Deliverable R3.2
Methodology for realizing VET curricula

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Deliverable Title	Methodology for realizing VET curricula
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Short Description	The methodology presented in this deliverable is adopted in realizing the modular high-quality VET curricula in the lighting sector. It is based on the principles of adult education and it includes the specification of learning outcomes and learning objects and associated ECVET. It supports three types of learning through a staged approach that combines MOOC, e-Learning, face-to-face training and work-based learning.
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Abstract

This deliverable entitled "Methodology for realizing VET curricula" provides the main methodology for the ECOSLIGHT project in order to implement the VET curricula; at a second level it provides the methodology adopted for the content production procedure for all components of the VET curricula (MOOC and Specialization Course, and work-based learning). It is part of the Task 3.2 – Design of VET Methodology. Special emphasis is given to the methodology to produce learning outcomes.

Initially, reference is made to issues that concern adult education for professional development (Chapter 2), while in Chapter 3 the methodology adopted by the ECOSLIGHT consortium and used throughout the project lifecycle in order to realize the ECOSLIGHT VET curricula is described. Next, Chapter 4 refers to the two-stages training (MOOC and Specialization course) and the methodology adopted in order to develop content for the ECOSLIGHT VET curricula based on the learning outcomes (*4.1 Instructional design methodology for the ECOSLIGHT MOOC content development* and *4.2 Instructional design methodology for the ECOSLIGHT Specialization course content development*). Last, the reader may find in the Appendices the set of templates that must be filled in during the methodologies implementation, flowcharts for the appropriate monitoring of the content design and development process, supportive documents to the above methodologies, a methodology on how to write effective learning outcomes according to Bloom taxonomy and many more.

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1 Introduction

This deliverable entitled "Methodology for realizing VET curricula" aims to deliver the methodology for VET curricula, with special emphasis to the online learning objects that will be developed and provided to the public by the ECOSLIGHT project. The reader should keep in mind that the ECOSLIGHT employs a staged VET methodology, consisting of a MOOC, a blended learning stage, and a work-based learning stage. Therefore, this document provides deep insights for the content design and development, primarily for the MOOC and blended learning course, and secondary for the work-based learning component.

In brief the MOOC will be based on a curriculum of 22 competence modules, of 80 hours equivalent of learning. It will be delivered in 8 weeks, fully online, with the support of online tutors according to a predefined time schedule. The assessment will be based on the learning outcomes approach characterizing the competence modules delivered during the WP4 and 5, and will be conducted online through multiple learning objects, short lectures, case studies and self-assessment tests. The exams for the certification will be conducted separately.

Subsequently, the ECOSLIGHT Specialization Course will be a 24 week course, including face-to-face (around 24 hours), online and self-study (around 140-160 hours), assessment (16 hours) and work-based (around 200 hours, including 120 hours on the job in real work environment and 80 hours for the development of a job-role specific project) learning, delivering a specialized set of lighting, digital (basic and advanced), green, entrepreneurial and life competences.

The online learning component of the course will be based on a curriculum of around 20-25 competence modules (depending on the VET curricula), delivered fully online, with the support of online tutors in predefined time schedules. The face-to-face learning sessions will be used to enhance collaborative learning, solve questions, provide networking, and use triggering learning techniques such as brainstorming and implementing case studies and group learning. The work-based learning will be conducted by the learner in an organization implementing lighting activities, based on pre-defined and agreed learning activities characterized by their own learning outcomes, as an implementation of the competence modules (online learning), on a particular VET curricula related to a job role profile. The assessment of the online learning will be based on the learning outcomes characterizing the competence modules delivered, and will be conducted online through multiple choice assessment quizzes, graded practical assignments and self-assessment tests. The assessment of the work-based learning will be conducted through a WBL report and a WBL presentation based on predefined standards.

The training program, aggregately, will have a learning duration of around 480 hours (80 hours for the MOOC, around 200 hours for the specialization course learning, 200 hours the WBL). The 280 hours (around 58.3% of the duration) will be delivered online and face-to-face, whereas the 200 hours (around 41.7% of the duration) will be dedicated to the work-based learning. These numbers include both the MOOC and the specialization course, the assessment, but not the certification exams.

Chapter 2 presents the adult education principles. Chapter 3 refers to the methodology adopted by the ECOSLIGHT consortium and used throughout the project lifecycle in order to realize the ECOSLIGHT VET curricula. Subsequently, Chapter 4 refers to the two-stages training (MOOC and Specialization course) and the methodology adopted in order to develop content for the ECOSLIGHT VET curricula based on learning outcomes according to the Bloom Taxonomy and are described in details in *4.1 Instructional design methodology for the ECOSLIGHT MOOC content development* and *4.2 Instructional design methodology for the ECOSLIGHT Specialization course content development*. Last, the reader may find in the Appendices the set of templates that must be filled in during the methodologies implementation, flowcharts for the appropriate monitoring of the content design and development process, supportive documents to the above methodologies, a methodology on how to write effective learning outcomes according to Bloom taxonomy and many more. The self-assessment tests will be provided accordingly during the learning duration at regular intervals.

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2 Educating adults: an approach for professional development

2.1 Adult education

As constituted primary by Malcolm Knowles in the 1970s with the term andragogy and has been documented by a number of research results, adults do not learn the same way with younger students. Adults have special needs as learners and these needs should be taken into account when planning training for them. Therefore, a number of assumptions about adult learning are underlined: need to know, self-concept, prior experience, readiness to learn, learning orientation, and motivation to learn. Furthermore, the learning procedure should combine the social constructivism (Vygotsky) as adults have already full interaction with the society and emotional intelligence (Goleman); moreover, adults have greatly developed self-awareness, self-control, and empathy.

Therefore, the ECOSLIGHT consortium took into consideration all the above assumptions in order to realize the methodology for ECOSLIGHT VET curricula and took it into account in the design of the VET curricula and in the learning process, as follows;

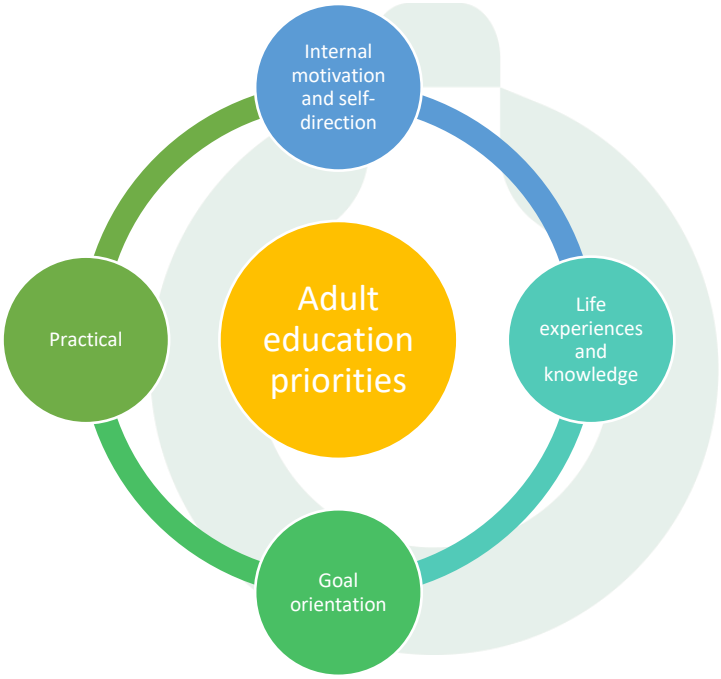

Figure 1: Adult education priorities

Internal motivation and self-direction
Adults believe they are responsible for their lives. They need to be considered and treated as capable and self-directed. The most serious motivators are internal (e.g. desire for increased job satisfaction, self-esteem); the design of learning materials and processes should take this into account.

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Life experiences and knowledge
Adults come into a learning activity with different prior experiences. There are differences in background, learning styles, motivation, needs, interests, and goals. Adults also learn better if the teaching is focused on problems to be solved rather than content to be memorized, creating a greater need for differentiation in teaching and learning techniques used (discussions, simulations, problem-solving activities, role playing or case methods). In line with the above emphasis in adult education, additional attention should be provided on the learning techniques that take into consideration the learners' experiences, such as group discussion, problem-solving, case methods, simulation exercises, games, and role-play, instead of using solely passive techniques such as lecture. Using a combination of these teaching strategies will have the greatest impact.

Goal orientation
Adults would like to learn things they need to know and do in order to manage effectively real-life situations. They have the intention to acquire relevant and adequate knowledge and want to learn what they can apply in practice; the most important they want to know is why they need to learn something before learn it. Thus, the learning objectives and the intended learning outcomes should be clearly identified in all learning components.

Practical
It is very important for educators / trainers to identify the appropriate ways and convert theoretical learning to practical activities. Work-based learning is a way for adult learners to apply the theoretical concepts they learned inside the classroom or online into real-life situations and actual working conditions and demands. Learning is assisted when appropriate ways of implementing theoretical knowledge in real life situations is made clear.

2.2 Learning types

Typically, formal learning is conducted in school, university or through other formal courses; and this is considered as the only valuable learning. According to the CEDEFOP (2008)[1],

Formal learning: Learning that occurs in an organised and structured environment (such as in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). Formal learning is intentional from the learner's point of view. It typically leads to certification.

Non-formal learning: Learning which is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. Non-formal learning is intentional from the learner's point of view. It typically does not lead to certification.

Informal learning: Learning resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective.

Non Formal courses may be conducted through MOOCs and other forms of online learning; some even carry some form of accreditation. Informal learning is flexible and it can suit one's mood and the way he or she wants to learn. It can be done when and where he / she wants and, most importantly, whenever he or she wants.

[1] https://www.cedefop.europa.eu/en/events-and-projects/projects/validation-non-formal-and-informal-learning/european-inventory/european-inventory-glossary#F

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2.3 The rule of 70-20-10

The 70-20-10 Model for Learning and Development is commonly used in professional training. The model was created in the 1980s by Morgan McCall, Michael M. Lombardo and Robert A. Eichinger, when they were researching on the key developmental experiences of successful managers. According to them, adults gain their knowledge from different sources. The 70% of the knowledge is gained through job-related experiences, the 20% by improving their experiences through interaction with others, while the last 10% is gained via formal training.

To be more specific, the 70% is thought to be the most beneficial for employees as it enables them to discover and refine their job-related skills, by making mistakes in a real-working context and interacting with other people in work settings. The knowledge gained through job-related experiences is the most beneficial for a professional. Employers increase their working skills, learn how to make decisions while addressing challenges, and enhance their communication skills through their daily interaction with their mentors and co-workers. They also learn from their mistakes and receive immediate feedback on their performance. Learning from others is the 20% conducted through social learning, coaching, mentoring, collaborative learning and other methods of interaction with peers. Encouragement and feedback are the main benefits of this approach. Last, the 10 % of the professional development comes from formal instruction and other training events.

Taking everything into account, the model of 70-20-10 is extensively applied due to the easy access to a variety of high-quality learning materials that exist. Web-based portals and data – sharing platforms (as the YouTube), are extensively used to train professionals.

2.4 The COVID-19 influence to the learning procedure

Formal instruction and the training events through webinars have gained a lot of attention from adults when the necessity of social distance for protection from a pandemic forced them to work from home. This effect has influenced the adults and made them to get in with the technology and be part of alternative ways of learning. Thus the 70% of the knowledge gained enhanced through job-related experiences was slightly changed due to the pandemic, up scaling the other two factors (e.g. through webinars).

2.5 The orientation of ECOSLIGHT

In the case of ECOSLIGHT, the aforementioned model was slightly changed for two reasons; first, the learners were mostly working adults, therefore the work-based learning experiences (i.e. the 70%) should be decreased and supported extensively by the online learning component. Second, based on the results of the identification of training needs and the extensive proliferation of contemporary technologies, theoretical knowledge with specific practical exercises (practical assignments) was selected as the ideal component. Therefore, the rule applied in practice was formulated to 45-10-45. This was a scientifically justified decision of the ECOSLIGHT consortium. The COVID influence to learning procedure influenced also the decision with a positive way in order to be adapted in real circumstances.

The ECOSLIGHT consortium follows a staged approach that combines MOOC, e-learning, face to face training and work-based learning, focusing mainly in non-formal and informal learning. In detail, the ECOSLIGHT project focuses to the development of lighting professionals, through a blended learning approach; this decision was taken in order to

(a) Respect the fact that (candidate) learners were working adults, many of them with family obligations and heavy work duties, therefore they should be supported to learn on their own pace (but in predefined intervals and schedules); in this regard, an extensive online learning approach should be followed and stressed as much as possible.

(b) In parallel, the (candidate) learners should be engaged in face-to-face sessions, in order to implement group learning, facilitate problem solving, exchange experiences and connect with their peers.

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(c) The practical application of the newly acquired knowledge was more than essential, in order to perform effectively and efficiently in their (newly defined) working (job) role, and in the context of a "real" organization, i.e. a lighting or state organization.

(d) This effort should be supported by tutors, in order to facilitate learning and solve the questions of the learners.

The main task of the tutor (no matter if it is a tutor of a competence or a supervisor in work-based learning) will be to monitor the development of the activities, so that the learning and engagement of the learner proceeds in an integrated and efficient way. The order and to maximize the effectiveness of the blended learning activities, they are defined in the training program and agreed between the VET provider and the social partners.

The ECOSLIGHT platform should include a variety of learning materials and practical assignments, divided into competences, designed wisely for the distance learning part of training, providing to the tutors and the learners content and pre-defined tools enhancing their collaboration, skills and competences development, and peer learning overall. The most challenging tutoring goal in a blended learning approach is the integration of the activities performed in presence and at a distance, in order to obtain the desired results. Tutoring should be done at three levels: (a) individual participants, (b) groups of participants, and (c) the VET curricula level.

Working with **individual participants** should build upon the knowledge and relationship developed with and between them. The tutor supports the participant by facilitating the use of online resources and classroom activities; helps him/her to reflect on the experiences developed; helps him/her to connect the new contents learned with his/her previous experience (this scaffolding action is crucial with adult learners); facilitates the participant's relations with the peer group; and finally, the tutor is the natural interface with the organisations (ECOSLIGHT partnership, local VET provider, social partners) that provide the training. The tutor has the obligation to prepare the individual participants for the group meetings. The variety of different disciplines in lighting such as physics (the light is part of the wavelength), architects (light is part of enhancing the construction), electrical engineering (light is part of the electrical planning), doctors (light is affecting the biological rhythms of human body) etc, creates huge awareness about the knowledge needed between these sciences. The tutor must identify the gaps, the missing basic knowledge between the individual participants and give the appropriate directions and educational material. One of the roles of the main competence is to prepare the individual participants for the group meetings.

When working with **groups**, tutoring should support the transformation of the group's participants into a learning community. In a social learning perspective, tutoring promotes collaboration among the participants and facilitates the development of peer consulting and peer support relationships among them. The tutor also controls and encourages participation in distance activities involving peer sharing and collaboration. The tutor should combine the different principles of lighting and encourage all the professionals to act as tutors and share their specific knowledge with the rest of the group. The tutor should emphasize to the circadian rhythm which are entrainment from the light spectrum, thus the professionals should apply the proper technical specification to indoor environment when they design a building.

In the delivery of the **training course**, the tutor collaborates in the didactic planning; gives his/her opinion on contents and verification tests; guarantees the usability of the resources dedicated to distance learning, and manages the transition from presence to distance. The tutor should prepare regularly self assessment tests and encourage the participant to involve with lighting industry.

Teaching is the didactic-specialist function of delivering technical disciplinary training content. In the blended learning context designed by the ECOSLIGHT project, teaching entails delivering lessons in presence and at a distance by using the online resources available on the ECOSLIGHT platform, but also preparing or overviewing the production of

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additional digital learning materials such as learning objects (LOs), readings, exercises. Teachers also develop the practical assignments, promote and monitor their delivery and assess (grade) their outcomes.

The functions described above are contiguous and complementary. In short, facilitation starts the dialogue with and support process of the participant; tutoring continues this process and oversees the whole didactic process; teaching is devoted to content delivery and assessment.

ECOSLIGHT will give an extra attention to the preparation of the individual participates as the scientific differentiation in the lighting major is huge.

As already foreseen, the main technological resource in ECOSLIGHT is the ECOSLIGHT Moodle platform (separate platform for the MOOC and the specialization course) that allows managing and delivering a range of online resources and activities designed to be carried out at a distance or in the classroom, at individual and group level, in both synchronous and asynchronous modes. Participants will be able to access the platform with rights that allow them, as they acquire the needed ability, to participate in the educational activities by reading content on the lessons' key topics, carrying out practical assignments, uploading files when requested, responding to learning quizzes, writing on the forums and other tasks.

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3 Implementing the ECOSLIGHT VET curricula

3.1 A methodology for vocational education and training implementation

In the ECOSLIGHT project, the consortium applies a two level methodology. The 1st level, described below, refers to the methodology that si adopted by the ECOSLIGHT consortium and is used throughout the project lifecycle in order to realize the ECOSLIGHT VET curricula. The 2nd level refers to the two training stages (MOOC and Specialization course) and the methodology adopted in order to develop content for the ECOSLIGHT VET curricula based on the learning outcomes according to the Bloom Taxonomy[2], as this is the most critical part for the effectiveness of both MOOC and Specialization course, and the work-based learning, and are described in details in *4.1 Instructional design methodology for the ECOSLIGHT MOOC content development* and *4.2 Instructional design methodology for the ECOSLIGHT Specialization course content development*.

Therefore, the 1st level methodology that is adopted by the ECOSLIGHT consortium for realizing ECOSLIGHT VET curricula using blended learning is an instructional methodology which is developed and provided to the lighting professionals during the lifecycle of the project. The methodology followed, illustrates the five phases of the instructional design of the well-known ADDIE model (Analysis, Design, Development, Implementation and Evaluation). This methodology – contextualized appropriately for the development of the ECOSLIGHT blended course.

3.1.1 Analysis phase

During the analysis phase the training problem that will be addressed through the ECOSLIGHT VET curricula is analyzed in order to specify the purpose of training, the knowledge domain, the main learning goals, the basic learning objectives and the learners' profile, and set the necessary limitations and knowledge prerequisites. Thus, the subject of teaching and the learning goals are determined, according to the *WP2 – Identification of emerging roles and needs in the lighting-related construction sector* results for the lighting professionals, defining the four emerging job role profiles: (a) Smart Lighting Systems Technician, (b) Lighting Consultant, (c) Lighting Systems Assistant Engineer, and (d) Landscape and Street Lighting Technician.

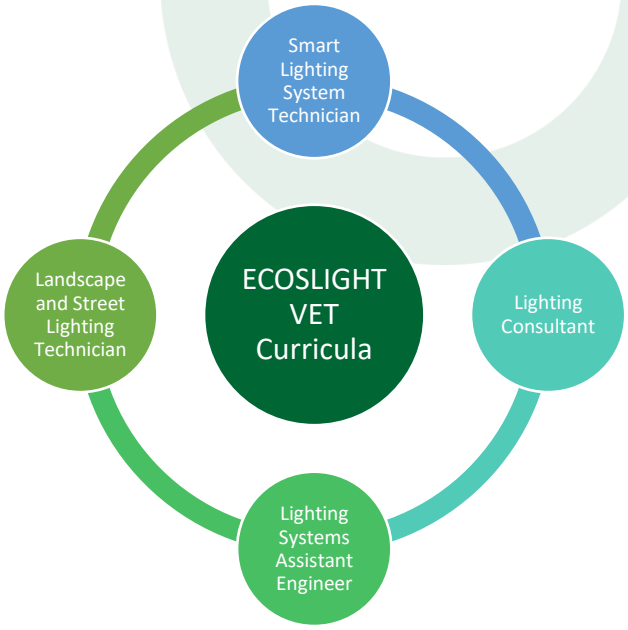

Figure 2: The selected ECOSLIGHT profiles for creating VET curricula

[2] Bloom, B.S. (1956). Taxonomy of educational objectives: The classification of educational goals. New York, NY: Longmans, Green.

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The **Smart Lighting Systems Technician** is an emerging profile, horizontal in a degree, which can be employed in indoor and outside; the proliferation of ICT technologies, sensors, and the IoT overall, has created the need of a job role profile capable of enhancing lighting tasks with smart lighting. This role can and should be at the level of technician and not upper, as the expertise and R&D come from IT professionals. A Smart Lighting Systems Technician is a hybrid technical expert on IT smart solutions and lighting that should be able to:

- Analyze the lighting project data.
- Determine information system requirements and define project objectives.
- Apply software development process, development environments, tools and techniques.
- Make recommendations for necessary IT system components e.g. hardware, software and networking systems.
- Design, implement and deploy new smart lighting services.
- Operate IT systems and services in relation to lighting.
- Provide support and training to various types of users.

A **Lighting Consultant**, crafts ideas, creates designs and then transforms them into real-life solutions with a successful blend of creativity and pragmatism. For this type of professionals it is essential to closely collaborate hand-in-hand with architects, designers and creative teams. Some of the main missions of a lighting consultant are to,

- Provide expert advice and solutions for beautiful and functional lighting indoor or outdoor
- Recommend sustainable lighting options that will create pleasant effects in every space
- Convert lighting needs into a clear design with everything required for purchasing and installation
- Design light that is functional, dynamic and enhances living spaces
- Work in close collaboration with customers.

Moreover, a Lighting consultant knows how to respond to the market demand thanks to his/her (or its, in case of a company) technical, artistic, normative competences and know-how, as well as the ability to listen to the needs of customers, offering assistance with willingness, dedication and sensitivity.

A **Lighting Systems Assistant Engineer** is concerned with the optimization of complex processes, systems, or organizations by developing, improving and implementing integrated systems of people, money, knowledge, information and equipment applied to Lighting Systems and its components, supporting the work of the Lighting Systems Engineer. He/she contributes to fast realization of prototypes as well as effective product development, by applying deep engineering knowledge of the most relevant coding platforms and standards, in combination with proven Agile collaboration methods and test-driven development.

The job of the Assistant Lighting System Engineers is versatile and strongly depends on the company that will employ such professional. It can be also found as Assistant Research Engineer (EQF 5). In all above cases, required skills and training level (from EQF level 5 and above degree) are similar, but the main difference is the required relevant experience.

An Assistant Lighting System Engineer should demonstrate a system approach to design and develop with the desire and curiosity to strive for continuous improvement. He/she needs a deep understanding of the first principles/engineering fundamentals that drive the requirements of lighting systems. Add to these expectations, a detailed understanding of the manufacturing, materials and processes utilized to produce your components as well as commercial and financial awareness

The main tasks that an Assistant Lighting Systems Engineer is dealing are:

- Developing and testing lighting components and modules for any kind of lighting
- Supporting the Development of functional requirements and specifications
- Supporting the preparation of prototypes of the new product concepts

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- Preparing reports with test summary analyses
- Supporting the implementation of projects to release to production new/changed products, components and processes.
- Keeping abreast of technical developments in own field through literature, technical contacts, and industry competition analyses
- Working closely with support functions and the Lighting Systems Engineer
- Working within a matrix organization whilst delivering towards project-based goals set by the program management team

A **Landscape and Street Lighting Technician** is responsible for the preparation, installation, rigging, wiring, operation and maintenance of lighting systems in theatres, venues, concert halls, broadcasting studios, indoor and outdoor live events etc. He or she implements the lighting design according to a lighting designer's plan and instructions and produces the appropriate visual effects for an arts/entertainment event, show or any type of broadcasted production. His / her work is physically demanding requiring physical mobility, balance, strength and agility because heavy lifting and working at heights in order to install the lighting equipment are often required. The work requires ability to use hand tools and power-driven machinery, knowledge of health and safety requirements and collaboration with other professionals, e.g. lighting designers, sound technicians, the theatre director, production manager etc. so as to deliver the optimal result in any type of production.

Key tasks and responsibilities of the Landscape and Street Lighting Technician includes the following:

- Interpreting a lighting designer's plan
- Installing, wiring, rigging, focusing and operating necessary lighting equipment
- Programming lighting control consoles and auxiliary equipment before the show/event
- Choose and combine colours to achieve the desired effect
- Provide and distribute power around the set and support areas
- Operating manual and computer-controlled lighting systems and controls during a show/event
- Performing routine maintenance functions such as replacing damaged light fixtures, luminaire drivers, color filters, so as to ensure the safe operation of lighting equipment and prevent technical problems
- Maintenance and proper utilization of electrical tools and equipment
- Operating within current health and safety regulations especially when working at heights and installing equipment
- Uninstalling all equipment at the end of the broadcast or production and ensure its safe transport and/or storage
- Attending production meetings to establish lighting requirements for a production
- Conferring with the lighting designer or the director of photography and other staff so as to integrate their creative vision into the lighting design as well as with other departments, such as sound and camera, the floor manager and producer etc.
- Coordinating the equipment and the technical crew and train other crew members as required
- Conducting risk assessments and ensure health and safety with regards to lighting
- Providing advice on the lighting budget and on the purchase of equipment
- Keeping abreast of the advances in technologies and techniques in the industry.

At the end of the phase, the **learners' profile** is identified as it is described in WP2 deliverables.

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3.1.2 Design phase

The design phase is the most essential and demanding one in the particular ECOSLIGHT VET curricula development methodology. The purpose of this phase is to identify and describe in detail the way training will be conducted during the project lifecycle. Subsequently, for each training phase and for each training component, the learning objectives are defined, as well as the educational strategy that will be applied and the learning outcomes are identified. In each phase, it is equally important to define the students' assessment methods.

Thus, the professional development for the four job roles that are specified under the *WP2 – Identification of emerging roles and needs in the lighting-related construction sector*, and described accordingly in *R2.2 – Emerging Job Profiles for ECOSLIGHT professionals related to lighting design and lighting technologies*, encompasses two main phases;

The first training phase conducted online for all the four roles concurrently (and before learners are allocated into / select them). The common training strategy applied through a **MOOC**, using the same learning materials and activities for all roles, addressing the learners' common needs. This decision si made because (a) the particular competences are common for all the four job role profiles, and (b) is considered as introductory to the second phase. All the individual participants should have a common ground of knowlegde, incorporating, biological part, optical part, energy part, emotional part and phychological part of lighting. Each of these issues has been introduced to different proffesionals of lighting industry, but a combination of all of them is neccessary for having an integrated outcome. The ECOSLIGHT has to undertake an analysis of published scientific studies and review experience from published application studies on non-visual effects of light on humans, with the aim to provide the knowledge for safe and beneficial use in lighting applications beyond illumination for vision.

The second phase follows a **blended learning approach**, where each different role (profile) will participate in online and traditional face-to-face learning sessions, and the learners will join an engaging and productive work-based learning activity.

The first stage of the VET methodology has foreseen a "horizontal" MOOC of 80 hours equivalent of learning. During this training, all participants are trained in 22 competences in 8 weeks. These 22 competences are the following:

Week	Competence	Type / Framework	Hours
1	Indoor Lighting for Buildings and Artificial Lighting	Lighting	4
1	Understand and promote the value of sustainable lighting	Green	5
2	Evaluating data, information and digital content	DigComp	3
2	Understand the sustainable assessment of lighting systems and solutions: purposes, methodologies, standards	Green	4
2	Spotting opportunities	EntreComp	3
3	Light for Outdoor installations	Lighting	4
3	Collaborating through digital technologies	DigComp	3
3	Growth mindset	LifeComp	3
4	Lighting system and components technologies including smart Lighting (indoor and outdoor)	Lighting	5
4	Understand the new sustainable lighting techniques applied to sustainable lighting	Green	4
5	Protecting personal data and privacy	DigComp	3
5	Understand the selection criteria of lighting services / systems and products in terms of sustainability	Green	4

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5	Creativity	EntreComp	3
6	Light influence on human health, well-being and working performance (Lighting Ergonomics)	Lighting	4
6	Vision	EntreComp	3
6	Valuing ideas	EntreComp	3
7	Understand the circular economy approach to lighting sector	Green	5
7	Critical thinking	LifeComp	3
7	Taking the initiative	EntreComp	3
8	Energy Efficiency and Lighting performance	Lighting	5
8	Planning and management	EntreComp	3
8	Coping with uncertainty, ambiguity and risk	EntreComp	3
		Total hours:	80

Table 1: MOOC competences

During the MOOC, each lighting competence will have a 4-5 hours learning equivalent, each basic digital competence (DigComp) 3 hours learning equivalent, each green competence 4-5 hours learning equivalent, while each entrepreurship (EntreComp) and life competence (LifeComp) around 3 hours of learning equivalent.

The second stage of the online learning, during the specialization course, is dedicated to each separate job role profile.

Competence	Type / Framework	Smart Lighting Systems Technician	Lighting Consultant	Assistant Lighting Systems Engineer	Landscape and Street Lighting Technician
Lighting Design and solving technical problems	Lighting	7	6	7	7
Lighting policy, regulation, energy labelling	Lighting	6	6	6	6
Economic models related to lighting	Lighting	7	6	6	6
Environmental impact of lighting	Lighting	7	7	7	7
Integrating and re-elaborating digital content	DigComp	5	4	4	4
Solving technical problems	DigComp	5	5	5	5
Identifying needs and technological responses	DigComp	5	4	4	5
Product/service planning	e-CF	7	6	6	6
Application design	e-CF	7	6	6	6
Innovating	e-CF	7	6	6	6
Application development	e-CF	7	7	7	7
Solution deployment	e-CF	7	6	6	6
User support	e-CF	7	6	6	6
Education and training provision	e-CF	7	6	6	6
Risk management	e-CF	7	6	6	6

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Understand the types and principles of the basic Environmental and Energy Labelling schemes and national / international policies	Green	7	6	6	6
Understand sustainable building certification systems in the lighting sector	Green	7	6	6	6
Understand the use of Environmental and Energy Labelling	Green	7	6	6	6
Understand the Life Cycle Costing (LCC) process, apply the LCC to build environment decision-making to lighting cases	Green	7	6	6	6
Understand the new sustainable / green trends in lighting and how to integrate the environmental / sustainability criteria in the lighting design process	Green	7	6	7	7
Ethical and sustainable thinking	EntreComp	5	5	5	5
Financial and economic literacy	EntreComp	5	4	4	4
Working with others	EntreComp	5	5	5	5
Learning through experience	EntreComp	5	5	5	5
Flexibility	LifeComp	5	4	4	4
Empathy	LifeComp	5	4	5	5
Communication	LifeComp	5	4	5	5
Collaboration	LifeComp	5	4	5	5
Managing learning	LifeComp	5	5	5	5
	Total hours:	**178**	**157**	**162**	**163**

Table 2: Specialization course competences

During the Specialization course, each lighting competence will have a 6-7 hours learning equivalent, each basic digital competence (DigComp) 4-5 hours learning equivalent, each green competence 6-7 hours learning equivalent, while each entrepreurship (EntreComp) and life competence (LifeComp) around 4-5 hours of learning equivalent. The e-CF competences correspond to the level 5 of the EQF. A part of the learning equivalent of each competence during the Specialization course will include a practical assignment oriented to the tasks of each different job role profile. The variation of the learning equivalent per competence is based on the needs originated from the ECOSLIGHT quantitative survey and the ECOSLIGHT interviews.

The application of the concurrent implementation of competences originating from DigComp, e-CF, EntreComp, LifeComp, in conjunction with lighting related competences and other originating from various "green-related" frameworks is one of the key achievements of ECOSLIGHT. So far, there is not another implementation in the sector based on all these European frameworks and priorities.

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Thereafter, the specification of the course's Learning Outcomes (LOut) is conducted using the Bloom's Taxonomy[3], analyzing the learning goals and objectives that have been previously set (Analysis phase) in particular knowledge, abilities or skills (i.e. learning outcomes) that the learner should ideally be able to do after the successful completion of the course.

For each learning outcome defined, a Learning Object (LO) should be designed in the current step in order to fulfill it. The design should include at least the following information:

- The LO's *title*
- A short *description* of the LO's content
- The primary *language* used within the LO
- The LO's *learning resource type*
- The *format* of the LO
- The *keywords* describing the topic of the LO
- The *learning outcomes* that the LO serve
- *Reference to existing educational material* that can be used as content of the LO

The above elements constitute in substance, the draft of a LO and provide all the required information that is necessary for the development of LOs. Subsequently, each one of the two training phases (MOOC and Specialization course) will be analytically designed as described in details in Chapter 4.

[3] The reader may found a complete guide for writing effective Learning Outcomes in the Appendix

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3.1.3 Development phase

The development phase includes the production of the learning material (content) which is based on the design realized in the previous phases of the ECOSLIGHT VET curricula. The learning objects (core, additional supportive material, collaboration and assessment learning objects) are developed as described in the previous phase, according to their technical type with respect to their learning resource type for each of the two training phases (MOOC and Specialization course) and for every competence as described in details in Chapter 4.

During the development phase, authors collaborate with multimedia developers, video experts (technical staff), who contribute in creating or editing qualitative educational videos and additional digital educational material as described in the design phase. In parallel, the technical team sets up the online platform, integrates the educational material into the platform and creates the platform manuals, while social partners design the implementation of the MOOC, the blended course and the Work-based learning.

During the design and development phases of the main methodology, and in order to apply the second of the two level methodology, the well-known ADDIE model (Analysis, Design, Development, Implementation and Evaluation) is applied in the two training phases (MOOC and Specialization course). The objective is to develop training content based on the learning outcomes approach according to the Bloom Taxonomy for the realization of the ECOSLIGHT VET curricula, as this is the most critical part for the effectiveness of both the MOOC and Specialization course. More specifically, the consortium applies the methodology provided by the WP3 leader, the HOU. This methodology which is based on the learning outcomes of the Bloom taxonomy, aims to produce learning objects based on the identified learning outcomes.

Bloom and his colleagues advanced their work mainly in the cognitive domain, as this is required in the majority of the cases. They produced a hierarchical framework through which one (trainee) may build upon prior learning and upscale his or her knowledge. Additionally, it is used extensively to write learning outcomes providing the foundations for developers. Its ready-made structure, in conjunction with the provided (list of) verbs, facilitates significantly the writing of learning outcomes. Bloom's taxonomy of cognitive domain consists of the following six levels (Bloom et al, 1956, Kennedy et al, 2006).

Also during the design and development phases, an important number of supportive documents were developed by HOU in order to support all participants in these phases in the ECOSLIGHT VET content development and improve the quality of the results (training materials). These supportive documents can be found in the Appendix 2 Supportive documents and they are:

Supportive documents
1. ECOSLIGHT MOOC instructions for completing the TB3 and TB3a tables (Design of Learning Objects) + Workload estimation (in Appendix 2)
2. Comments on ECOSLIGHT TB3 - Learning object template (in Appendix 2)
3. Scientific Reviewer Check Form Template (MOOC + Specialization Course) (accompanying document)
4. Scientific Reviewer Check Form for Practical Assignments (accompanying document)
5. Assessment Objects (Guidelines + Template) (accompanying document)
6. Transcripts Template (accompanying document)
7. Educational Video Guidelines (accompanying document)
8. Structural guidelines for online distance learning textual material (in Appendix 2)
9. Structural guidelines for online distance learning presentations (in Appendix 2)
10. Guidelines to select OER for the ECOSLIGHT Project (accompanying document)
11. Presentation Learning Object Template(accompanying document)

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12. Learning Object Description Template (accompanying document)
13. Practical assignments (types) (in Appendix 2)

Table 3: List of supportive documents for the development phase

3.1.4 Implementation phase

During this phase, the training is implemented as designed and developed in the previous phases, and the learning effectiveness is assessed. The primary goal of this phase is the dissemination and publication of the courses. The courses promoted and disseminated via the social networks, advertising, communities and email databases, newsletters and relevant websites of lighting. All the partners contribute to this effort, and especially the sector representatives. Subsequently, the training process of the ECOSLIGHT VET curricula (MOOC course, blended learning course and work based learning) are implemented in predefined time periods, supported by tutors and the technical staff.

First, the pilot version of the Massive Open Online Course (MOOC) which is developed under the ECOSLIGHT consortium is delivered in 80 hours equivalent of learning. During this training, all participants are trained in 22 competences in 8 weeks. If needed, and in order to decrease the drop-out rates, the MOOC will make a break in the middle of the period for 1-2 weeks, so as to facilitate and engage learners that have delayed their learning.

The delivery of the blended course is at the heart of the ECOSLIGHT project, after the completion of the ECOSLIGHT MOOC. It consists of Face-to-Face (or in class training), online and self-study via the e-learning platform and other educational sources. It is accompanied by a serious component of work-based learning.

Concerning the specialization course, the ECOSLIGHT VET methodology foresees that after a careful selection of trainees (based on particular criteria), they should be enrolled to the online learning devoting around 20 hours per week in the beginning. Then, gradually, this effort must decrease as they enrol in parallel to the work-based learning. Both online and work-based learning are characterized by particular learning outcomes. The online learning includes also practical learning activities (assignments) related to the actual working tasks of the four different ECOSLIGHT Job role profiles. Formative and summative techniques must be employed to validate the accomplishment of the foreseen learning outcomes.

The necessity of this tool is justified also from the European Lighting Expert Association (ELEA) which has established a Europe-wide harmonised educational standard for light and lighting, which is examined in the individual member countries by the national lighting societies. After passing the examination, registration with the ELEA as a European Lighting Expert (ELE) takes place. However, the gap of how someone can obtain the necessary knowledge for an ELE is huge. The ELE concept is suitable for all candidates with different education and previous knowledge in the field of light and lighting and for those who want to have a recognised confirmation of their knowledge and skills. An ELE can fulfil requirements that are demanding but do not necessarily require a university education degree. The target groups include: Electrical planners and installers, architects, interior designers, engineers, employees from the housing industry, facility management and wholesale trade, responsible persons from municipalities and authorities, sales staff from the lighting industry, operators of lighting systems, energy consultants. Thus, it is necessary that all these fields should be involved into the implementation phase.

The blended Course has an overall duration of around 200 hours in total. This includes Face to Face learning (24 hrs), online and self-study (140-160 hrs) and assessment (16 hrs).

The components of the blended course are:

1. **Face-to-face training:** this includes class-based activities and the practical application of the learning attained.
2. **Online learning through the participation to virtual classes and self-study:** The virtual learning environment contains lecture notes and practical assignments.
3. **Assessment test:** these are used to prepare the participants for the validating their progress. Formative and summative assessment is foreseen, as described in the Evaluation phase.

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The work-based learning of the ECOSLIGHT project is set to last 10 weeks (200 hrs), including 120 hrs of practical in real work environment learning (placement) and 80 hrs of project work. This phase provides an immersive experience for the learners as they have the opportunity to learn first-hand, by applying their knowledge and experience to a pre-defined situation. The Project partners are working in country clusters with the social partners (AFE (FR), EVBB (DE), TCG (GR), ELCA (IT)) undertaking the task to find and select the work places that will host the trainees. The sector representative partners are also engaged to the assurance of the quality of the learning materials, mainly through the scientific review of the practical assignments. In addition to this, they will select supervisors that will check on a weekly basis the learners' progress.

3.1.5 Evaluation phase

The curriculum evaluation is a necessary and important aspect of any training process. It provides the basis for curriculum policy decisions, for feedback on continuous curriculum adjustments and processes of curriculum implementation. The main objectives to the curriculum evaluation relate to:

- The effectiveness and efficiency of the training practice;
- The status of the curriculum contents and practices;
- The achievement of the goals and aims of the training programs.

Curriculum evaluation aims to examine the impact of the implemented curriculum on the trainee (learning) achievement in order to be revised if necessary, and to review the training and learning processes in the classroom (virtual of physical). In order to define the curriculum evaluation for the ECOSLIGHT VET curricula, we have to consider the *assessment strategy* and the *assessment methodology*. The *assessment strategy* refers to the overall framework within which the various assessment activities that are envisaged are set, while the *assessment methodology* refers to the techniques and tools for the assessment of the activities designed and realized, and the acquired learning outcomes. Moreover, the evaluation must be conducted in two directions. *Formative evaluations* should take place in every phase while the *final (summative) evaluation* takes place at the end of all phases, in order to uncover improvement issues. Therefore, the evaluation consists of formative and summative assessment that includes:

Formative assessment
The formative evaluation is conducted in each stage of the process and includes information collection (through check sheets, focus groups results, interviews, questionnaires etc.) in order to identify problems in the training process. During the procedure, revisions can be done whenever evaluation considers it necessary. The purpose of the formative evaluation is (a) to estimate the correct implementation of every step of the development process and (b) to verify the quality of the delivered course.

Summative assessment
The final assessment measures the effectiveness of the training process. Providing feedback from trainees and team members using interviews, system logs (providing information of platform usage, rates of attendance in every activity etc.), questionnaires etc. The summative assessment should not be confused with the certification examinations.

The ECOSLIGHT consortium has adopted the following approach so as to address these complementary components in every stage and step of the realization of VET curricula. First of all, for each one of the two training phases (MOOC and Specialization course) during the content development procedure, it uses both the formative assessment (using check-lists and technical and scientific reviewers) and summative assessment (using questionnaires). The quality of the outcomes in each phase during the content development process is assured by the employment of three roles; the **author**, the **technical reviewer**, and the **scientific reviewer**. The author is responsible to design and develop the content. The technical reviewer monitors the intermediary outcomes and assures that they follow the instruction, e.g. each particular template is appropriately filled in. The scientific reviewer assures on the coherence and validity of the contents produced.

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Thus, during the delivery of the MOOC and the blended learning course, the acquisition of the learning outcomes (educational performance) is measured in order to define the training effectiveness (using learning quizzes, practical assignments etc.). On the other hand, in the work-based learning, **monitoring** is conducted by both the VET provider and the social partner / sector representative (per country). Given the fact that on-site visits are not always feasible, at least in high frequency as many learners / WBL sites are spread all over the countries,

- The social partners / sector representatives send a message to the learners every week requesting information about the progress of the WBL and to solve their questions;
- The VET providers send a message to the learners every two weeks focusing mostly on the learning aspect of the WBL.
- Both kinds of partners enhance their monitoring through on site visits or through other means of communication.

Assessment methods used are analyzed in the following sections. In general, the following types of monitoring and assessment will be adopted in the ECOSLIGHT specialization courses:

Type of assessment	Online	Face-to-face	Work-based learning
Formative	• Observation (monitoring) of learners' progress by the tutor • Monitoring of the learners' progress for the submission of practical assignments • Informative feedback from tutors through a form	Collaborative learning (not graded)	• Description of tasks and activities performed (trainee – supervisor) • Weekly question by the social partner / sector representative • Bi-weekly questionnaire by the VET provider • On site visits[4]
Summative	• Learning quizzes • Practical assignments		• Final presentation • WBL final report

Table 4: ECOSLIGHT assessment types

Thus, methods used include the following: online forms (questionnaires), papers (practical assignment description), exams, project assessment. Peer assessment will not be employed in these training activities, at least in the pilot phase of the ECOSLIGHT. Concerning the Work-based learning, the ECOSLIGHT project will develop and share with the engaged stakeholders (trainees, VET providers, employers) indicative learning activities furnished with learning outcomes, oriented to the different identified job role profiles. The assessment of the work-based learning will be conducted through (a) a WBL (predefined) detailed report, respecting the copyrights issue, and (b) a WBL presentation. The engagement of sector representatives to that approach ensures the scientific coherence of the approach and the compliance with the EQAVET principles.

All summative questions / project work in the online learning will be based on units of learning outcomes per learning module. The summative assessment of the WBL will be based on the WBL presentation (30%) and the WBL report (70%). Formative assessment will also be based on learning outcomes, mainly qualitatively by the tutor.

[4] Includes also communication through other means (e.g. Skype)

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	Assessment Questions	Project work	Observation in WBL (tutor-supervisor)	Assessment of the implementation of competences during the WBL activities[5]	WBL project reporting
Assessor	*Automatic*	*Tutor*	*Tutor – Supervisor*	*Supervisor*	*Social Partner / VET provider*
Grades	*Predefined*	*Scale 1-10*	*Scale 1-10*	*Scale 1-10*	*Scale 1-10*

Table 5: Grading approach

Concerning the grading,

- In the MOOC, each competence module will contribute equally to the final grade, with the percentage of each competence spread equally between the assessment objects. The learner should reach the threshold of 80% in order to pass and receive a certificate.
- The Specialization course final grade is synthesized with the grade of the blended learning (50%) and the grade of the work-based learning (50%).
    - Concerning the blended learning, the following formula will be applied:

$$Module\ Grade = \left[\frac{0,6 * \text{ of sum quiz grades}}{\text{Nr of quizzes} * 10} + \frac{0.4 * \text{ of sum P. A. grades}}{\text{Nr of P. A. } * 10}\right] * Max\ Grade$$

    - The work-based learning grade will be synthesized by the grade of the WBL report (70%) and the grade of the WBL presentation (30%).

Overall, in order to obtain the certification for each Job role profile, participants have to complete the following:

a) Successfully complete the "ECOSLIGHT MOOC on Essential Digital Skills for Lighting Professionals". This will be an 8 week course with a total study load (learning equivalent) of around 80 hours delivering a complete set of lighting, digital (basic and advanced), green, entrepreneurship and life competences for lighting professionals in the Digital Era.

The course will be based on a curriculum of 22 competence modules, delivered fully online, with the support of online tutors. The assessment will be based on the learning outcomes characterizing the competence modules delivered, and will be conducted online through multiple choice assessment quizzes.

Examination: Pass (80%) / Fail

b) Successfully complete the "ECOSLIGHT Specialization Course for (one of the Job Role profiles)". This will be a 24 week course, including face-to-face (around 24 hours), online (around 160-180 hours) and work-based (around 200 hours) learning, with a total study and practice load of around 400 hours, delivering a specialized set of lighting, digital, green, entrepreneurship and life competence for each separate Job Role Profile.

The online learning component of the course will be based on a curriculum of around 29 competence modules (depending on the VET curricula), delivered fully online, with the support of online tutors. The face-to-face learning sessions will be used to enhance collaborative learning, solve questions, and implement case studies. The work-based learning will be conducted by the learner in a lighting or state organization, based on pre-defined and agreed learning activities furnished with learning outcomes. The assessment of the online learning will be based

[5] Very difficult to be implemented, very time consuming

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on the learning outcomes characterizing the competence modules delivered, and will be conducted online through multiple choice assessment quizzes and graded practical assignments (accumulating the 50% of the final grade). The assessment of the work-based learning will be conducted through a report and a presentation based on predefined standards (accumulating the 50% of the final grade).

Examination: Pass (80%) / Fail

c) Successfully complete the certification procedure for the assigned job role profile. *The design of the certification procedure will be detailed in the next version of this methodology*.

Successful trainees will be nominated with a certification with around 30 - 32 ECVET points (depending on the job role profile), since the training program, aggregately, will have a learning duration of 480 hours (80 hours the MOOC, 200 for the specialization course learning, 200 hours for the WBL). The 280 hours (around 58.3% of the duration) will be delivered online and face-to-face, whereas the 200 hours (around 41.7% of the duration) refers to the work-based learning. These numbers include both the MOOC and the specialization course. The ECOSLIGHT curricula are intended to correspond to the Level 5 of the:

- European Qualifications Framework
- French Qualifications Framework
- Germany Qualifications Framework
- Hellenic Qualifications Framework
- Italian Qualifications Framework

3.2 Association of ECVET to the ECOSLIGHT VET curricula

The mobility and the provision of equal opportunities to EU citizens (and professionals) is at the heart of the EU agenda. All these people that move towards EU countries borders in order to improve their welfare and social well-being, dispose skills and competences obtained in various settings, originating mainly from formal, non-formal and informal learning activities. These activities can be translated into learning outcomes, a "connecting link" that can be used to facilitate the recognition of citizens' knowledge, skills and competences. In 2009, the EU published the Recommendation of the European Parliament and of the Council on the establishment of a European Credit System for Vocational Education and Training (ECVET)[6]. The aim of this Recommendation was to create a European Credit System for VET in order to facilitate the transfer, recognition and accumulation of assessed learning outcomes of individuals who are aiming to achieve a qualification.

According to the CEDEFOP, the ECVET "enables learners to accumulate, transfer and use their learning in units as these units are achieved, in order to build a qualification gradually from the learning outcomes they acquired through various and different formal, non-formal and informal learning activities / contexts. The system is based on units (groups) of learning outcomes as part of qualifications that can be assessed and validated".

ECVET points are numerical representations of the overall weight of learning outcomes in a qualification and of the relative weight of units in relation to the qualification[7]. Typically, the VET systems do not use units of learning outcomes[8], in order to structure qualifications. ECOSLIGHT decided to form units of learning outcomes. Following a top-down approach, the units formulated will be represented as competences / modules, entitled under the umbrellas of lighting, digital (e-CF and DigComp compliant), green, entrepreneurial and life competences. In compliance with the Recommendation of 2009, each unit (module / competence) will include a generic title, it will belong to one or more of the defined job role profiles (prospective qualifications mapped to the EQF and the four NQfs), the learning outcomes will be included, the assessment criteria (objects), and the duration of the unit as well.

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009H0708(02)&from=EN
[7] https://www.ecvet-secretariat.eu/en/content/what-are-ecvet-points
[8] http://www.ecvet-projects.eu/Documents/Examples_Units%20of%20LO_guidelines _2nd%20generation.pdf

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A wise examination will be conducted so as to ensure that these units of learning outcomes are discrete and separate, therefore a re-organization / re-grouping of learning outcomes in units will not be required. The reader must have in mind that the four ECOSLIGHT Job Role Profiles do not consist (yet) formal qualifications, as this procedure is very time consuming and different between the countries; but, the ECOSLIGHT consortium designs the procedure as if they were already (formal) qualifications, while in parallel the sector representatives in the project countries will explore how and hopefully will initiate and implement the procedure of the formal recognition of ECOSLIGHT curricula as occupations.

Moreover, the "ECOSLIGHT" units will be described as follows (compliant with the 2009 Recommendation of Council):

- They will be described in legible and understandable terms by referring to knowledge, skills and competences contained in them. The respective learning content design templates will include fields that enable the author to fill in this kind of information;
- They are constructed and organized in a coherent way with regard to the overall qualification. In the ECOSLIGHT case, the units (modules) will be formed following the pre-defined in the frameworks descriptions, customized to the needs of the ECOSLIGHT VET curricula (in the lighting sector). They will be also placed in range so as to facilitate the learner to gradually obtain the respective knowledge and develop the skills and competences required from the Job Role profile of interest.
- They will be constructed in a way that enables discrete assessment and validation of learning outcomes contained in the unit. All (online) training materials that will be developed by ECOSLIGHT will be characterized by one or more learning outcomes; each learning outcome will be assessed by at least one assessment object. A separate procedure will be described in R3.3 orienting to the validation of prior, non-formal and informal learning, with the outer objective of the validation of learning outcomes.

According to the Recommendation, 60 ECVET points are allocated to the learning outcomes expected to be achieved in a year of formal full time VET. Given the fact that the four project countries (France, Germany, Greece and Italy) have not established yet a specific convention for defining ECVET points[9], the following methodology will be used to estimate the ECVET points for the ECOSLIGHT VET curricula:

- 1 year full time VET ≅ 900 hours
- ECOSLIGHT MOOC AND ECOSLIGHT specialization course (incl. online, f2f, WBL) ≅ 480 hours, i.e. the 53.3% of 1 year of full time VET

Thus, the ECOSLIGHT will award each VET curricula with around 30-32 ECVET points (depending on the curricula), upon the successful completion of the ECOSLIGHT training activities and certification.

Of course, ECVET points can be allocated to each different unit according to their relative weight within the qualification. This work can be done when the ECOSLIGHT Job Role Profiles become official qualifications, but a preliminary allocation will be conducted during the piloting phase.

[9] e.g. in Malta, 1 ECVET point = 10 learning hours

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4 Designing and developing training content for the ECOSLIGHT VET curricula

4.1 Instructional design methodology for the ECOSLIGHT MOOC content development

The professional development for the four job roles specified under the *WP2 – Identification of emerging roles and needs in the lighting-related construction sector*, and described accordingly in *R2.2 – Emerging Job Profiles for ECOSLIGHT professionals related to lighting design and lighting technologies* includes two main stages; the first training stage is conducted online for all the four roles in parallel. The common training strategy will be applied through a MOOC, using the same learning materials and activities for all roles, addressing the trainees' common needs. The second stage follows a blended learning approach, where each different role (profile) participates in online and traditional face-to-face learning sessions, followed by an engaging and productive work-based learning activity.

The methodology described below, follows a team-based approach for the online training content development. This methodology adopts the basic elements of the well-known ADDIE model (Analysis, Design, Development, Implementation and Evaluation), illustrating an iterative and self-corrected training process since it provides continuous assessment in every step.

The quality of the outcomes in each phase will be assured with the employment of three roles; the **author**, the **technical reviewer**, and the **scientific reviewer**.

The author is responsible to design and develop the content. The technical reviewer monitors the intermediary outcomes and assures that the author follows the instruction, e.g. each particular template is appropriately filled in. The scientific reviewers assures on the coherence and validity of the contents produced.

4.1.1 Analysis

During the analysis phase, the training problem that will be addressed through the course is analyzed in order to specify the purpose of training, the knowledge domain, the main learning goals, the basic learning objectives, the learners' profile and the timeframe of the training process. It is equally important to define the learners' background knowledge and to set any necessary limitations and knowledge prerequisites.

The expected outputs of this phase are:

A1. Learners Characteristics: Determination of learners' characteristics and their specific needs.

A2. Course Description: Includes the description of the course, i.e. the training problem it addresses, the context of application, the learning goals, the learning objectives and the learners' needs that the course meets. It also specifies its total duration.

A3. Course Time Table: Determines the course length, the schedule, the sequence and the timetable of the course.

A4. Special Needs for the Learning Environment: Special needs are also described (if any) in order to be included in the learning environment.

Indicative questions include the following:

What are the intended audience and its characteristics? What is the desired knowledge outcome? What are the learning limitations? In what ways the knowledge will be delivered? What are the training framework and the duration of the educational process?

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Example (MOOC outline):

The MOOC course will last 8 weeks. Each week, will include on average 10 hours of study and will contain 2 to 3 modules (competences) (e.g. a module is equivalent to a Digital (e-CF) competence, or an Entrepreneurship competence or a Lighting competence).

Every module described above consists of 2 to 5 units (learning activities – subchapters / subsections). In each unit (learning activity) an educational strategy should be applied in order to deliver any combination of core learning objects (e.g. video, presentation, etc), additional educational materials (e.g. e-books, additional readings, etc), collaboration objects (e.g. forum) and assessment objects (projects, self-evaluation exercises, quizzes) in order for the trainees to be able to fulfill the specific learning outcomes.

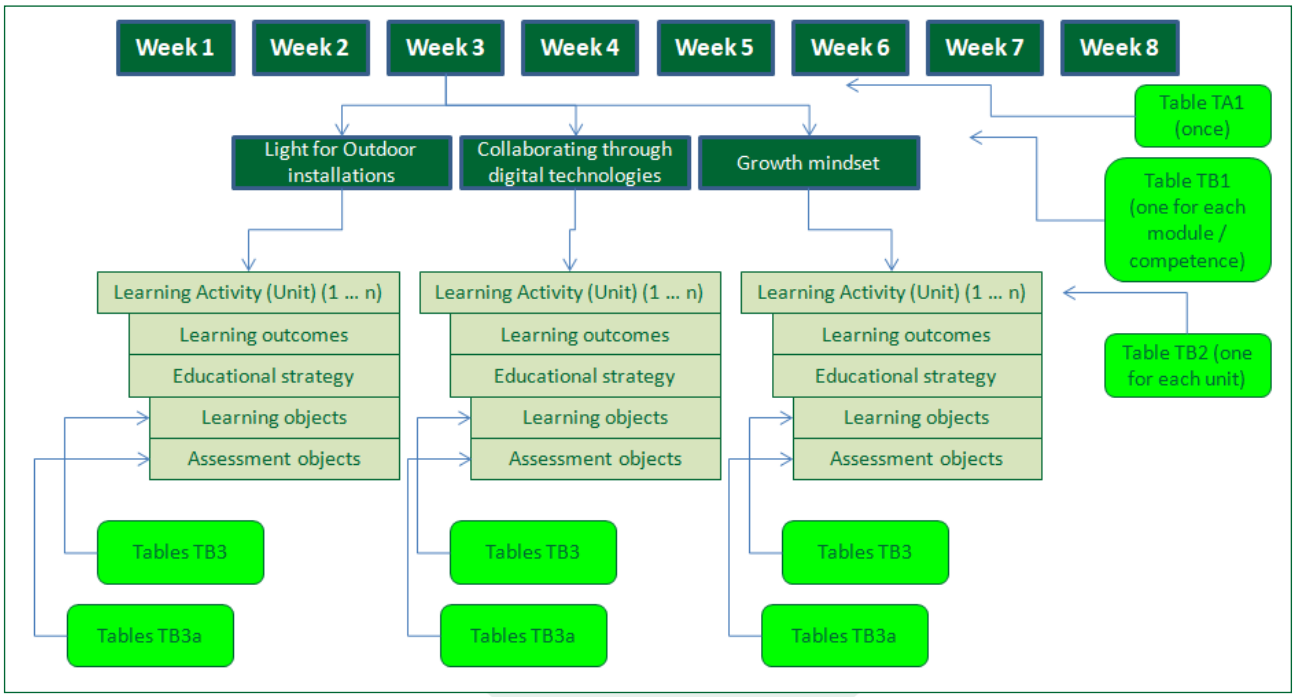

Figure 3: MOOC analysis flowchart

The respective tables can be found at the Appendix.

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4.1.2 Design phase

The design phase is the most essential and demanding one in this course development methodology. The purpose of this phase is to define and describe the detailed learning objectives for each module (competence), the units (learning activities) in which each module is divided to, the educational strategy that will be applied in each unit and the learning outcomes of each unit. In this phase, it is important to define the trainees' assessment method. Additionally, the learning objects should be designed according to their learning outcomes. It should be noted that units (learning activities) demonstrate the way that knowledge (learning objects, additional educational material, quizzes, wikis, projects etc.) should be provided to the trainees according to the educational strategy adopted.

The main outputs of this phase are:

B1. Course Module Description: A detailed description for every course module (competence).

B2. Course Units (Learning Activities) Description: A detailed description of the units (learning activities) per course module.

B3. Learning Outcomes: A catalog recording the course units (learning activity) learning outcomes.

B4. Learning Object Design: A detailed description of the Learning Objects per unit (learning activity).

B5. Learner Assessment Description: A detailed description of the learner assessment of the course module / unit.

The activities of the design phase for the ECOSLIGHT MOOC development are presented in the following flowchart. Each output is related to a specific template (in the Appendix 1) that must be filled in for every module.

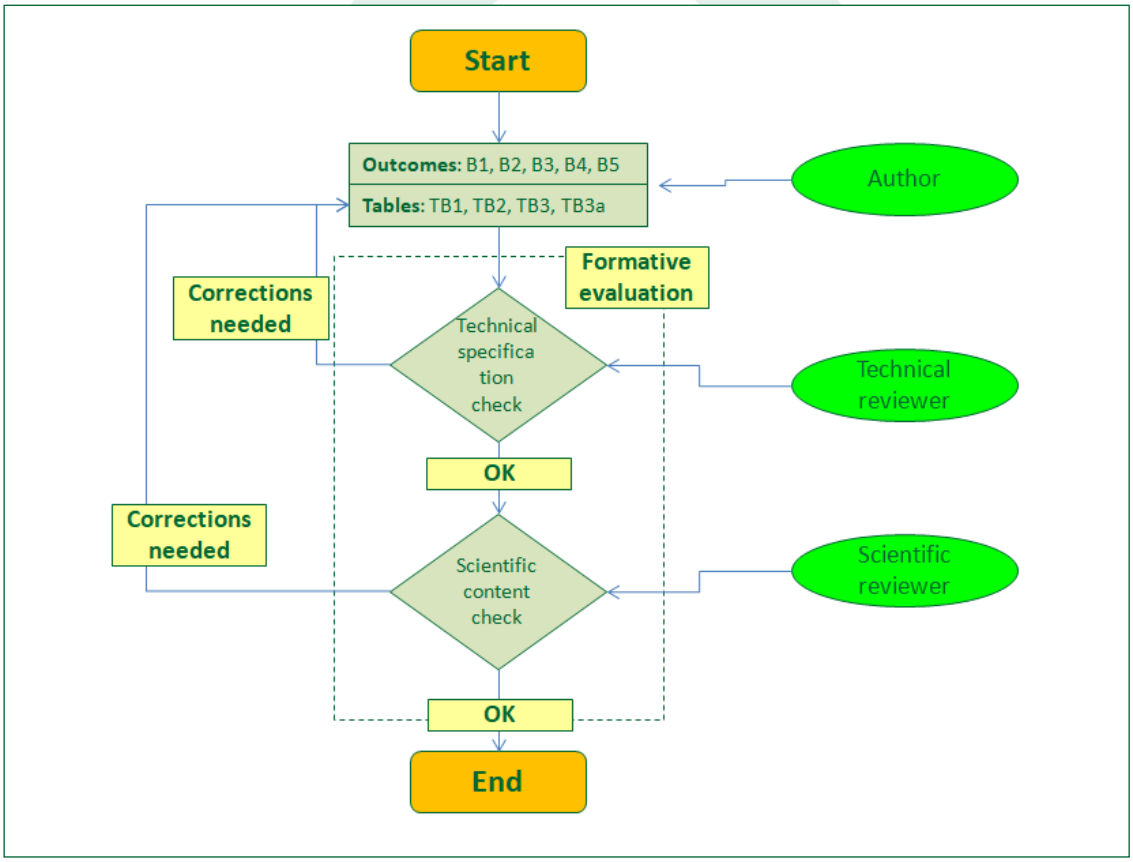

Figure 4: MOOC design flowchart

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ACTION Required

Please fill in the templates labeled

- TB1: Course Module Description / Schedule (Design phase)
- TB2: Course Unit (Learning Activity) Description (Design phase)
- TB3: Learning Object Description (Design phase)
- TB3a: Assessment Object Design and Production (Design Phase)

In the Appendix, as many times as needed!

4.1.3 Development phase

The development phase includes the production of the training material (content) which is based on the design realized in the previous phase. The learning objects (core, additional supportive material, collaboration and assessment learning objects) are developed as foreseen in the previous phase according to their technical type with respect to their learning resource type, and are uploaded to the online platform. It is recommended to use the educational material guidelines provided, since there are providing instructions on "what to do" and "what to avoid" during the development process. These guidelines are provided for both the pedagogical and technical aspect of the training material.

During the development phase, authors may collaborate with multimedia developers, video experts (technical staff), who could contribute in creating or editing qualitative educational videos and additional digital educational material as described in the design phase. In parallel, the technical team sets up the online platform, integrates the training material into the platform (according to the course module, learning activities templates) and creates the platform manuals.

The main outcomes of this phase are:

C.1 Learning Objects Development: The creation or the adaptation of existing material in order to create all the necessary educational materials and content required for the particular course, based on the previous design.

C.2 Course Development: Set up of the course in the platform[10] and integration of the educational material into the platform.

C.3 User Guides Development: Creation of user's manuals for the online platform.

In the following flowcharts, the reader may see the procedures for the course development (educational material and content, course and user guides) as an example.

[10] According to the MOOC best practices, each course consists of the following 5 pages: a) the Course Info page with news, announcements and additional information, b) the Courseware page that includes the page that shows the sections of the course and the educational material, c) the Discussion page where discussion forums will be placed, d) the Progress page, which provides updates with useful information and each trainee's personal path, and e) the Syllabus Page, which includes the Course / Modules Information.

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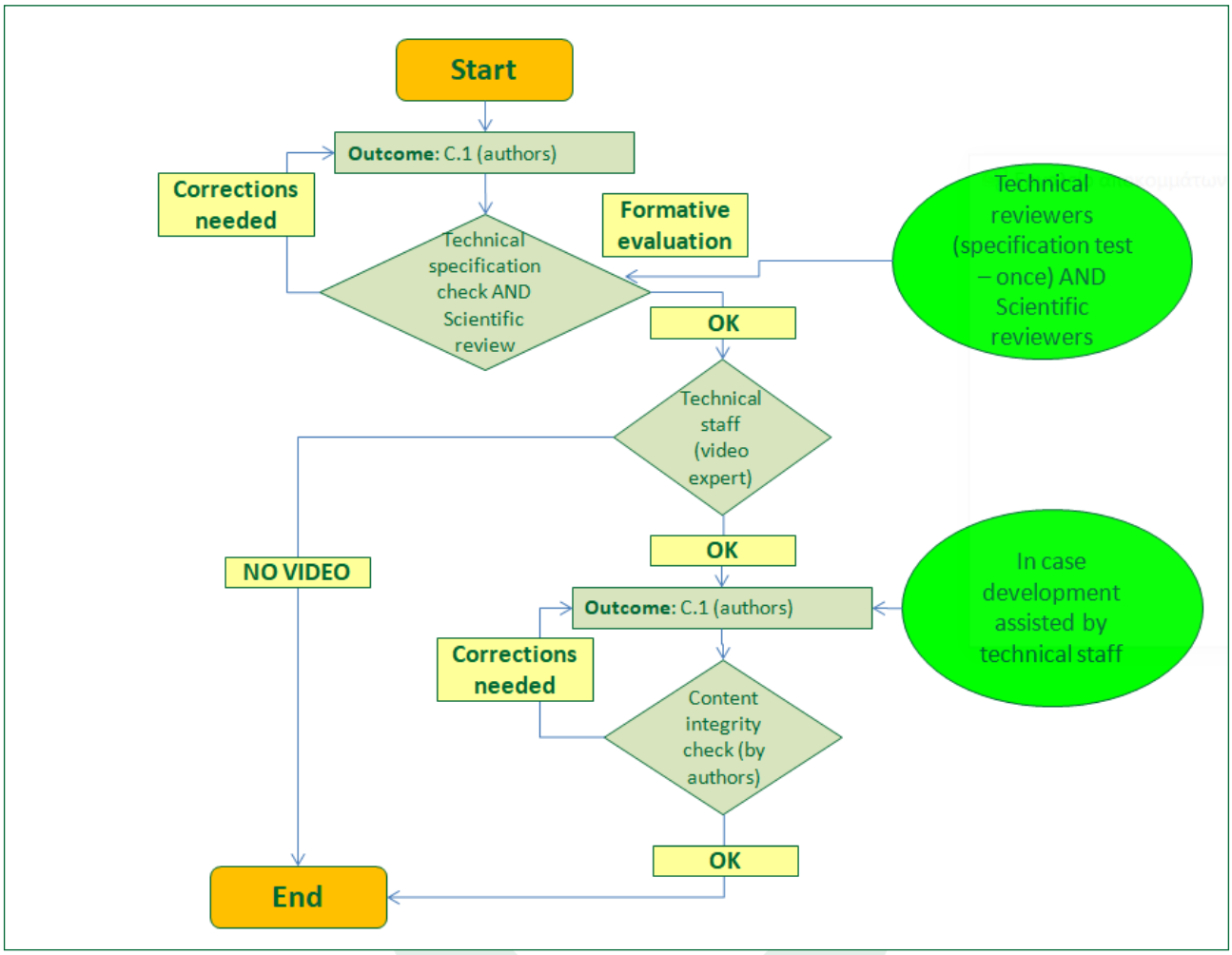

Figure 5: Course development (training materials and content) flowchart

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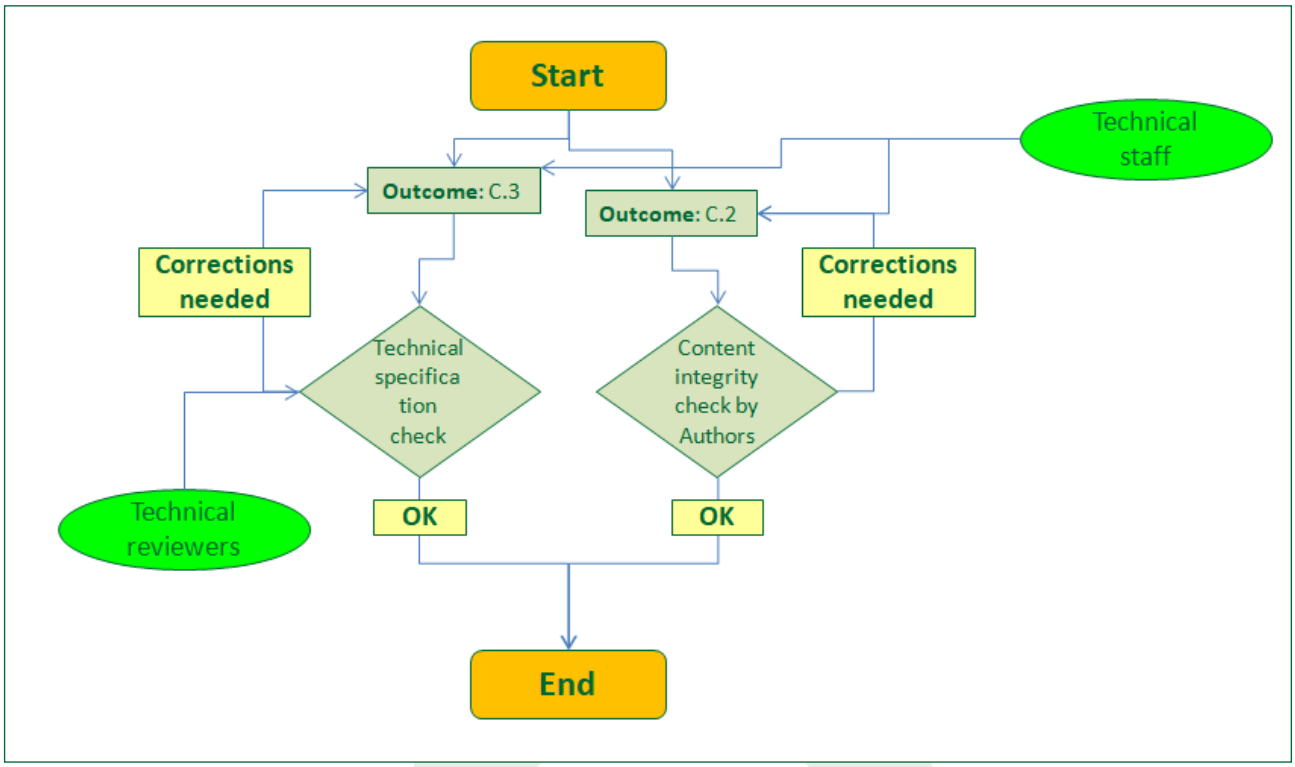

Figure 6: Course development (course setup and used guides) flowchart

4.1.4 Implementation phase

During this phase, the educational process is implemented as designed and developed in the previous phases, and the learning effectiveness is evaluated. The primary goal of this phase is the dissemination and publication of the course. The course can be promoted and disseminated via the social networks, advertising, communities and email databases, newsletters and relevant websites of lighting and construction. The education process (course) will be realized in a predefined time period since tutors and technical staff must support, operate, monitor and audit the education process through the platform.

The main outcomes of this phase are:

D.1 Publication of the available course in communities and social networks.

D.2 Realization of the educational process.

D.3 Support and operation of the education process and the platform.

4.1.5 Evaluation phase

The evaluation of the proposed methodology shall be conducted in two directions. Formative evaluations should take place in every phase while the final evaluation takes place at the end of all phases, in order to uncover improvement issues. Therefore, the evaluation consists of formative and summative assessment, which includes:

Formative Assessment: The formative evaluation is conducted in each stage of the process and includes information collection (check sheets, focus groups results, interviews, questionnaires etc.) in order to identify problems. During the procedure, revisions must be done whenever evaluation considers it necessary. The purpose of the formative evaluation is (a) to estimate the correct implementation of every step of the development process and (b) to verify the scientific quality of the course.

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Summative Assessment: The final assessment measures the effectiveness of the educational procedure; providing feedback from users and team members using interviews, system logs (providing information of platform usage, rates of attendance in every activity etc.), questionnaires etc.

4.2 Instructional design methodology for the ECOSLIGHT specialization course content development

A MOOC is a static online training effort while the specialization course employs blended learning and work-based learning. The ECOSLIGHT **blended training course has foreseen around 140 – 160 hours of training material** for each job role profile for the online and self-study components, plus the assessment components. The educational content of the **blended training course** should be developed using the existing Methodology (as described and implemented in the framework of WP3) with some modifications as shown below.

According to the description of the WP5, the Specialization course consists of the following:

Blended Learning
Blended training course will last 24 weeks (6 months), with an effort of at least 150 hours (learning equivalent) A1: Online and self-study (110 hours) (material)[11] A2: Face-to-face sessions (24 hours = 6 x 4 hours) (once a month) (incl. teleconference sessions) A3: Assessment (16 hours)
Work-Based Learning
Work-based learning will last 10 weeks, approximately 20 hours of work in the placement per week (totally 200 hours) B1: Work placement (120 hours) B2: Job role specific project (80 hours)
Additional training activities (T5.4)
Additional training (f2f) activities for Trainers, Employers and Learners C1: A 2-days seminar for training the Trainers C2: A 1-day course for training the Employers C3: A 1-day course for training the Learners

Table 6: The fundamentals of piloting the specialization course

As described earlier, during the Specialization course each lighting competence will have a 6-7 hours learning equivalent, each basic digital competence (DigComp) 4-5 hours learning equivalent, each green competence 6-7 hours learning equivalent, while each entrepreurship (EntreComp) and life competence (LifeComp) around 4-5 hours of learning equivalent. The e-CF competences correspond to the level 5 of the EQF. Each module includes a part of core material and a practical assignment. The practical assignment is oriented to the tasks of each different job role profile (on average the 30 %). The variation of the learning equivalent per competence is based on the needs originated from the ECOSLIGHT quantitative survey and the ECOSLIGHT interviews.

Core material consists of material similar to the one developed for the MOOC (Learning (educational) objects and Assessment Objects). The only difference is that, the e-learning material for the Specialization course mostly consists of lectures (self-running presentation – power point presentation with voice over) and additional material of any kind for self-study (papers, videos, e-books etc.). The design and development process is the same as it is for the MOOC.

[11] As described earlier, around 140 – 160 hours of online and self-study learning equivalent material is foreseen. This originates from the need to cover the foreseen number of competence (22 in the MOOC, 29 in the specialization course), and the employment of various competence categories (Lighting, digital, green, entrepreneurship, life competences), supported also by the results of the ECOSLIGHT quantitative and qualitative survey.

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Practical assignments can include one or more of educational material types as project, example or activity (case study, problem solving, text composition, open ended question) (see Appendix 2 for more details on the above mentioned educational material types) that can be assigned on the learner level (see Appendix 1 for a template for the development of this kind of material). The design and development process is the same as this of the MOOC.

For each Job Role Profile a competence participates into, multiple practical assignments will be developed customized and adjusted for every profile (in collaboration with the local learning clusters or the sector representative or a lighting professional / expert).

TIP

For the specialization course, it is suggested to write Learning Outcomes of the three upper levels of the Bloom taxonomy (4. Analysis, 5. Synthesis, 6. Evaluation) and use verbs like:

arrange, classify, compare, differentiate, distinguish, infer for the **Analysis** level,
construct, create, design, develop, generate, integrate, reconstruct for the **Synthesis** level, and
assess, criticize, decide, evaluate, grade, judge, predict, rate, recommend for the **Evaluation** level,

That are more suitable for activities like these.

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6 Appendix I: Templates

6.1 Organization phase

TA1: Course description (Analysis phase)		
1	Course (MOOC) title	**ECOSLIGHT MOOC on Essential Skills for Lighting Professionals**
2	Course description	
3	Knowledge domain	
4	Training problem	
5	Course addressed to	
6	Course type	
7	Learning goals[12]	
8	Basic learning objectives	
9	Course length	
10	Learners' profile	
11	Learners' background knowledge	
12	Participation prerequisites	
13	Special needs from the education environment	

Table 7: TA1 – Course description (analysis phase)

[12] Goals are broad statements, general intentions, intangible, abstract and in general hard to get measures. Objectives are specific, precise, tangible, concrete and measurable. In practice, they are statements that define the expected goal of the course, e.g. "Monitoring and accurate interpretation of data" for "A.7 – Technology Trend Monitoring".

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6.2 Analysis phase

MOOC Course Schedule					
Week	**Module Code**	**Competence (Module)**	**Author**	**Technical Reviewer**	**Scientific Reviewer**
1	W1.1	Indoor Lighting for Buildings and Artificial Lighting			
1	W1.2	Understand and promote the value of sustainable lighting			
2	W2.1	Evaluating data, information and digital content			
2	W2.2	Understand the sustainable assessment of lighting systems and solutions: purposes, methodologies, standards			
2	W2.3	Spotting opportunities			
3	W3.1	Light for Outdoor installations			
3	W3.2	Collaborating through digital technologies			
3	W3.3	Growth mindset			
4	W4.1	Lighting system and components technologies including smart Lighting (indoor and outdoor)			
4	W4.2	Understand the new sustainable lighting techniques applied to sustainable lighting			
5	W5.1	Protecting personal data and privacy			
5	W5.2	Understand the selection criteria of lighting services / systems and products in terms of sustainability			
5	W5.3	Creativity			
6	W6.1	Light influence on human health, well-being and working performance (Lighting Ergonomics)			
6	W6.2	Vision			
6	W6.3	Valuing ideas			
7	W7.1	Understand the circular economy approach to lighting sector			
7	W7.2	Critical thinking			
7	W7.3	Taking the initiative			

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8	W8.1	Energy Efficiency and Lighting performance			
8	W8.2	Planning and management			
8	W8.3	Coping with uncertainty, ambiguity and risk			

Table 8: MOOC schedule and task allocation

Specialization Course Schedule (filled in once per Job Role Profile)					
Week	**Module Code**	**Competence (Module)**	**Author**	**Technical Reviewer**	**Scientific Reviewer**
		Lighting Design and solving technical problems			
		Lighting policy, regulation, energy labelling			
		Economic models related to lighting			
		Environmental impact of lighting			
		Integrating and re-elaborating digital content			
		Solving technical problems			
		Identifying needs and technological responses			
		Product/service planning			
		Application design			
		Innovating			
		Application development			
		Solution deployment			
		User support			
		Education and training provision			
		Risk management			
		Understand the types and principles of the basic Environmental and Energy Labelling schemes and national / international policies			
		Understand sustainable building certification systems in the lighting sector			

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		Understand the use of Environmental and Energy Labelling			
		Understand the Life Cycle Costing (LCC) process, apply the LCC to build environment decision-making to lighting cases			
		Understand the new sustainable / green trends in lighting and how to integrate the environmental / sustainability criteria in the lighting design process			
		Ethical and sustainable thinking			
		Financial and economic literacy			
		Working with others			
		Learning through experience			
		Flexibility			
		Empathy			
		Communication			
		Collaboration			
		Managing learning			

Table 9: Specialization course schedule (per Job Role Profile)

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6.3 Design phase

TB1: Course module description (design phase)		
1	Course module code	*Course Module code*
2	Course module title	*Title of Course Module*
3	Course module description	*Description of the module (up to 100 words)*
4	Knowledge domain	*Knowledge domain of the module*
5	Learning objectives	*Learning objectives (4 up to 10) for the specific course module*

Learning outcomes for the Cognitive domain (Bloom Taxonomy)	
Code	**Learning Outcome** (please underline the verb and the concept of the knowledge domain used) *Upon completion of this module, the learner will be able to …*
1. Knowledge level	
2. Comprehension level	
3. Application level	
4. Analysis level	
5. Synthesis level	
6. Evaluation level	

Units	
Unit Code (*, **)	Unit title

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Table 10: TB1 – Course Module Description (Design phase)

Note 1: A unit (learning activity) should be approximately 1-2 hours of study

Note 2: For each Unit specified above please fill in a Table TB2

Note 3: Learning outcomes for the Affective and the Psychomotor domains can also be written

TB2: Course unit (Learning activity) description (Design phase)		
1	Unit code	*Unit code (as defined in TB1)*
2	Unit title	*Title of Unit (as specified in TB1)*
3	Unit description	*Description of the Unit (learning activity) (up to 100 words)*
4	Educational strategy	*Description of the educational strategy (e.g. presentation, role playing, case study) will be adopted for the specific unit (learning activity)*
5	Learning outcomes (LOut)	*Record the Learning Outcomes for the specific unit (use Table's TB1 codes)*
6	Unit core (self-produced) material (Learning object (LO)) (code and title)	*List of Learning objects (videos, presentations, etc.) included in the specific unit (codes should be consistent and should reflect the corresponding unit) (for each core material specified here please fill in a TB3)*
7	Unit additional (O.E.R.) material (code and title)	*List of additional material (e-books, additional readings, etc) included in the specific unit (codes should be consistent and should reflect the corresponding unit) (for each additional material specified here please fill in a TB3)*
8	Collaboration objects (code and title)	*List of Collaboration objects (e.g. forum) included in the specific unit (codes should be consistent and should reflect the corresponding unit) (for each collaboration material specified here please fill in a TB3)*
9	Assessment objects (projects, self-evaluation exercises, etc.) (code and title)	*Detailed description of the learners' assessment for the specific unit (codes should be consistent and should reflect the corresponding unit) (for each assessment object specified here please fill in a TB3a)*
10	Unit schedule	*Description of the educational path for the defined unit*
11	Key words	*Key words (3 to 10)*

Table 11: TB2 – Course Unit Description (Design phase)

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<table>
<tr><th colspan="3">TB3: Learning object (Design phase)</th></tr>
<tr><td>1</td><td>Learning object code</td><td>Enter code (as defined in TB2)</td></tr>
<tr><td>2</td><td>Learning object title</td><td>Title of Learning object(as defined in TB2)</td></tr>
<tr><td>3</td><td>Learning object description</td><td>Description of the Learning object (up to 100 words)</td></tr>
<tr><td>4</td><td>Language</td><td>Language for the specific learning object</td></tr>
<tr><td>5</td><td>Learning recourse type (IEEE LOM)</td><td>Definition of the learning recourse type (theory, simulation, experiment, etc.) for the specific learning object (select from the list in following list)
<table>
<tr>
<td>1. Guidelines
2. Presentation
3. Demonstration
4. Lecture
5. Definition-Principle-Law
6. Narrative Text (theory)
7. Analogy
8. Example
9. Activity
Case Study
Problem Solving
Text Composition
Question
Else (specify)
10. Simulation
Interactive
Non Interactive</td>
<td>11.Self-Assessment
Multiple Choice Questions
Open Type Question
Problem Statement
Else (specify)
12. Experiment
13. Serious Game
14. Exercise
Multiple Choice Questions
Open Type Question
Problem Statement
Else (specify)
15. Project</td>
</tr>
</table></td></tr>
<tr><td>6</td><td>Technical type (IEEE LOM)</td><td>Definition of the technical type (document, video, wiki etc.) for the specific learning object(select from the list below)
<table>
<tr><td>Text</td><td>Document
Hypertext</td></tr>
<tr><td>Image</td><td>Photo
Map
Graph
Image</td></tr>
<tr><td>Streaming media</td><td>Audio Recording
Animation
Self-running Presentation
Webcast
Video</td></tr>
<tr><td>Application</td><td>Interactive Software
Hypermedia Application
Wiki</td></tr>
</table></td></tr>
</table>

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			Presentation
7	Workload (Estimated study time) (min)	*The estimated study time needed for an average learner in minutes*	
8	Key words	*Key words (3 to 10)*	
9	Learning outcomes (LOut)	*Record the Learning Outcomes for the specific learning object (should be a subset of the learning outcomes defined in the corresponded unit (learning activity)). In case you define more learning outcomes than those defined in the relative unit (learning activity) please update appropriately the relative unit learning outcomes field.*	
10	Extended learning object description	*Describe the learning objects in details*	

Table 12: TB3 – Learning Object (Design phase)

TB3a: Learning object (Assessment object) description (Design phase)			
1	Learning object code	*Enter code (as defined in TB2)*	
2	Learning object title	*Title of Learning object(as defined in TB2)*	
3	Language	*Language for the specific learning object*	
4	Learning recourse type (IEEE LOM)	*Definition of the learning recourse type (theory, simulation, experiment, etc.) for the specific learning object(select from the list below)*	
		9. Activity *Case Study* *Problem Solving* *Text Composition* *Question* *Else (specify)* *11.Self-Assessment* *Multiple Choice Questions* *Open Type Question* *Problem Statement* *Else (specify)*	*14. Exercise* *Multiple Choice Questions* *Open Type Question* *Problem Statement* *Else (specify)*
5	Technical type (IEEE LOM)	*Text*	*Document*
6	Workload (Estimated study time) (min)	*The estimated study time needed for an average learner in minutes*	
7	Write down the assessment object (quiz)	*Use the template below as many times as needed and modify accordingly to specific question type (1 template for each question).*	
Question Template			
No.			
Question (stem)			
Possible answers			

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Correct answer	
Response to correct answer	
Response to wrong answer(s)	
Times the question can be taken	
Is the question part of a test?	

Table 13: Assessment object design and production (Design phase)

6.4 ECOSLIGHT MOOC instructions for completing the TB3 and TB3a tables (Design of Learning Objects) and Workload estimation

Regardless of the exact stage you currently are, please consider the instructions below for the correct completion of the TB3 table and TB3a both refer to the Second part of the Design Phase which is the Learning Objects design:

1) You should fill in one TB3 table for each learning (core material), additional and collaboration object and one TB3a table for each assessment object defined in the first part of the design phase.

2) You should fill in all fields provided but you should pay attention to the **field 7** where you should define approximately the **estimated study time (workload) in minutes**.

- The workload for **a textual** learning object depends on the content. In the case of a journal article, it is approximately 3-4 pages an hour; if it is a book chapter then 5 pages per hour are more appropriate. In case the content is even easier increase pages per hour accordingly.
- A safe way to estimate a **video** learning object workload is to double its duration. For example, if the video lasts 4 minutes, the study/comprehension time for the video is 8 minutes approximately.
- The workload of a **hypertext** is the sum of the text itself plus the workload of each object it links to.
- For each **assessment object** the workload estimation is the accumulation / sum of each individual question's workload this object consists of. Workload for questions of types like "multiple choice" or "fill in the blanks" or "matching" is more or less 5 min (each) and questions of type "yes/no (or true/false)" is more or less 3 min (each).

3) In case you design a learning (or additional or collaboration) object you should include:

a) An Introduction to the object at the beginning, b) a comprehensive description of the contents/concepts separated in sections if necessary and c) a Synopsis at the end. You should also include any other information you consider necessary for the approval by the scientific reviewers.

Alternatively, if you make a ppt video learning object, you could include your ppt file instead of the above description (if it is ready).

Additionally, in case you design a video learning object you need to include scenes design, the setup of the presenters / speakers, the cameras setup and the script. You should also provide us with any other information you consider necessary in order our video expert sends you feedback and/or comments.

Please notice that content information prior to the production phase is considered crucial in order to avoid possible unnecessary process backtracking.

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Important notifications:

- Please notice that each module has different **time effort** (learning equivalent). So, e.g. an entrepreneurship module should be approximately 3 hours which is the total of time of work study PLUS the time needed for the assessment (after the educational material the trainee should do quizzes, multiple choice questions, self –evaluation exercises etc).
- Assessment objects content should also be approved by the scientific reviewers.

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6.5 Scientific Reviewer Check Form Template (MOOC + Specialization Course)

SCIENTIFIC REVIEWER CHECK FORM TEMPLATE

SCIENTIFIC REVIEWER

Check Form Template

(Analysis + Design phases)

Course Module (Code and Title): ……

Reviewer's name / Institute: ……

Review Date: ……/……/……

1. Module schedule design is comprehensible and sufficiently describes the state-of-the-art of this knowledge domain and the defined learning objectives.	
Please specify potential inadequacies or errors, if any:	

2. Concepts and content included sufficiently describe each unit (learning activity) outline and are in accordance with the defined learning objectives.	
Unit code	Please specify potential inadequacies or errors, if any:

3. Learning outcomes defined, determine in the appropriate level and adequately the concepts to be taught.	
LOut code	Please specify potential inadequacies or errors, if any:

4. Core and additional material described are sufficient and in accordance with each unit description and content.	
Unit code	Please specify potential inadequacies or errors, if any:

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5. Assessment objects defined are appropriate and efficiently assess the student's mastery of the concepts and other contents covered in each unit.	
Unit code	Please specify potential inadequacies or errors, if any:

6. Please specify if any additional improvements/comments are required.

Reviewer decision:

Accepted as is	**Accepted with minor revisions** (no need for re-reviewing)	**Accepted with revisions** (need re-reviewing)

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6.6 Scientific Reviewer Check Form for Practical Assignments

SCIENTIFIC REVIEWER CHECK FORM TEMPLATE

SCIENTIFIC REVIEWER

Check Form Template

(Analysis + Design phases)

Course Module (Code+Title): ……

Role Profile: ……

Reviewer's name / Institute: ……

Learning object (practical assignments) code: ……

Review Date: ……/……/……

1. Learning object (practical assignments) **description** is comprehensible and sufficiently describes the state-of-the-art of this knowledge domain/module.	
Please specify potential inadequacies or errors, if any:	

2. Learning object (practical assignments) **content / subject** is suitable with the job profile associated.	
Please specify potential inadequacies or errors, if any:	

3. **Learning outcomes** defined, determine in the appropriate level and adequately the concepts to be taught.	
LOut code	Please specify potential inadequacies or errors, if any:

4. **Extended practical assignments description** described is sufficient and in accordance with unit description and content.	
Please specify potential inadequacies or errors, if any:	

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5. **Preparatory / Additional material** (literature, further readings) defined are appropriate and efficiently enhance the student's mastery of the concepts and other contents covered in each unit.	
Please specify potential inadequacies or errors, if any:	

6. **Exemplary answer** of the practical assignment given sufficiently describes the unit's (learning activity) outline and is sufficiently measurable.	
Please specify potential inadequacies or errors, if any:	

6. Please specify if any additional improvements/comments are required.

Reviewer decision:

Accepted as is	**Accepted with minor revisions** (no need for re-reviewing)	**Accepted with revisions** (need re-reviewing)

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6.7 Assessment Objects (Guidelines and Template)

6.7.1 Assessment object – What is it?

In the VET context, training materials are designed based on the pre-determined expectations and trainees are evaluated to what extent they master these expectations. In order to evaluate the degree of mastery of these expectations in learning we usually use assessment objects.

One of the most common assessment object used is the quiz in which the trainees (as individuals or in teams) attempt to answer questions correctly. It is a "game" to test their knowledge about a certain subject, in order to refine programs and improve their learning. Quizzes are usually scored in points and many of them are designed to determine the trainee's successful learning process. This can be made by grading and weighing each question's correct answer (sometimes you can also add negative grading in wrong answers).

Quizzes consisting of a number or questions that can be categorized in:

Open-ended questions which are hard to assess automatically, but can be used to initiate some individual activity (e.g. read this article and comment…) or even better some group activity (e.g. after reading this article, join the forum discussion about the "XYZ" topic and present your opinion).

Closed-ended questions which are ideal for an automated assessment. The most common types of this kind of questions are: Multiple Choice Questions (MCQ), fill-in-the-blank, matching, yes/no (or true/false), drag and drop into text, drag and drop onto image etc.

Multiple choice question (MCQ) [PLEASE PREFER THIS TYPE OF QUESTIONS FOR THE ASSESSMENT OBJECTS]

A *Multiple Choice Question* consists of a question and several alternative answers, among which one is the correct ("keyed") answer and one or more incorrect ("distractor") answers.

Example:

What the acronym of SWOT analysis means?

a. Strengths, Weaknesses, Opportunities and Threats

b. Strategy, Work, Office and Team spirit

c. Strength, Willingness, Opportunity and Target

d. Strategic goals, Working capital, Organizational Change and Test marketing.

Fill in the Blanks Question [PLEASE AVOID THAT AS IT TYPICALLY CREATES PROBLEMS IN ONLINE PLATFORMS]

The *Fill in the Blanks* allows e-learning designers to create cloze tests. Portions of words or sentences are removed from a text and the trainee is asked to provide the missing word or words.

Example:

(1)……. is known as the "red" planet because of its surface color.

Correct answer/s: 1. Mars (or mars)\

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Matching Question

Matching questions have a content area and a list of names or statements that must be correctly matched against another list of names or statements. For example "Match the Capital with the Country" with the two lists "Canada, Italy, Japan" and "Ottawa, Rome, Tokyo".

Yes/no (or true/false) Question

In this kind of question only two choices for an answer are given: True or False. The question content can include an image or a code (html or other).

Example:

Every decision-making process produces a final choice, which may or may not prompt action.

True / False

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6.7.2 Technical tips

The following table summarizes the basic properties of MCQ, but is applicable to all types of closed-ended questions. At the end you can find Internet sources that provide more insight, guidelines and examples.

Remember (a) to phrase the question (stem) in a clear and meaningful way and (b) to match the question (and correct answer) to learning outcomes and the wrong answers to common misconceptions associated with these learning outcomes (avoid obviously wrong or silly distractors).

Question	Concise, clear text, without useless references. Avoid negative phrasing. Can contain an image.
Possible answers	a. At least 4, numbered b. Each possible answer must be chosen carefully, so as not to overlap and to be clearly mutually exclusive c. Avoid "none of the above", "all of the above" or combinations (i.e. "1 and 3") d. The correct answer must correspond to one learning outcome and should be possible to deduct it from the learning material e. The wrong answers must correspond to common misconceptions f. The correct answer should not be (too) obvious
Correct answer	To keep it simple, only one answer should be unquestionably correct. Give its number here
Response to correct answer	Congratulating text with possible suggestions for follow up learning steps or further readings
Response to wrong answer(s)	a. Could be the same for all wrong answers or different for each b. If the same feedback is chosen, then a generic statement explaining why the answer was wrong citing the most common misconceptions and which answer is correct should be given, followed by what the student should read in order to repair the misconceptions c. If different feedback should be given per wrong answer, then make sure that the feedback identifies the student misconception that led to the wrong answer and indicates what the student should read in order to repair the specific misconception
Times the question can be taken	Indicate how many times the trainee can attempt to answer the question before feedback (other than correct / not correct) will be presented. Usually this number is 1.
Is the question part of a test?	If so, then the answers to all questions of the test are usually presented at the end of the test, together with the total score.

Examples

Please review the following links of assessment objects types to get some ideas:

Guidelines for writing MCQ

https://cft.vanderbilt.edu/guides-sub-pages/writing-good-multiple-choice-test-questions/

http://theelearningcoach.com/elearning_design/rules-for-multiple-choice-questions/

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https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/developing-assignments/assignment-design/designing-multiple-choice-questions

MCQ types

http://www.surveyanalytics.com/help/116-inline.html

About closed ended questions and their (other than MCQ) types

https://www.questionpro.com/close-ended-questions.html

www.jsuccba.com/mhearn/Questionnaires/Question%20Types%202.doc

About closed vs open ended questions

https://blog.socialcops.com/academy/resources/closed-ended-and-open-ended-questions/

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6.8 Transcripts template

[Presenter Name, Surname, Organisation]

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

END OF SCRIPT

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6.9 Educational video guidelines

6.9.1 Video – What is it?

Video[13] is an electronic medium for the recording, processing, storing, copying, playback, broadcasting, and display of moving visual media. A video can be processed, inserting comments or subtitles, presentations, sounds etc. Digital video is an electronic representation of moving visual images (video) in the form of encoded digital data (digital media used for the recording, processing and storing processes). The most common video types, related to educational content, include interviews, conversations, lectures, directed scenarios and screencasts.

Interview

An interview[14] is a conversation including questions and answers. A person (the interviewer) asks predefined questions, while the invited persons (interviewees) respond (usually within predetermined time), with participants talk in turns. Interviews usually involve a transfer of information from the interviewee to the interviewer (and therefore to the audience), which is usually the primary purpose of the interview. Slides can also be inserted (in a presentation form) or images, while the interviewee speaks, in order to make the response more conceivable.

Conversation

A conversation[15] is an interactive communication between two or more people on a specific subject. In conversations, we can also add slides (in presentation form) or images, in order to make the speaker more understandable.

Lecture

A lecture[16] is an oral presentation with the purpose to present information, or teach people or students a particular subject, usually using slides in presentation form or images.

Directed scenario

This type of video usually refers to a presentation of a specific object. For example, it presents an exhibit, a sight-seeing, an experiment, etc. Usually it includes also audio narrations for the pictures presented. Actors or speakers can be included (optionally) so as to make the presentation more vivid.

Screencast

A screencast[17] (also known as a video screen capture) is a digital recording of the computer screen output, containing often also audio narration. The term screencast is compared to the related term screenshot; whereas screenshot generates a single picture of a computer screen, a screencast is essentially a movie of the changes over time that a user sees on a computer screen, enhanced with audio narration.

[13] https://en.wikipedia.org/wiki/Digital_video; https://en. wikipedia.org/wiki/Video
[14] https://en.wikipedia.org/wiki/Interview
[15] https://en.wikipedia.org/wiki/Conversation
[16] https://en.wikipedia.org/wiki/Lecture
[17] https://en.wikipedia.org/wiki/Screencast

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6.9.2 Technical tips

General tips

- The shooting should preferably be done using two identical cameras at the same time; one for a close-up shot and one for a medium shot (from waist up). Make sure to arrange the same settings to both cameras (ISO, White Balance, fps, aperture, shutter speed).
- Keep your videos up to 7 minutes maximum (without cuts) in total (preferably up to 5 minutes), in order to keep the audience interested. If it is not possible to film for 7 minutes straight, split the video in two parts.
- The frame rate should be set at 25fps.
- Avoid camera movements.
- Capture should focus on the presenters and keep the camera on eye-level.
- Do not change the video settings or lighting during recording.
- Avoid echoing. Before you start recording, check the acoustics of the place.
- It is necessary to clap (hands or with a clapper) in the center of the frame after you make sure that the camera and the sound are rolling. Before clapping, the camera operator or the director should say clearly the title of the interview and the clip (for example “Marketing 2.1, take 1”).
- The slides of the presentation should not appear in the frame of the video; they will be added later during video editing. During the recording of the lecture the cameras should focus on the lecturer.
- Sound should be recorded using lavalier microphones, which are connected with the camera.

For the Presenters

- Presenters should use simple language, without complex terms. If they have to use a complex term, they should explain it briefly.
- Presenters should avoid wearing: white, black, brands.
- When there is only one presenter, he/she should focus their look into the camera.
- Presenters should not speak quickly and not hold anything in their hands.
- Presenters should not speak too close or too far from the microphone. Make sure that each speaker's voice sounds clearly.
- They should have prepared their speeches and read them through autocue (there are online applications[18]). All questions and answers should be written down and rehearsed before the shooting.
- The presenter may choose if he/she wants to speak standing up or seated down.
- In case we want to add graphics on the side of the frame, the presenter should stand/ sit on the right half of the frame.
- The make-up should be plain and discreet. Likewise for the hair.

Background – Space

- The background should be empty and of a bright color for graphics in white color, or of a dark color in case of graphics in black color. Avoid backgrounds with designs / patterns or objects.
- There should be lots of light making sure that no intense shadows are created on the presenter or on the background. The face should look clear and bright.

[18] Examples: https://www.cueprompter.com/; http://www.freeteleprompter.org/;

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- Avoid or eliminate external sounds. Please record in isolated places or in a studio. However, if you choose to shoot at an exterior space, make sure that it is not too noisy and no people interfere in the frame. An exterior shooting should be done only in case a professional is in charge.

Footage

- The footage should be sent without any editing (no logos, no intro/outro, no music)
- The footage of the shooting should be sent accompanied by the text of the speech and the "ppt" presentation or any other material that needs to be showed (video/ image etc.) stating when it should be displayed.
- Please provide HOU the best four (4) takes (2 takes for each camera) of each presentation.

Examples

Please review the following videos to get some ideas:

https://www.youtube.com/watch?v=CDIYpmmYzDo&index=46&list=PL_ov0kIxA5utev8Sery_4rMbV2uGho6fc

https://www.youtube.com/watch?v=uSqKMmFRGuA&index=17&list=PL_ov0kIxA5utev8Sery_4rMbV2uGho6fc

https://www.youtube.com/watch?v=mju0Fw9Vj1w&index=19&list=PL_ov0kIxA5utev8Sery_4rMbV2uGho6fc

https://www.youtube.com/watch?v=dCn2VOkriuQ&list=PL_ov0kIxA5utev8Sery_4rMbV2uGho6fc&index=45

6.9.3 Miscellaneous tips

Educational material should be self-guided and enhance student interaction with the material. It should include explanatory examples and encouraging comments. At the beginning of each section, definition of the goals and the expected learning outcomes should be contained, as well as a synopsis at the end.

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6.10 Structural guidelines for online distance learning textual material

For a document to be useful as an online distance learning resource, it should contain some of the following elements (elements marked with an * are considered mandatory):

1. Elements at the start of the document
    a. Aim / objectives *
    b. Learning outcomes *
    c. Keywords *
    d. Introduction
    e. Pre-requisite knowledge
    f. Table of contents / figures / tables
2. Elements in the body of the document
    a. Sections / sub sections *
    b. Tables
    c. Figures
    d. Examples
    e. Case studies
3. Elements at the end of the document
    a. Synopsis
    b. List of references
    c. Glossary
    d. Further reading

In the following, each of these elements is briefly explained.

Aim / objectives

The aim provides a brief explanation of the general contribution of the document. The objectives specialize the aim using more concrete terms. This element should not exceed 5 lines of text.

Learning outcomes

They describe the knowledge / skills / competences (attitudes) that the student will develop after studying the document. They should be based on Bloom's taxonomy and specialize some of the learning outcomes of the module. Should be introduced as: After studying this resource, you will be able to: (followed by a list of outcomes). The list should not contain more than 10 outcomes; 5 is a good number.

Keywords

A set of keywords that provide the main terms used in the document. Note that for each of these terms, an explanation should be provided in the text and they could be summarized in the glossary. The first appearance of a term should be easily identifiable (i.e. using boldface). The list should not contain more than 10 terms; 6 is a good number.

Introduction

Introduces the reader to the contents that will follow. Places the resource in context and associates it with any previously learned material (if applicable). Also summarizes the resource contents. Should be used only for medium-sized and long documents (i.e. more than 4 pages). Should not exceed 10% of the total length of the document.

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Pre-requisite knowledge

Lists the knowledge and skills which are necessary in order to make optimum use of the resource. May not be used for short or medium-sized documents. Could be part of the introduction. Should not exceed 10 lines of text.

Table of contents / figures / tables

Provides an overview of the content and allows direct access to parts of the document. Should be used only for long documents (i.e. more than 12 pages).

Sections / subsections

Contain the body of the document. Should be structured in paragraphs. Avoid using more than 3 levels. Should be numbered.

Tables, figures and graphs

Tables and graphs are used to summarize and provide an overview text contents. Figures usually amplify or extend the text. Better be placed within the text or at the marginal space (if enough space is provided); better avoid wrapping text around them. Should be placed within a frame. Should be large enough so to be legible. Should always be numbered and have a caption. When referenced from the text, one should write “in figure 1”, never write “in the following figure”. In case the document will be printed, one should be careful with the use of colors (and the references made to them).

Examples

Are used to contextualize or personalize a part of the document. Should be placed within a frame. Should always be numbered and have a title. When referenced from the text, one should write “in example 1”, never write “in the following example”.

Case studies

Are used to contextualize or personalize a part of the document based on real or imaginary situations. Should be placed within a frame. Should always be numbered and have a title. When referenced from the text, one should write “in case study 1”, never write “in the following case study”.

Synopsis

Is placed at the end of the document and summarizes its contents and the learner’s achievements from studying it. Should be used only for medium-sized and long documents (i.e. more than 4 pages). Should not exceed 5% of the total length of the document.

List of references

Contains the list of resources referenced to in the text. The list should either be numbered or placed in alphabetical order. Use either APA or IEEE style. Make sure that each item in the list is referenced at least once in the text.

Glossary

Lists in alphabetical order the important terms used (or introduced) in the text, with a brief explanation.

Further reading

Provides selected resources (OERs) for further reading. For each resource, provide its reference (using APA or IEEE style) and a brief summary (no more than 5 lines).

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6.11 Structural guidelines for online distance learning presentations

For a presentation to be useful as an online distance learning resource, it should contain some of the following elements (elements marked with an * are considered mandatory):

1. Elements at the start of the presentation
    a. Title slide *
    b. Aim / objectives *
    c. Learning outcomes *
    d. Keywords *
    e. Table of contents
2. Elements in the body of the presentation
    a. Sections / sub sections *
    b. Tables / Graphs / Figures
3. Elements at the end of the presentation
    a. Synopsis
    b. List of references
    c. Further reading
    d. Presenters' bio
    e. Thank you / Credits *

In the following, each of these elements is briefly explained. It is assumed that each presentation is accompanied by narration.

Title slide (1 slide)

Shows the title of the presentation, together with contextualization information (e.g. module / unit it belongs to). The name(s) of the presenter(s) could also appear here.

Aim / objectives (1 slide)

The aim provides a brief explanation of the general contribution of the presentation. The objectives specialize the aim using more concrete terms. A brief introduction to the topic of the presentation could be provided here, too.

Learning outcomes (1 slide)

They describe the knowledge / skills / competences (attitudes) that the student will develop after watching the presentation. They should be based on Bloom's taxonomy and specialize some of the learning outcomes of the module. Should be introduced as: After studying this resource, you will be able to: (followed by a list of outcomes). The list should contain about 5 learning outcomes (approximately).

Keywords (1-2 slides)

A set of keywords that provide the main terms used in the document, together with a brief explanation. The list should not contain more than 10 terms; 6 is a good number.

Table of contents (1-2 slides)

Provides an overview of the presentation contents. If the presentation contains sections and sub-section, they should be mentioned here, together with the main slide titles of each. This is an alternative location for a brief introduction to the topic of the presentation.

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Sections / subsections

Make up the body of the presentation. In general, the main content of the presentation should be structured in a way that allows it to be viewed in non-sequential (i.e. the student can jump to any subsection) and modular (i.e. the student can stop at the end of a section and continue later) ways. The entire presentation and each section could be preceded by an introduction.

Tables, figures and graphs

Better be placed next to the text, or in a stand-alone slide (no text). Avoid placing text in random positions around graphical elements. Should be large enough to be legible.

Synopsis (1 slide)

Is placed at the end of the presentation and summarizes its contents and the learner's achievements from watching it.

List of references (1 slide)

Contains the list of resources used in the presentation. Use either APA or IEEE style. Even if references are also placed in the slides that make up the body of the presentation, they should be summarized at the end as well.

Further reading (1 slide)

Provides selected resources (OERs) for further reading. For each resource, provide its reference (using APA or IEEE style) and a brief summary (no more than 5 lines).

Presenters' bio (1 slide per presenter)

Ideally, the presenters should present themselves. This can be done either in the beginning (i.e. after the title slide) or at the end of the presentation. A short textual bio with a photo should be shown, while each presenter speaks briefly about him/herself in first person (i.e. Hello, I am … and, in this presentation, we shall … - tenses should be adapted accordingly).

Thank you / Credits (1 slide)

Thanks the student for watching the presentation. Shows the names of the contributors to the presentation (i.e. author(s), narrator(s), visual effects creator(s), musical score author(s) etc.) and contact details if further communication from the student is necessary. Also shows the licensing mode and takes into account the EU publication requirements.

A template is delivered based on the aforementioned guidelines.

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6.12 Practical assignments (types)

Project

With the term "Project", or "creative and synthetic work" we mean a small or large scale, group or individual work, which, through a cross-thematic approach, urges and supports the learner in the interdisciplinary study of a specific subject. The project is based on the core pedagogical principles of self-learning, participatory learning, in-depth and collaborative learning. Through a process of study, research, evaluation, and critical synthesis of resources, the trainee learns how to learn.

Example

Example is a specific (characteristic, representative) and well defined case that clarifies a concept, a rule, a pattern, a method or a process.

Activity

Activities suggest the learner to study a topic and deepen his / her knowledge and understanding to that, enable the learner to apply what he / she has learned, assist him / her to the memorization and exploitation of his / her experiences, and help him / her to link them to the subject under study, gaining control of the knowledge he / she has acquired.

For activities usually (unlikely to what is required for the self-assessment exercises), there is no single correct answer (or course of action of the learner) accepted for all learners. It is neither possible for the author of the material to provide all the possible answers and all the possible mistakes of the learners, in order to discuss them under a template answer. This is the main difference between activities and self-assessment exercises. This, of course, does not mean that the activities must stay unanswered by the author. The author of the material should always provide a typical correct answer or provide the key points of subjects or sentences a correct answer should include, when this is not possible, a description of the actions the learner should follow in order to implement correctly the activity.

Activity: Case Study

Case study is an extensive example that describes an actual case where the learner learns (or could learn) what has learned in practice. It starts with a description of the facts of the case, followed by a critical analysis of how it was implemented in practice what the learner learned, and a description of alternative ways of dealing with the situation. Critical analysis and / or description of alternative ways of coping are requested by the learner, depending on the purpose of the case study. Case studies consider an important learning tool that helps the learner to consolidate existing or new knowledge developed.

A case study can be exploited in two ways:

a. Consolidate existing and / or apply the knowledge developed,

b. Stimulate the heuristic process towards learning, when the acquisition of the required knowledge has not yet been completed.

In both cases, conclusions are drawn based on the study of the specific case, or at least assumptions are developed for the knowledge under study in its totality.

Activity: Problem solving

Problem solving focuses to the presentation of a real or hypothetical problem of direct interest to the learners, involving them in their analysis and in finding solutions, urging them in parallel to work out ways to implement the solution they have chosen.

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Activity: Text composition

The text composition activity describes a subject and asks the learners to study and criticize texts – that are provided to them, or they asked to search for them and choose – in order to compose their own documented text for the description / analysis / interpretation / processing of the topic under study.

Activity: Open type question

An open-ended question that usually requires a wider and more complex treatment for its response than a question in self-assessment exercises.

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7 Appendix III: Learning outcomes for instructional design

Adopting learning outcomes in the educational or training process serves the shift of the traditional approach oriented to the teachers towards an approach oriented to the learner. In the former strategy, teachers were responsible to select both the instructional strategy and the content. The course descriptions consisted of the content that would be used in lectures – or in other forms – while assessment focused on how well the learners assimilated this content. The "learner-centred" model adopts an "outcome-based" approach, focusing on what the learners will learn, master and be able to do as they progress through the course.

According to the European Qualifications Framework (2017)[19],

- *Qualification* means a formal outcome of an assessment and validation process which is obtained when a competent authority determines that an individual has achieved learning outcomes to given standards.
- *Learning outcomes* means statements regarding what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and responsibility and autonomy.
- *Knowledge* means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of EQF, knowledge is described as theoretical and / or factual.
- *Skills* means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).
- *Responsibility and autonomy* means the ability of the learner to apply knowledge and skills autonomously and with responsibility.
- *Competence* means the proven ability to use knowledge, skills and personal, social and / or methodological abilities, in work or study situations and in professional and personal development.

Especially for learning outcomes, the following guidelines apply when developing them,

- Use the ABCD / SMART approaches in writing the learning outcomes.
- Each learning outcome should refer to one and only level in Benjamin Bloom's taxonomy.
- Each learning outcome should contain one and only one action verb; use the list of verbs associated with each level in the taxonomy.
- Each learning outcome should contain one concept of the knowledge domain.
- The learning outcomes must be observable, measurable and capable of being assessed.
- Avoid complicated sentences. If necessary use more one than one sentence to ensure clarity.
- Avoid vague terms like know, understand, learn, be familiar with, be exposed to, be acquainted with, and be aware of. These terms are associated with teaching objectives rather than learning outcomes.
- Bear in mind the timescale within which the outcomes are to be achieved and the available resources. There is always the danger that one can be over-ambitious when writing learning outcomes.
- Before finalizing the learning outcomes, evaluate them with colleagues and students.

[19] Council Recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning (2017/C 189/03).

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7.1 Writing learning outcomes

Writing learning outcomes with emphasis on correctness and quality requires the employment of particular techniques, like the ABCD and SMART approaches. Additionally, they must address – exclusively and separately – one of the levels identified in the Bloom taxonomy[20] [21], i.e. *the Cognitive (knowledge-based), the Affective (emotion-based) and the Psychomotor (action-based)* domains. Two main approaches are used to write learning outcomes; the ABCD and the SMART approach. The author of learning outcomes may select the most convenient for him / her to use.

7.1.1 The ABCD approach

Back on 1984, Mager[22] argued that learning objectives should be specific and measurable in order to guide appropriately instructors and learners. In this regard, he introduced the ABCD approach in writing them, which included four main elements: **A**udience, **B**ehavior, **C**ondition and **D**egree of mastery. The description for each is presented below[23].

Audience (A)	Determines who will master the outcome. A very common way to begin a learning outcome is: "The learner will be able to…". Typical questions used are "Who? Who are your learners?".
Behavior (B)	Identifies what a learner is expected to be able to perform as a result of achieving the learning outcome, or, in other words, how will the learner demonstrate achievement of the outcome. Typical questions used are "What? What do you expect the learners to be able to do?"
Condition (C)	Describes the important conditions (if any) under which learner's performance is to occur. Typical questions include "How? Under what conditions or context will the learning occur? What will the learner be given or already be expected to know to accomplish learning?".
Degree of mastery (D)	Wherever possible, describes the criterion of acceptable performance by describing how well the learner must perform in order to be considered acceptable. Typical questions include "How much? How much will be accomplished, how well will the behavior need to be performed, and to what level?"

Table 14: The ABCD approach for writing learning outcomes

The reader should keep in mind the following when writing learning outcomes following the ABCD approach.

- The *verb* used to describe a desirable behavior in a learning outcome must come from / comply with the Bloom's taxonomy (Cognitive, affective, psychomotor domains). This verb must describe a behavior that is observable. However, take into account that a performance can be overt or covert:
    - An overt performance can be observed directly, whether that performance is visible or audible.
    - A covert performance cannot be observed directly; it may be mental, invisible, cognitive, or internal. A covert performance can be used as a learning outcome as long as there is a direct way determining whether it satisfies the outcome.
- The specification of *condition* should be detailed enough so that another competent person would recognize the desired performance. Typical questions include, "What will the learner be allowed to use?", "What will the learner will be denied to use?", "Under what conditions the desired performance is expected to occur?", "Are there any skills that the learner specifically should not develop?".

[20] Bloom, B. S.; Engelhart, M. D.; Furst, E. J.; Hill, W. H.; Krathwohl, D. R. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain. New York: David McKay Company.
[21] Bloom, B.S., Masia, B.B. and Krathwohl, D. R. (1964). Taxonomy of Educational Objectives Volume II: The Affective Domain. New York: McKay.
[22] Mager, R. F. (1984). Preparing instructional objectives, 2nd edition. Belmont, California: Pitman Learning.
[23] The ABCD Method of Writing Measurable Objectives. https://www.cusoeprofessionaleducation.org/uploads/2/9/5/8/29585257/writig_objectives_abcd2014.pdf

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- Indicators of degrees of mastery (performance) include the time limits, accuracy, quality, etc. By specifying the acceptable level of performance for each outcome, one has the means for determining whether instruction is successful. Both the teacher and the learner would know the quality of performance they have to work for.

Examples of well written outcomes are:

- **Given a verb in the present tense, the learner will be able to re-write the verb in future tense with no more than two errors in tense**.
- **Given 2 hours of study, the learner will solve 4 out of 5 problems of bandwidth allocation**.
- **Given a map of Europe, the learner will be able to list 5 major rivers in 2 minutes**.

7.1.2 The SMART approach

SMART[24] stands for **S**pecific, **M**easurable, **A**ttainable (or **A**ction-oriented), **R**elevant, and **T**ime-Bound.

Specific	The learning outcome should be clear and well defined, describing the knowledge, skills and competences that a learner should be able to demonstrate following exposure to a learning activity
Measurable	Achievement of learning objectives can be measured through benchmarks or targets by specific evaluation methods during or after the session
Attainable (Action-oriented)	The objective includes an action verb that demonstrates change or acquisition of knowledge, skills or competences
Relevant	The objective reflects relevant expectations of knowledge, skills and competences acquisition/change given the conditions for instruction
Time-bound	The objective specifies a time frame in which learners are expected to achieve the learning objective(s)—usually by the end of the session

Examples of SMART learning outcomes are:

- **Following this session**, **participants will describe four measures** that **can protect against lung cancer**.
- **After attending the lecture and studying chapter 2**, **learners will list the three domains of Bloom's taxonomy**.
- **By the end of this course**, the learner **will become proficient** in **Microsoft Excel** by **creating financial spreadsheets** to be used to **conduct museum's financial analyses**. The supervisor will evaluate his spreadsheets and written analysis.

[24] Anderson, L. & Krathwohl, D., et al. (2001). A Taxonomy for Learning, Teaching, and Assessing: a revision of Bloom's taxonomy of educational objectives, New York : Longman.

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7.2 The Bloom Taxonomy

The aforementioned approaches to writing learning outcomes are based on the work of Benjamin Bloom, who identified three domains of learning – cognitive, affective and psychomotor – each of which is organized as a series of levels or prerequisites. The three domains can be defined as follows:

Cognitive: it is the most widely used of the three domains. It refers mostly to knowledge structures and contains a classification (or taxonomy) of thinking behaviors from the simple recall of facts up to the process of analysis and evaluation [25].

Affective: it refers to the way we deal with things emotionally, such as feelings, values, attitudes, motivations, etc., and ranges from mere awareness through to being able to distinguish implicit values through analysis [26].

Psychomotor: it mainly emphasizes physical skills involving co-ordination of the brain and muscular activity and it prevails in areas like laboratory science subjects, health sciences, art, music, engineering, drama and physical education. Bloom and his colleagues never created levels in this domain, though other researchers later did, like Dave (1970)[27] and Simpson (1972)[28].

Each of these domains is further analysed in the following sections.

7.2.1 Cognitive domain

Bloom and his colleagues advanced their work mainly in the cognitive domain, as this is required in the majority of cases. They produced a hierarchical framework through one (learner) may build upon prior learning and upscale its knowledge. Apart from other purposes, it is used extensively to write learning outcomes providing the foundations for developers. Its ready-made structure, in conjunction with the provided (list of) verbs, facilitates significantly the writing of learning outcomes.

Bloom's taxonomy of cognitive domain consists of the following six levels (Bloom et al, 195620, Kennedy et al, 2006[29]):

1. **Knowledge:** the ability to recall or remember facts without necessarily understanding them. Some of the action verbs used to assess knowledge are: *Arrange, collect, define, describe, duplicate, enumerate, examine, find, identify, label, list, memorize, name, order, outline, present, quote, recall, recognize, recollect, record, recount, relate, repeat, reproduce, show, state, tabulate, tell.*

2. **Comprehension**: the ability to understand and interpret learned information. Some of the action verbs used to assess comprehension are: *Associate, change, clarify, classify, construct, contrast, convert, decode, defend, describe, differentiate, discriminate, discuss, distinguish, estimate, explain, express, extend, generalize, identify, illustrate, indicate, infer, interpret, locate, paraphrase, predict, recognize, report, restate, rewrite, review, select, solve, translate.*

3. **Application**: the ability to use learned information (i.e. ideas and concepts) to solve problems in new situations. Some of the action verbs used to assess application are: *Apply, assess, calculate, change, choose, complete, compute, construct, demonstrate, develop, discover, dramatize, employ, examine, experiment, find, illustrate,*

[25] Anderson, Lorin W.; Krathwohl, David R., eds. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Allyn and Bacon. ISBN 978-0-8013-1903-7.
[26] http://www.nwlink.com/~donclark/hrd/Bloom/affective_domain.html
[27] Dave, R. H. (1970). Developing and Writing Behavioural Objectives. (R J Armstrong, ed.) Tucson, Arizona: Educational Innovators Press.
[28] Simpson, E. (1972). The classification of educational objectives in the psychomotor domain: The psychomotor domain. Vol. 3. Washington, DC: Gryphon House.
[29] Kennedy, D., Hyland, A. and Ryan, N. (2006). Writing and using learning outcomes: a practical guide. Article C 3.4-1 in Eric Froment, Jürgen Kohler, Lewis Purser and Lesley Wilson (eds.): EUA Bologna Handbook – Making Bologna Work (Berlin 2006: Raabe Verlag)

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interpret, manipulate, modify, operate, organize, practice, predict, prepare, produce, relate, schedule, select, show, sketch, solve, transfer, use.

4. **Analysis**: the ability to break down information into components and understand organizational structure (i.e. look for inter-relationships). Some of the action verbs used to assess analysis are: *Analyze, appraise, arrange, break down, calculate, categorize, classify, compare, connect, contrast, criticize, debate, deduce, determine, differentiate, discriminate, distinguish, divide, examine, experiment, identify, illustrate, infer, inspect, investigate.*

5. **Synthesis**: may be defined as the ability to combine parts together. Some of the action verbs used to assess synthesis are: *Argue, arrange, assemble, categorize, collect, combine, compile, compose, construct, create, design, develop, devise, establish, explain, formulate, generalize, generate, integrate, invent, make, manage, modify, organize, originate, plan, prepare, propose, rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize.*

6. **Evaluation:** may be defined as the ability to judge the value of information for a given purpose or situation. Some of the action verbs used to assess evaluation are: *Appraise, ascertain, argue, assess, attach, choose, compare, conclude, contrast, convince, criticize, decide, defend, discriminate, explain, evaluate, grade, interpret, judge, justify, measure, predict, rate, recommend, relate, resolve.*

Examples: (**Active verb** – Bloom's taxonomy level) + (**Criterion**) + (**Concept of the knowledge domain**) + (**Condition**)	
Level 1: Knowledge	**Describe** the **7** main phases of an **information system development life cycle**.
Level 3: Application	**Construct** the **conceptual model of a database** using the **entity relationship model**.

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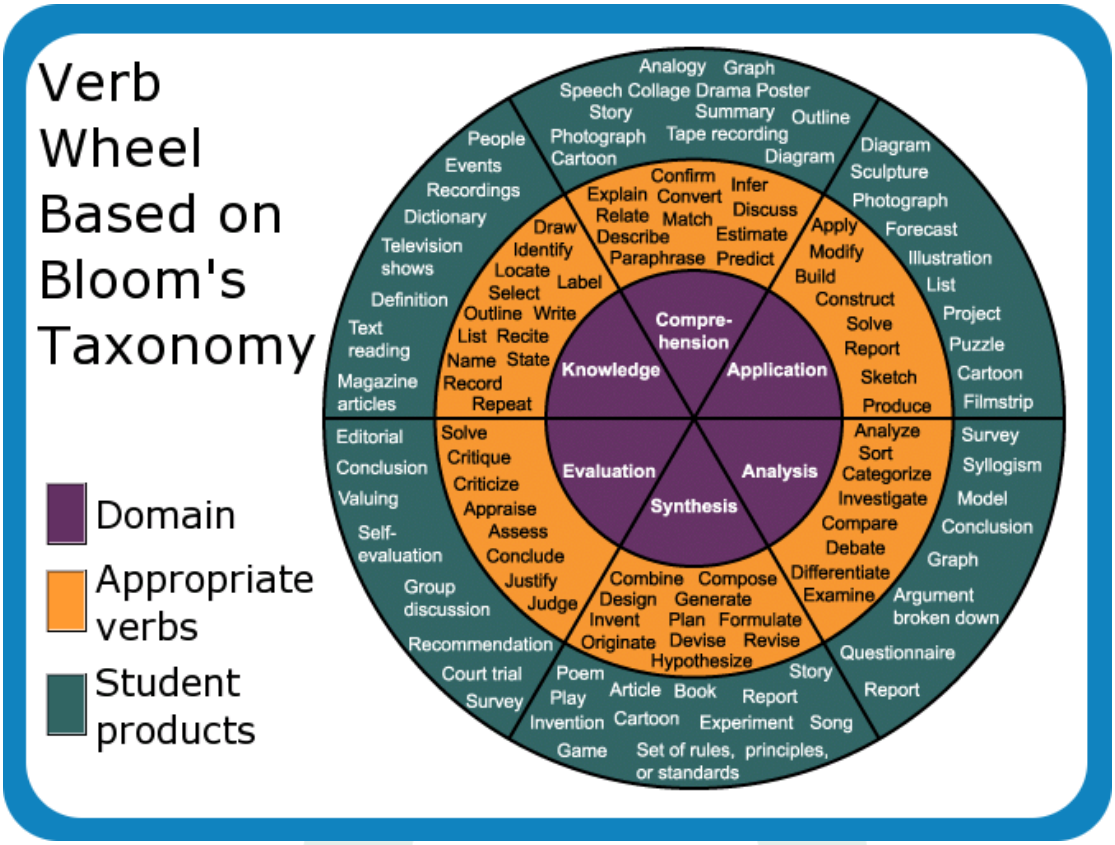

Figure 7: The verb wheel based on Bloom's taxonomy

(Source:http://2.bp.blogspot.com/_337GUHQH0FY/SmpJpr5va5I/AAAAAAAABmU/UFiQn59gIT8/s1600-h/bloomwheel.png)

When writing learning outcomes for the cognitive domain, it is suggested that:

- One should try to include learning outcomes for all levels of the taxonomy.
- One should try to avoid overloading the list with outcomes which are drawn from the lower levels of the taxonomy.
- One ought not to try to address higher levels until those below them have been covered (the taxonomy is effectively serial in structure).

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7.2.2 Affective domain

In order to describe the way in which we deal with things emotionally, Bloom and his colleagues developed five major categories [30]:

1. **Receiving**: refers to a willingness to receive information, e.g. the individual accepts the need for a commitment to service, listens to others with respect, shows sensitivity to social problems, etc. *Verbs / keywords: Acknowledge, ask, attentive, courteous, dutiful, follow, give, listen, understand*.
2. **Responding:** refers to the individual actively participating in his or her own learning, e.g. shows interest in the subject, is willing to give a presentation, participates in class discussions, enjoys helping others, etc. *Verbs / keywords: Answer, assist, aid, comply, conform, discuss, greet, help, label, perform, present, tell*.
3. **Valuing:** ranges from simple acceptance of a value to one of commitment, e.g. the individual demonstrates belief in democratic processes, appreciates the role of science in our everyday lives, shows concern for the welfare of others, shows sensitivity towards individual and cultural differences, etc. *Verbs / keywords: Appreciate, cherish, treasure, demonstrate, initiate, invite, join, justify, propose, respect, share*.
4. **Organization:** refers to the process that individuals go through as they bring together different values, resolve conflicts among them and start to internalize the values, e.g. recognizes the need for balance between freedom and responsibility in a democracy, accepts responsibility for his or her own behavior, accepts professional ethical standards, adapts behavior to a value system, etc. *Verbs / Keywords: compare, relate, synthesize*.
5. **Characterization:** at this level the individual has a value system in terms of their beliefs, ideas and attitudes that control their behavior in a consistent and predictable manner, e.g. displays self-reliance in working independently, displays a professional commitment to ethical practice, shows good personal, social and emotional adjustment, maintains good health habits, etc. *Verbs / keywords: act, discriminate, display, influence, modify, perform, qualify, question, revise, serve, solve, verify*.

7.2.3 Psychomotor domain

As detailed earlier, the psychomotor domain mainly emphasizes physical skills involving co-ordination of the brain and muscular activity; in practice, it prevails in areas like laboratory science subjects, health sciences, art, music, engineering, drama and physical education. Bloom and his colleagues never created levels in this domain, though other researchers later did, like Dave (1970)27 and Simpson (1972)[28] did. Dave (1970) proposed a hierarchy consisting of five levels:

1. **Imitation**: observing the behaviour of another person and copying this behaviour. This is the first stage in learning a complex skill.
2. **Manipulation**: ability to perform certain actions by following instructions and practicing skills.
3. **Precision**: ability to carry out a task with few errors and become more precise without the presence of the original source. The skill has been attained and proficiency is indicated by smooth and accurate performance.
4. **Articulation**: ability to co-ordinate a series of actions by combining two or more skills. Patterns can be modified to fit special requirements or solve a problem.
5. **Naturalization**: displays a high level of performance naturally ("without thinking"). Skills are combined, sequenced and performed consistently with ease.

[30] Verbs / keywords retrieved from Bloom's Taxonomy: The Affective Domain.

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Subsequently, Simpson (1972) developed a more detailed hierarchy consisting of seven levels[31]:

1. **Perception**: ability to use observed cues to guide physical activity. *Verbs: Choose, describe, detect, differentiate, distinguish, identify, isolate, relate, select*.
2. **Set (mindset)**: readiness to take a particular course of action. This can involve mental, physical and emotional disposition. *Verbs / keywords: Begin, display, explain, move, proceed, react, show, state, volunteer*.
3. **Guided response**: attempts at acquiring a physical skill, which lead to better performance. *Verbs / keywords: Copy, trace, follows, react, reproduce, respond*.
4. **Mechanism:** the stage where earned responses become more habitual and movements can be performed with some confidence and level of proficiency. *Verbs / Keywords: Assemble, calibrate, construct, dismantle, display, fasten, fix, grind, heat, manipulate, measure, mend, mix, organize, sketch*.
5. **Complex Overt Responses:** refers to physical activities involving complex movement patterns. Responses are automatic and proficiency is indicated by accurate and highly coordinated performance with a minimum of wasted effort. *Verbs / Keywords: Assemble, build, calibrate, construct, dismantle, display, fasten, fix, grind, heat, manipulate, measure, mend, mix, organize, sketch. These verbs / keywords are the same with the level "Mechanism" but will have adverbs or adjectives that indicate that the performance is quicker, better, more accurate, etc*.
6. **Adaptation:** at this level, skills are well developed and the individual can modify movements to deal with problem situations or to fit special requirements. *Verbs / keywords: Adapt, alter, change, rearrange, reorganize, revise, vary*.
7. **Origination:** creativity for special situations is possible because the skills are so highly developed. *Verbs / keywords: Arrange, build, combine, compose, construct, create, design, initiate, make, originate*.

7.3 The ECOSLIGHT methodology for writing learning outcomes

Taking into account the previous theories, methods and approaches, the ECOSLIGHT partnership adopts the following steps to write learning outcomes:

- **Step 1:** Collect data related to the topic of the course or the module and prepare a textual description.
- **Step 2:** Analyze the meaning of every word given and define every unknown term.
- **Step 3:** Differentiate between knowledge, skill and competence; these correspond to different levels in Bloom's taxonomy.
- **Step 4:** Apply the ABCD and SMART approaches to create one learning outcome for each knowledge, skill or competence.
- **Step 5:** Evaluate the learning outcomes for clarity, coherence, completeness (with respect to the domain AND to Bloom's taxonomy levels) and ability to be assessed.
- **Step 6:** Go to step 1 if any of the above conditions is not met and repeat the cycle.

Note that steps 1 and 2 belong to the Preparation phase, steps 3 and 4 belong to the Development phase, whereas steps 5 and 6 belong to the Evaluation phase.

[31] Verbs / keywords retrieved from Bloom's Taxonomy: The Psychomotor Domain.

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