Interface graphics in Java
	12. Thread in Java

Informatics - 5th Year

NQF level 4

Contact hours: 200 approx.

Credits: 8 approx.

Elective Course: Informatics	
Total hours of study	1 scholastic year approximately 200 hours
NQF level	4
ECTS credits	8 approx
Target audience	ICT students (I-VET)

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Course Objectives	The course is focused on the following:
	1. Relational databases and SQL language
	2. XML
	3. Dynamic web pages
Learning outcomes	After completion of the course students are expected to be able to:
	1. Install and consciously manage a DBMS.
	2. Design a relational database based on a customer's requests
	3. Knowing how to design XML files to be easily usable
	4. Design and create a client server application starting from a customer request
Prerequisites	Informatics Course 4th Year (see section above)
Learning Units	1. DBMS
	2. Normalization
	3. SQL
	4. DDL - DML
	5. DBMS MS-SQL Server
	6. PHP Server client programming
	7. Cookies and session
	8. Multitasking in Linux
	9. Multithreading in Windows

Technologies and design of informatics and telecommunication systems

NQF level 4

Contact hours: 132 approx.

Credits: 6 approx

Elective Course: Technologies and design of informatics and telecommunication systems	
Total hours of study	1 scholastic year approximately 132 hours
NQF level	4
ECTS credits	6 approx
Target audience	ICT students (I-VET)

Course Objectives	The course is focused on the following: 1. Network architectures and formats for data exchange 2. Android and mobile devices 3. Sockets and communication with UDP / TCP protocols 4. Server side applications
Learning outcomes	After completion of the course students are expected to be able to: 1. Classify distributed architectures and network applications 2. Make an app 3. Use Android Monitor 4. Designing a Client-Server Application 5. Create a dynamic web application based on a formal request from a client 6. Develop an APP
Prerequisites	Sequential and parallel processes Communication and Synchronization Classic Concurrent Programming Problems Specification of the software requirements Software documentation
Learning Units	1. Client-server model 2. XML and JSON 3. Mobile devices and networks 4. Android: an operating system for mobile applications 5. Sockets and protocols for network communication 6. Connection via socket 7. Servlet, JSP and Java Bean 8. The Google API **9. Android app development**

4.1 Integration Phase 1: Prepare

According to the results of the VET providers research of ARIS project (publicly available on the project's website), there is a need for ICT professional operators to improve their technical skills regarding Artificial Intelligence Technologies.

As the existing curriculum mainly focuses on technical skills' improvement of ICT professionals regarding ""old"" technology, integrating an ARIS learning unit focusing on technical skills would provide learners with a well-rounded skill-set.

To this end, the design of the new curriculum should be structured around the

following main learning objective: Improvement of technical and managerial skills of ICT professionals on Artificial Intelligence main techniques and applications

Guided by this objective, the ARIS Learning Units could be integrated with the existing curriculum and form the new one as follows:

1. 4th year, Informatics: ARIS "Unit 1: Foundations of Artificial Intelligence"
2. 5th year, Informatics: ARIS "Unit 2: Introduction to Machine Learning"
3. 5th year, Technologies and design of informatics and telecommunication systems:
   a. ARIS Unit 3: Lesson 1, Brain Origin and Elements of ANN
      Unit 3: Lesson 2, Simple perceptrons and supervised learning
   b. ARIS Unit 4: Lesson 1, Natural Language Processing Introduction
      Unit 4: Lesson 2, Neural Networks for NLP and Libraries

4.2 Integration Phase 2: Design

Assuming that there is constraint in duration of the new curriculum, and having taken into account the interconnections of existing learning units because of prerequisites, for each of the 3 courses considered some of the existing learning units need to be removed or replaced.

To introduce the ARIS Learning Units as foreseen in the previous Section 4.1, it has been considered that the following existing learning units could be removed and replaced in each of the 3 courses considered:

1. 4th year, Informatics : *Thread in java*
2. 5th year, Informatics : *Multitasking in Linux , Multithreading in Windows*
3. 5th year, Technologies and design of informatics and telecommunication systems: *Android App Development*

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LEARNING UNITS OF NEW CURRICULUM

ID Description Duration Credits

Summing up all changes described indicatively above, the new curriculum for each course could be described as follows:

Informatics - 4th Year

NQF level 4

Contact hours: 200 approx.

Credits: 8 approx.

Elective Course: Informatics	
Total hours of study	1 scholastic year approximately 200 hours
NQF level	4
ECTS credits	8 approx
Target audience	ICT students (I-VET) ICT professionals (C-VET)
Course Objectives	The Course is focused on the following: 3. Introduction to Object Oriented Programming 4. Introduction to Java **5. Introduction to Artificial Intelligence**
Learning outcomes	After completion of the course students are expected to be able to: 9. Encode in Java from a diagram UML 10. Know the advantages of object oriented programming 11. Handle input e the output and the formatting of the output 12. Encode inheritance, the polymorphism and the interfaces 13. Use containers 14. Manage events of a GUI 15. Code a "event-driven" programming 16. To develop a GUI based on some requests **17. Explain the goals of Artificial Intelligence, define its main areas and applications**
Prerequisites	Know the concept of algorithm Know the concept of variable and constant Classify C / C ++ data structures Translate algorithms in a source program Define the constituent parts of a software module Know the mechanism of passing variables by Value, Reference and Address Knowing how to document a program

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Learning Units	13. Introduction to Object-Oriented programming 14. UML diagrams 15. Inheritance e polymorphism 16. Java language 17. Data structures dynamics 18. Use of derivation in Java 19. Types of data "Generics" 20. Abstract classes e interfaces 21. Management of exceptions 22. File management in Java 23. Interface graphics in Java **24. Foundation of Artificial Intelligence**

Informatics - 5th Year

NQF level 4

Contact hours: 200 approx.

Credits: 8 approx.

Elective Course: Informatics	
Total hours of study	1 scholastic year approximately 200 hours
NQF level	4
ECTS credits	8 approx
Target audience	ICT students (I-VET)
Course Objectives	The course is focused on the following: 4. Relational databases and SQL language 5. XML 6. Dynamic web pages **7. Introduction to machine learning**
Learning outcomes	After completion of the course students are expected to be able to: 5. Install and consciously manage a DBMS. 6. Design a relational database based on a customer's requests 7. Knowing how to design XML files to be easily usable 8. Design and create a client server application starting from a customer request **9. Recognize different types of machine learning algorithms and tasks**
Prerequisites	Informatics Course 4th Year (see section above) including **Foundation of Artificial Intelligence**
Learning Units	10. DBMS 11. Normalization

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	12. SQL 13. DDL - DML 14. DBMS MS-SQL Server 15. PHP Server client programming 16. Cookies and session **17. Machine learning languages and resources** **18. Supervised and unsupervised ML**

Technologies and design of informatics and telecommunication systems

NQF level 4

Contact hours: 132 approx.

Credits: 6 approx

Elective Course: Technologies and design of informatics and telecommunication systems	
Total hours of study	1 scholastic year approximately 132 hours
NQF level	4
ECTS credits	6 approx
Target audience	ICT students (I-VET)
Course Objectives	The course is focused on the following: 5. Network architectures and formats for data exchange 6. Android and mobile devices 7. Sockets and communication with UDP / TCP protocols 8. Server side applications **9. Foundation of Neural Networks and Deep Learning**
Learning outcomes	After completion of the course students are expected to be able to: 7. Classify distributed architectures and network applications 8. Make an app 9. Use Android Monitor 10. Designing a Client-Server Application 11. Create a dynamic web application based on a formal request from a client 12. Develop an APP **13. Train a simple perceptron using a supervised learning training to solve a classification task**

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Prerequisites	Sequential and parallel processes Communication and Synchronization Classic Concurrent Programming Problems Specification of the software requirements Software documentation **Foundation of Artificial Intelligence** **Introduction to Machine Learning**
Learning Units	10. Client-server model 11. XML and JSON 12. Mobile devices and networks 13. Android: an operating system for mobile applications 14. Sockets and protocols for network communication 15. Connection via socket 16. Servlet, JSP and Java Bean 17. The Google API **18. Simple perceptrons and supervised learning** **19. Neural networks for NLP and libraries**

References

1. Cedefop (2015) Handbook for VET Providers (ISSN: 2363-216X)
   https://www.cedefop.europa.eu/files/3068_en.pdf

2. Cedefop (2021) OVERVIEW OF NATIONAL QUALIFICATIONS FRAMEWORK
   DEVELOPMENTS IN EUROPE 2020
   https://www.cedefop.europa.eu/files/8611_en.pdf

3. Cedefop (2020) ADULT LEARNING AND CONTINUING VOCATIONAL EDUCATION
   AND TRAINING VALUED BY EUROPEANS
   https://www.cedefop.europa.eu/files/9152_en.pdf

4. Cedefop (2019) NQF DEVELOPMENTS 2019
   https://www.cedefop.europa.eu/files/9150_en.pdf

5. Cedefop (2020) VET for the future of work
   https://www.cedefop.europa.eu/en/publications-and-resources/country-reports/vet-future-work

6. Cedefop ReferNet Network (2016). VET in Europe - Country report Belgium
   https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_BE.pdf

7. Cedefop ReferNet Network (2016). VET in Europe - Country report Greece
   https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_GR.pdf

8. Cedefop ReferNet Network (2016). VET in Europe - Country report Spain
   https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_ES.pdf

9. Cedefop ReferNet Network (2016). VET in Europe- Country report Lithuania
   https://cumulus.cedefop.europa.eu/files/vetelib/2016/2016_CR_LT.pdf

10. Cedefop ReferNet Network (2018). VET in Europe- Country report Italy,
    https://cumulus.cedefop.europa.eu/files/vetelib/2019/Vocational_Education_Training_Europe_Italy_2018_Cedefop_ReferNet.pdf

Appendix

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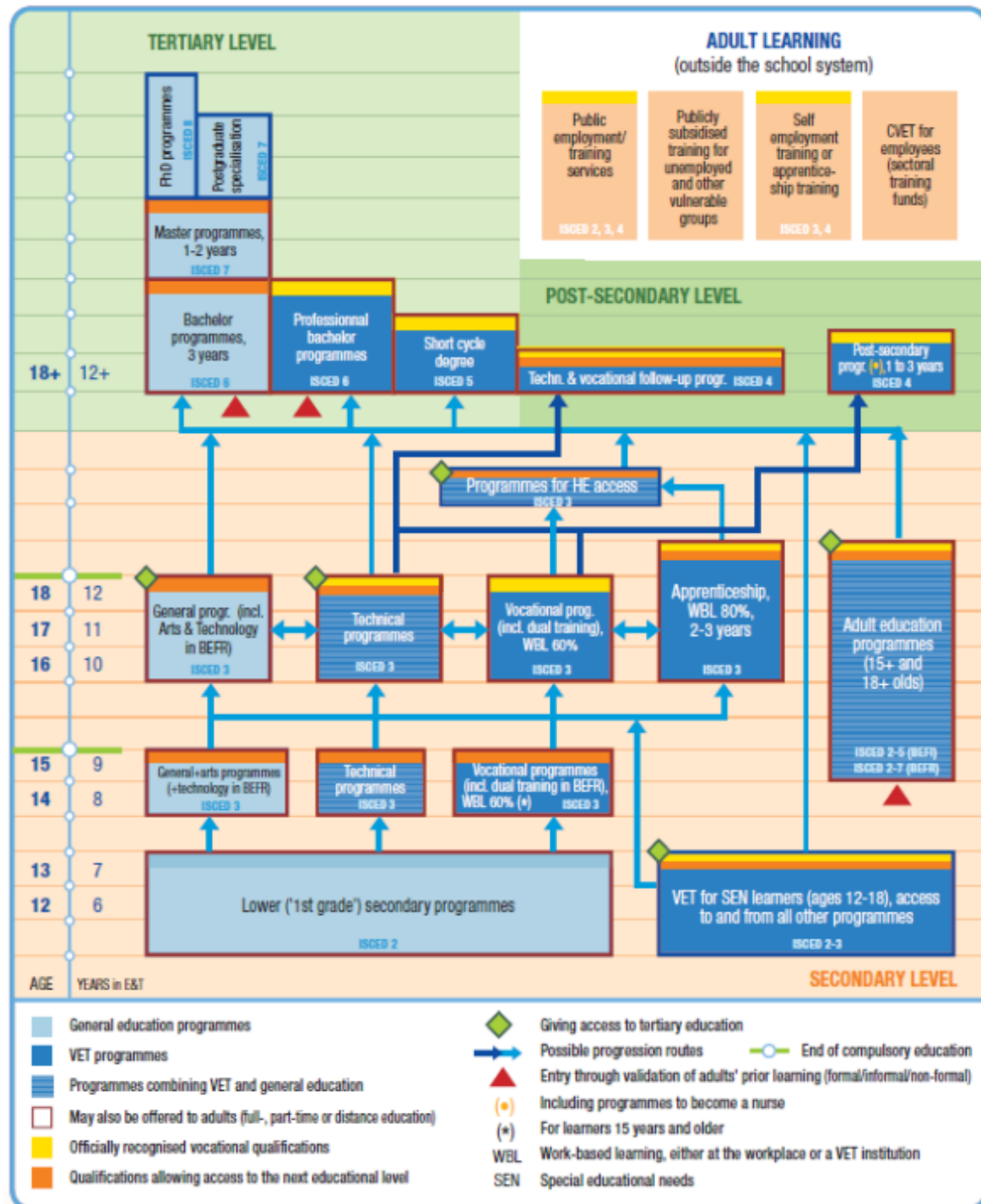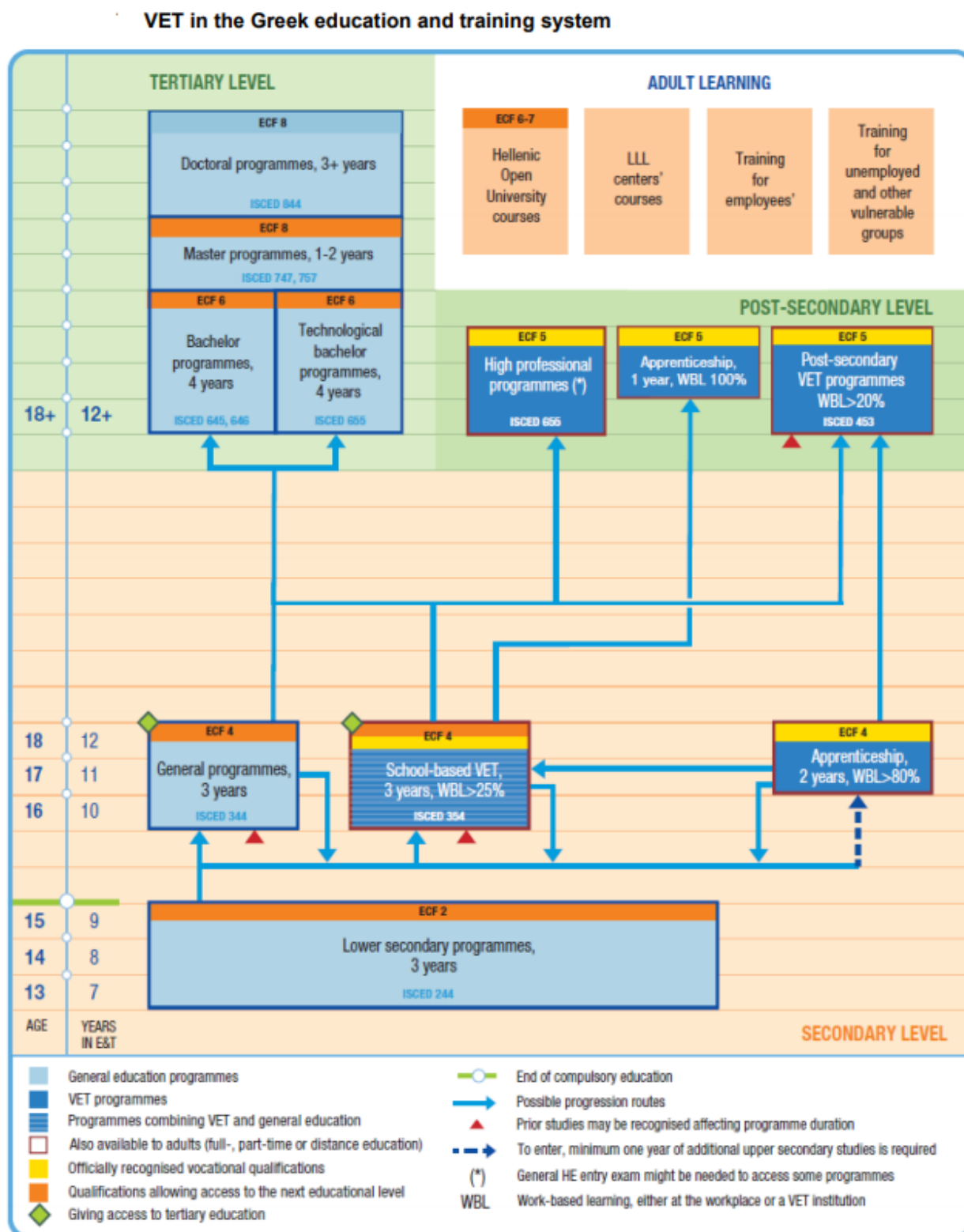
Figure 1. VET in Belgium

VET in the Belgian education and training system

NB: ISCED-P 2011. Levels do not fully fit VET and qualifications systems. See also Annex 10.
Source: Cedefop and ReferNet Belgium.

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Figure 2. VET in Greece

VET in the Greek education and training system

NB: ISCED-P 2011
Source: Cedefop and ReferNet Greece.

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Figure 3. VET in Spain

Diagramme of the national education and training system

NB: ISCED-P 2011
Source: Cedefop and ReferNet Spain.

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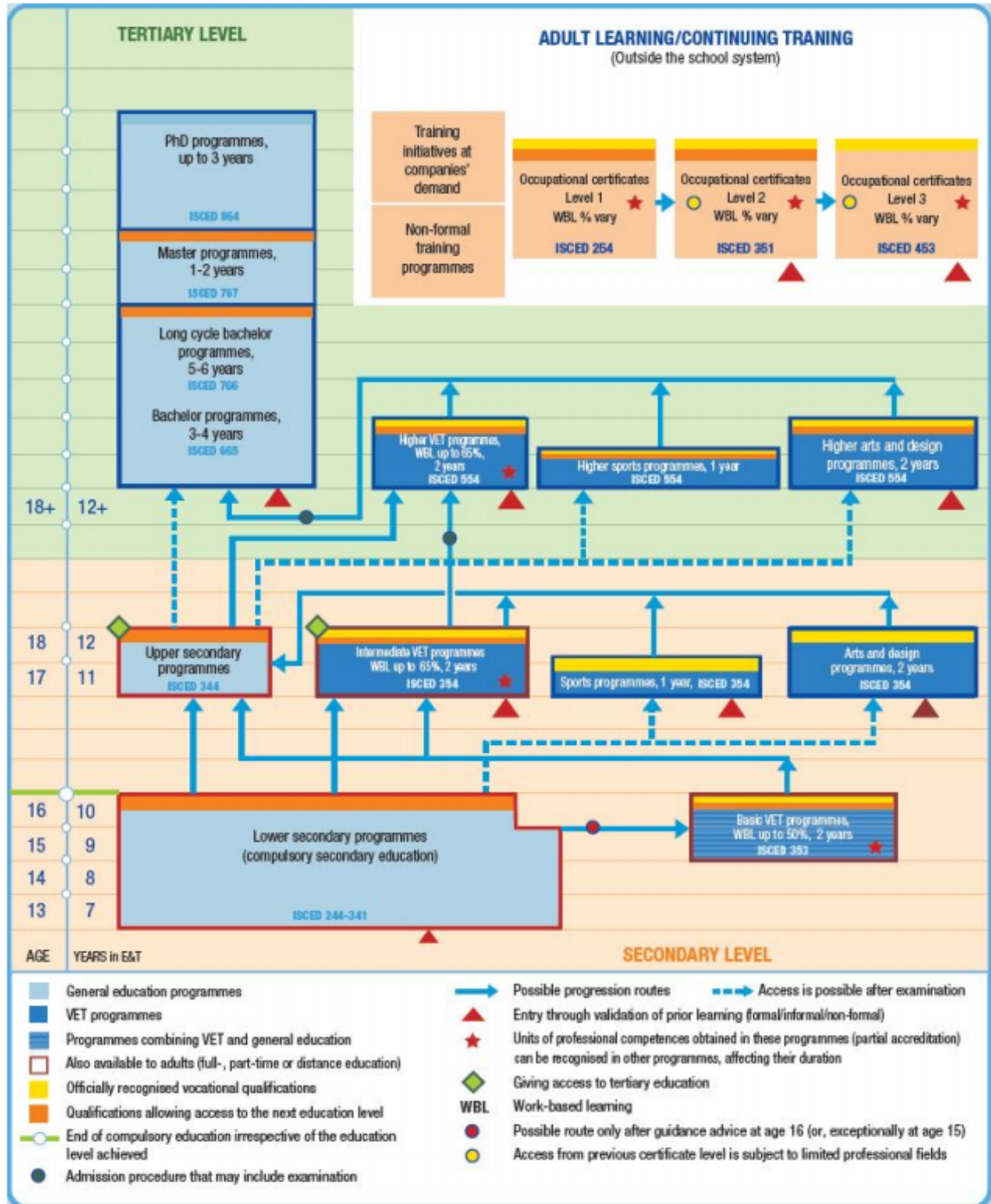
Figure 4. VET in Lithuania

Figure 4. **VET in Lithuania's education and training system**
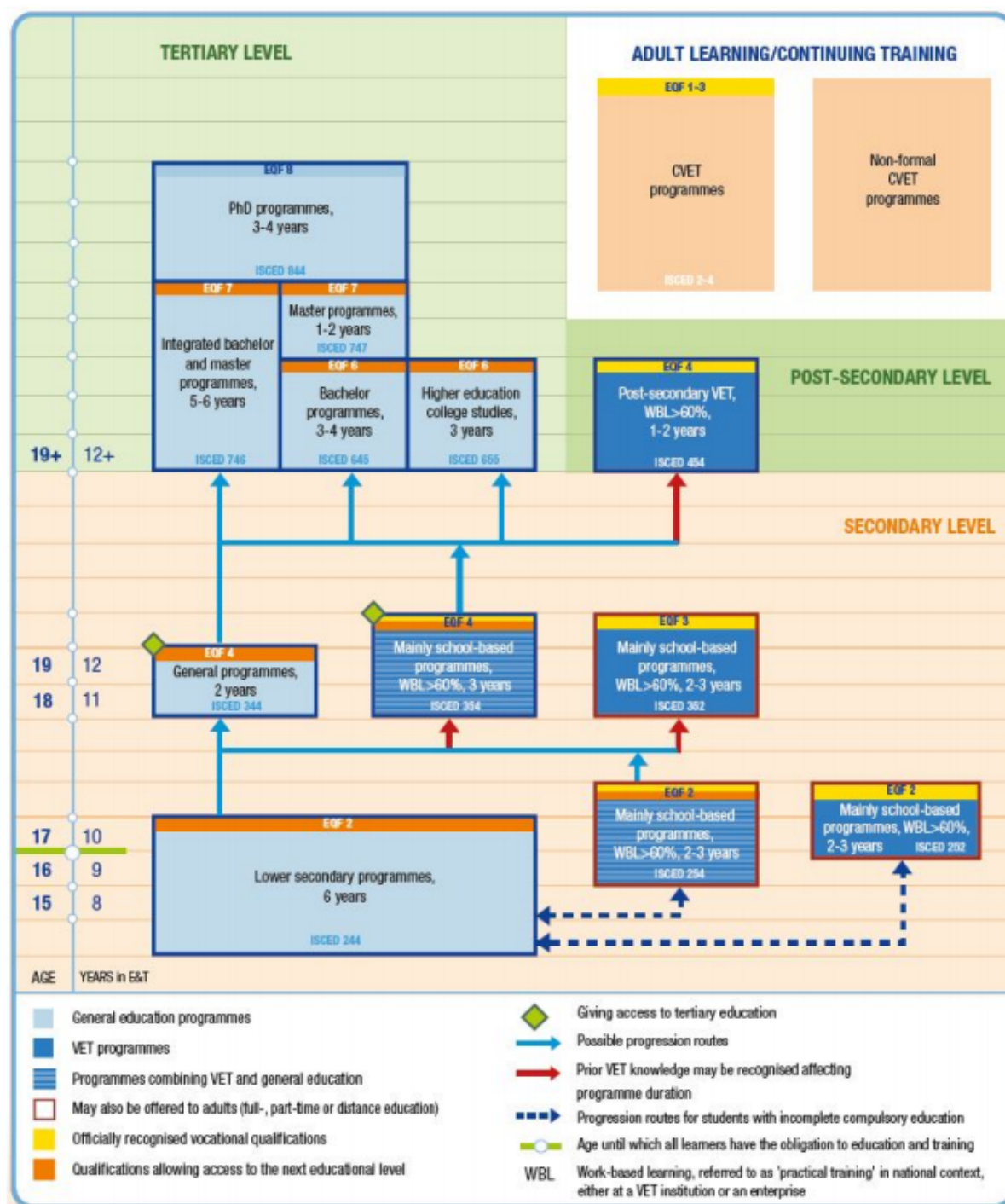
NB: ISCED-P 2011.
Source: Cedefop and ReferNet Lithuania.

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Figure 5. VET in Italy

VET in Italy's education and training system (ISCED-11)
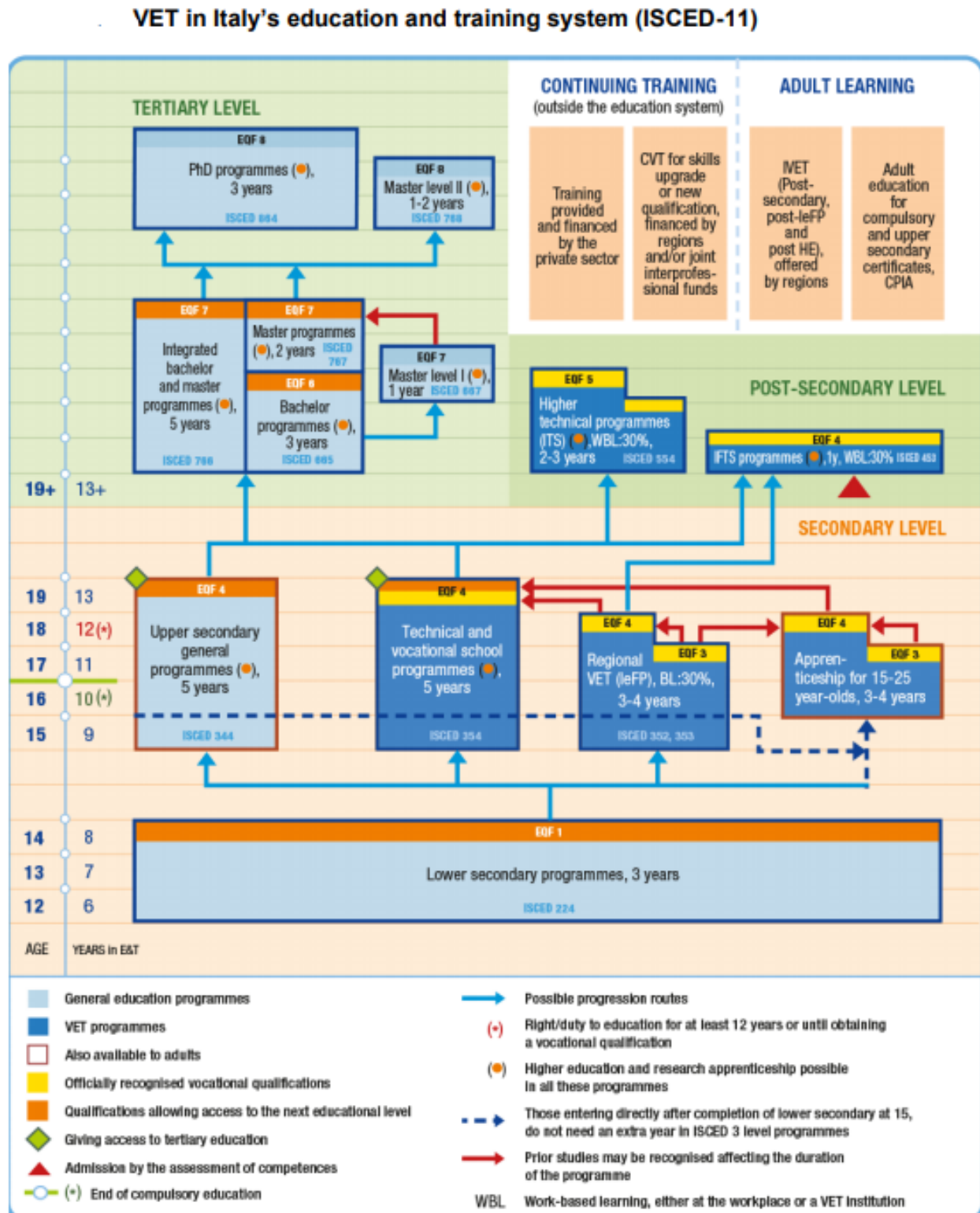
Source: Cedefop, in cooperation with ReferNet Italy.