D3.5 – ECSA Educational and Pedagogical Aspects

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Lead Partner	TU Graz
Author(s)	Dominik Zupan, Jan Eberl
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0.9	17.12.2025	Patrick Cogez	Aeneas
0.10	22.12.2025	Alessandra Messana	IAL-FVG
0.11	08.01.2026	Eerika Kokkonen	Okmetic
0.12	15.01.2026	Victoria Cummings	SEMI Europe
0.13	16.01.2026	Cian Ó Murchú	Tyndall
0.14	26.01.2026	Dominik Zupan	TU Graz
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Content

1. Introduction

The main goal of Work Package 3 (WP3) is to establish a governance and functioning model of the European Chips Skills Academy (ECSA), as well as the European Chips Skills Alliance, further on referred to as Alliance[1]. WP3 of ECSA therefore covers the skills strategy as well as the ECSA institutional arrangements, operational features and all educational aspects.

This deliverable defines the educational and pedagogical aspects of the Alliance. Therefore, this deliverable provides a summary on educational activities, such as online and on-site courses, summer schools etc., but also other activities such as student and teacher mobility, micro-credentials and work-based learning (WBL). By providing a broad range of activities, we ensure, that every stakeholder of the Alliance can contribute to the goals of the Alliance by:

- supporting **networking and community building**,
- providing **education, training and career guidance**,
- supporting **skills intelligence**, or
- endorsing **competence synchronization** and mutual recognition of education (e.g. through **micro-credentials**).

Therefore, this deliverable includes best practices on all these activities including relevant pedagogical considerations.

1.1 Document Structure

This document is organised as follows: In section 2, we summarise best practices on educational and networking activities that were proposed by the consortium partners. In section 3, we describe various types of mobility and ongoing activities associated with mobility of students and learners. In section 4, we explain how we certify educational activities using micro-credentials.

This document builds on the governance, functioning and operational features described in the deliverables "ECSA Institutional Arrangements (Governance and Functioning)" (project identifier D3.3), and "ECS-Academy Operational Features and Tools" (project identifier D3.4). It is further on, strongly linked with "ECS-Academy Implementation and Validation Plan" (project identifier D3.6), that regularly validates the Alliance, but also its individual activities.

[1] Please find a detailed definition and explanation on the Alliance in "ECSA Institutional Arrangements (Governance and Function)" (project identifier D3.3) and in "ECS-Academy Operational Features and Tools" (project identifier D3.4).

1.2 Executive Summary

The document summarises the activities of the European Chips Skills Academy (ECSA), operating under the European Chips Skills Alliance with regard to education, networking, mobility, and certification to offer a flexible lifelong learning in microelectronics, from EQF levels 3 to 8. This deliverable therefore sets the base for the launch of the ECSA governance and functioning in February 2026.

Goals and Coverage

This deliverable details the core activities of Work Package 3, building on related documents for governance, tools and validation (D3.3, D3.4, D3.6). It gathers partner best practices on educational and networking activities on courses, summer schools, internships, mobility and micro-credentials. It explains how these activities are connected to the ESCO classification framework to ease recognition across Europe.

Learning and Networking Options

This deliverable lists various educational and networking activities like in-person summer schools, online courses (MOOCs/OERs), internships, teacher training, visits, work-based learning, outreach, projects, challenges, student ambassadors, mentoring, career advice, and lab hands-on sessions. It summarises the target groups, pros/cons, setup needs, and real partner examples. The activities were gathered from all partners using a shared template in the appendix.

Mobility

Mobility enables networking and learning opportunities. We focus on short, affordable in-person physical mobility activities (such as the ECS Summer Schools), as well as virtual and blended mobility activities (the student ambassador programme).

Certificates and Micro-Credentials

We describe two certificate types: full micro-credentials and certificates of attendance, both linked to the ESCO framework. The certificate of attendance uses automated examination, whereas the full micro-credential requires supervised tests approved by experts. All micro-credentials are modular for clear career paths via Europass and job sites and connected with occupations present in ESCO. The learning and networking platform and the Skills Hub store all certificates, provide gamified badges and suggest personal learning paths based on jobs or courses.

2. Educational Activities, Networking Activities and Pedagogical Aspects

The Alliance integrates a wide range of educational and networking activities developed and implemented by the Alliance members. These activities form the operational core of the decentralised academy and span various formats – from summer schools and internships to online courses, micro-credentials, and recognition programs.

The activities address different learner groups, including school pupils, university students, teachers, and professionals seeking upskilling or reskilling from European Qualification Framework (EQF) level 3 to 8 and therefore include different pedagogical aspects. These educational activities are designed by industry, higher education institutions (HEIs), and vocational education and training (VET) providers and reflect real-world demands based on the outcomes of the Skills Strategy (project identifier D3.2). Additionally, the activities promote inclusivity, and strengthen career pathways into the microelectronics sector and support the upskilling and reskilling recommendations proposed in the Skills Strategy (project identifier D3.2).

In the following section, we provide a summary of the most relevant learning and networking activities of the Alliance. This includes a short description of all activities, including pedagogical aspects, advantages and disadvantages. We provide a template to collect best practices for activities of all Alliance members in Appendix A – Best Practice Template for Alliance Activities. Further on, we append all partner individual best practices for activities in Appendix B – Best Practice Examples on Partner Activities.

2.1 In-Person Learning Events and Summer Schools

In-person learning formats such as summer schools, masterclasses, and immersive workshops play a vital role in the ECSA educational landscape. They provide structured, high-impact opportunities for students, early-career professionals, and school-age learners to fully engage with microelectronics topics. These formats blend theoretical knowledge with hands-on exposure, industry networking, and collaborative learning—often hosted in academic or industrial settings.

Key Characteristics

These activities typically run over multiple days, with contributions from university lecturers and industry experts. Participants gain direct access to state-of-the-art facilities, project-based learning, and career development insight. The events are often structured around a specific theme or technology (e.g., IC design, robotics, sensor integration).

Partner Examples

- **TU Dresden**: memrisTEC Summer School: A 6-day programme combining lectures and team-based learning around memristive devices, showcasing applications for IoT and biosensing. Preparation and hosting involved a month-long effort from TU Dresden.
- **Infineon:** Summer School & MasterClass: Held in Villach, these week-long, onsite events mix technical lectures, site visits, and social activities. The MasterClass includes lab tours and workshops tailored for small cohorts, while the Summer School targets a larger group with Fab tours and expert talks.
- **AENEAS:** ECS Summer School: This yearly 5-day programme brings together (for each edition) 40 students with strict gender balance from across Europe to explore the full ECS value chain. Industry speakers present real-world use cases, and demonstrations allow students to connect theory with application.
- **Melexis:** Robot Workshops for Kids: A hands-on electronics introduction for children aged 6–12 using Melexis-designed bots. Focused on playful engagement, sensors, and teamwork to spark early interest in STEM.
- **SISAX:** Fabmobil Workshops & IC Design Lecture Series: Workshops delivered via a mobile lab bus touring schools in Saxony, coupled with an academic lecture series at Saxon universities to build IC design skills and awareness.
- **SISAX:** MINT to be: Gender-inclusive role model sessions that target school-aged girls and non-binary youth to counter stereotypes in tech career pathways.
- **SEMI**: High Tech University (HTU): flexible workshop that uses micro:bits in age-appropriate projects to introduce primary and secondary school students to working with electronics.
- **Tyndall**: TY Programme - The annual programme gives secondary school students a flavour of a week in the life of a researcher and an opportunity to learn about topics like electronics, sensors, materials science, electrochemistry, photonics and physics through talks, demonstrations and lab tours and hands on activities over the course of a week.

Pros

- High engagement and retention through hands-on and face-to-face interaction.
- Builds strong peer networks and student–industry relationships.
- Immediate access to expert knowledge, labs, and demonstrations.
- Tailored for career orientation and skill deep-dives.

Cons

- Resource-intensive in terms of staff, coordination, and logistics.
- High costs (e.g., Infineon's Summer School: ~€40,000/event).
- Limited scalability due to space, equipment, and staffing constraints.
- Accessibility challenges (travel, accommodation, etc.) for some learners.

Tools and Infrastructure

- Lecture rooms, demo labs, cleanrooms (e.g. Imec, Infineon).
- Pre-recorded videos and slide decks for preparation
- Kits or bots (e.g., Melexis workshop robots)
- Buses equipped with Fabmobil tech (3D printers, microelectronics gear)
- Event platforms for registration, communication (e.g., Webex, internal portals)

Literature & Links

- https://memristec.de/summerschool-2025/
- https://www.infineon.com/cms/en/product/promopages/schools/
- https://silicon-saxony.de/en/silicon-saxony-fabmobil-brings-stem-education-and-chip-knowledge-to-saxon-schools/
- https://www.melexis.com/en/info/stem/stem-projects
- https://aeneas-office.org/2025/03/18/ecs-summer-school-2025/
- https://www.semi.org/eu/HTU-Europe
- https://www.tyndall.ie/education/tyndall-transition-year-programme/
-

2.2 Online Learning (MOOCs, OERs)

Online learning plays a central role in ECSA's mission to deliver accessible, scalable, and modular education in microelectronics and adjacent fields. Whether used for foundational knowledge, upskilling, or outreach, online formats such as MOOCs (Massive Open Online Courses), Open Educational Resources (OERs), and asynchronous training modules enable learners to engage with content flexibly and at their own pace

Key Characteristics

These courses often include multimedia content (videos, simulations), interactive assessments, and learning paths aligned with ECSA's skill frameworks. They are frequently hosted on established platforms and in some cases developed in collaboration with industry.

Partner Examples

- **TU Graz**: ElectrONiX MOOC: A 5-week course hosted on the iMooX platform, combining videos, scripts, simulations, and self-assessments. Learners earn badges and certificates upon completion. The MOOC is designed to level out knowledge gaps across diverse learner groups.
- **BME:** Open Educational Resources (OERs): Moodle-based, asynchronous courses covering engineering fundamentals. While password-protected, they are open upon request and cater to a wide audience including schools and reskilling participants.
- **ANCCP:** ECoVEM Courses (TECAD, CTAD-DC/AC, Teacher Training): A suite of online microelectronics modules co-developed with Analog Devices. They include both technical and pedagogical content, emphasizing inclusivity and alignment with VET profiles.
- **Melexis:** Technicians Academy: Internally deployed learning content through the TEO platform, combining digital learning kits and online modules with workplace-based training. Designed for internal upskilling of operators toward technician roles.
- **Knolyx:** Open Online Courses & Agile Training: A platform offering general professional development courses (e.g., time management) as well as domain-specific Agile training. Courses are both synchronous and asynchronous, with customisation based on learner profiles.
- **AENEAS**: The lectures delivered during the 2024 and 2025 editions of the ECS Summer School have been recorded and the videos and slide sets were made available on the ECSA online training platform.

Pros

- Highly scalable and accessible across geographic and socioeconomic boundaries.
- Self-paced flexibility supports working professionals and diverse learners.
- Reusable content; easy to update and align with emerging technologies.
- Supports multilingual, inclusive, and mobile learning environments.

Cons

- Requires significant up-front content development effort.
- Learner engagement can be lower without supervision or interaction.
- Digital divide still presents barriers (connectivity, devices).
- Pedagogical support and feedback mechanisms can be limited.

Tools and Infrastructure

- Learning Management Systems: Moodle, iMooX, UNED
- Multimedia Content: Videos, simulations, interactive quizzes
- Badging & Certification Systems: Used in MOOCs and ECSA Skills Hub
- Digital Learning Kits: (e.g. Melexis TEO platform)
- Support Tools: Forums, asynchronous help desks

Literature & Links

- https://imoox.at/series/electronix
- https://teo.training/
- https://ecovem.eu/

2.3 Research-Based Internships

Internships are a cornerstone of practical learning within the ECSA ecosystem, providing a bridge between academic study and industrial application. These experiences enable students to apply theoretical knowledge in real-world settings, develop soft skills such as teamwork and communication, and gain insight into workplace expectations and company cultures.

Key Characteristics

Internship models within ECSA are often embedded in research & development environments, supervised by experienced mentors, and designed in alignment with formal university requirements for credits or certificates.

Partner Examples

- **BME:** Student Internships: BME offers international internships within its lab infrastructure, open to visiting students through Erasmus+ or bilateral agreements. Interns collaborate with BME professors on research tasks over a 1–3 month period, with tailored supervision and learning objectives.
- **Knolyx:** Internship Program: In cooperation with the Politehnica University of Bucharest, Knolyx has hosted over 20 students in long-term internships. Interns are gradually integrated into the team, assigned real tasks in product development, and often hired after program completion.
- **Tyndall**: Summer Fellowship Programme - The programme is open to all undergraduate students in Ireland and is a paid programme where students do a 12 week research project with a parallel 8-week development programme to build complementary skills for a scientific career.

Pros

- Real-world experience enhances employability and builds confidence.
- Strengthens academia–industry links and university relevance.
- Enables tailored mentoring and feedback.
- Often results in employment offers or longer-term collaboration.

Cons

- High time commitment for supervisors/mentors.
- Requires legal/administrative alignment with sending institutions.
- Not all learners can relocate or participate in person.
- Varying levels of engagement depending on host structure.

Tools and Infrastructure

- University–industry contracts or agreements (for credit/certification)
- Workplace systems for task management and supervision
- Feedback templates or internship diaries
- Communication tools for hybrid format

Literature & Links

- https://edu.vik.bme.hu/
- https://knolyx.com/
- https://www.tyndall.ie/tyndall-summer-fellowship-programme/

2.4 Train the Trainer Events

ECSA recognises the important role of teachers, trainers, and education professionals in shaping the next generation of microelectronics talent. To ensure the effective delivery of content across VET and HEI contexts, several partners have developed targeted "Train the Trainer" events. These activities aim to enhance pedagogical skills, update technological knowledge, and facilitate cross-border and interdisciplinary peer exchange and can create a multiplier effect.

Key Characteristics

The events vary in structure, ranging from workshops and study visits to hybrid training programmes, and often include collaborative content development, digital tools training, and structured feedback mechanisms. They also serve as multipliers by equipping trainers to cascade knowledge in their home institutions or networks.

Partner Examples

- **CIMEA**: Study Visit on Micro-Credentials Instructional Design: As part of the MICROCASA project, CIMEA organised a study visit in collaboration with the European University of Rome for Southeast Asian HE professionals. The event focused on designing, certifying, and recognising micro-credentials aligned with European QA frameworks. A mix of theoretical modules, practical exercises, and platform demonstrations were used to ensure participants could later implement micro-credential schemes in their home institutions.
- **ANCCP:** ECoVEM Teacher Training Programme: This blended training series targeted VET teachers and technical educators in Spain. Over six weeks, participants engaged in hybrid sessions covering course design, equality in microelectronics, simulations, photovoltaic systems, circular economy, and the use of Moodle-based OERs. The course helped teachers integrate emerging technologies and inclusive pedagogies into their practice.
- **VSB-TUO:** Battery Teachers Forum: Hosted by Škoda Auto in Mladá Boleslav, this peer forum brought together over 30 educators from nine countries to exchange on e-mobility training. Activities included plant tours, best practice presentations, and facilitated discussions on digital and green transition skills. The model is now being continued under the CaBaTT project and has strong replication potential.
- **ANCCP:** During the Erasmus+ mobility, done in Colombia in December 2025, ANCCP disseminated and promoted ECSA courses and digital certifications to key Colombian institutions, including Fundación Universitaria Antonio de Arévalo (UNITECAR), Universidad Tecnológica de Bolívar (UTB), Escuela Superior de Administración Pública (ESAP), Universidad Simón Bolívar (UNISIMON) and Fundación Universitaria Tecnológico Comfenalco, with coordination support from LACEEI. ECSA courses were presented as flexible, online training units focused on microelectronics, but not only, Diversity, Equity and Inclusion (DEI) in our sector is also included for instance, suitable for integration into vocational education, higher education and international cooperation projects. This practice strengthened institutional awareness, supported future collaborations, and ensured the transferability and sustainability of ECSA course outcomes beyond the original project.

Pros

- Enhances didactic quality and alignment with new skill demands.
- Creates multiplier effects, training the trainers amplifies outreach.
- Facilitates international collaboration and mutual learning.
- Encourages reflective practice and peer benchmarking.

Cons

- Scheduling and engagement can be challenging due to participants' teaching loads.
- Outcomes depend heavily on participants' motivation and institutional support.
- Travel or coordination costs for multi-day formats.

Tools and Infrastructure

- Learning platforms (Moodle, UNED, custom e-learning systems)
- Hybrid meeting tools (Zoom, Teams)
- Materials: video lectures, simulations (e.g., OrCAD, Pspice)
- Digital wallets and micro-credential certification systems

Literature & Links

- https://www.cimea.it/
- https://ecovem.eu/
- https://sites.google.com/view/cabatt/project-cabatt

2.5 Study Visits & Peer Learning Events

Study visits and peer learning formats are an essential part of ECSA's operational model, offering structured opportunities for networking, mutual exchange, and exposure to best practices across institutions and industries. These short-term, targeted activities often involve participants travelling to a host organisation to engage in a mix of presentations, site visits, workshops, and interactive sessions.

Key Characteristics

Such formats support capacity building, policy dialogue, and transnational knowledge transfer—making them particularly effective for teaching staff, decision-makers, and vocational trainers.

Partner Examples

- **VSB:** ASA Study Visit (Stuttgart): Organised with the Automotive Skills Alliance, this two-day event included visits to Bosch and Mercedes-Benz, discussions on workforce upskilling, and practical insight into VET and apprenticeship systems. A strong emphasis was placed on human-centric transformation and company–region collaboration.
- **VSB:** Battery Teachers Forum: A peer-learning forum hosted by Škoda Auto, gathering 30+ teachers from 9 countries to exchange best practices in e-mobility and reskilling. Includes company visits and thematic discussions on teaching and training delivery.
- **Infineon:** School Visits: Short, 3-hour factory and Fab tours for school and university groups. These events offer career orientation, hands-on demonstrations, and an introduction to real-world industry processes.
- **Infineon:** Infineon Hub at TU Wien: A university-based tech and event space operated by Infineon, offering a platform for informal peer learning, networking, and study visits. Students, PhD candidates, and industry professionals collaborate through events, workshops, and mentoring activities. The Hub strengthens the academia–industry interface and promotes innovation-oriented exchanges.
- **CIMEA:** Study Visit on Micro-Credentials: Hosted in collaboration with the European University of Rome, this event trained Southeast Asian HE professionals in designing, validating, and certifying micro-credentials. A blend of theoretical sessions and digital wallet demos provided actionable knowledge for replication.

Pros

- Promotes exchange of ideas, peer networking, and benchmarking.
- Enhances cultural understanding and European cooperation.
- Enables in-depth thematic focus in a short time frame.
- Builds trust and community within a network.

Cons

- Limited scalability due to travel/logistics costs.
- Requires careful agenda planning and preparation.
- May be less inclusive for some participant groups (e.g., visa/access issues).
- Follow-up or long-term impact often depends on individual motivation.

Tools and Infrastructure

- Meeting spaces (onsite or online platforms like Zoom/Teams)
- Agenda setting and briefing materials
- Logistics coordination (e.g., transfers, visits, accommodation)
- Certificates of participation or follow-up surveys

Literature & Links

- https://automotive-skills-alliance.eu/stuttgart-study-visit-an-opportunity-for-rich-discussions-within-the-european-year-of-skills/
- https://microcasa.uc3m.es/

2.6 Dual Learning & Work-Based Learning

Dual learning and work-based learning (WBL) models combine structured theoretical instruction with direct application in an industry environment. As a core pillar of ECSA's pedagogical approach, these models aim to integrate education and employment pathways, ensuring learners acquire both academic qualifications and practical competencies.

Key Characteristics

Typically, these programs involve rotations between classroom learning and workplace assignments, and often lead to recognised qualifications or employment within the host organisation.

Partner Examples

- **Imec**: Imec School: A six-month dual-learning programme for operator-level roles. Combines cleanroom tool training with theoretical sessions (physics, chemistry, process techniques). Delivered by over 50 internal trainers in short focused modules. Graduates are immediately employable as process assistants.
- **Melexis:** Technicians Academy (Belgium): An internal upskilling pathway using digital and physical training kits through the TEO platform. Operators are trained for technician roles via a blend of self-study, hands-on production exercises, and mentoring by in-house experts.
- **Melexis:** Graduate Academy (Bulgaria): An 8-week summer practice programme introducing students or recent graduates to Melexis departments. Trainees complete real projects with 1:1 mentorship and have follow-up employment options. Over 60 engineers hired through the programme since 2014.

Pros

- Strong employability outcomes; often linked to real job offers.
- Promotes deep learning through applied practice.
- Supports retention and internal career development.
- Flexible, adaptable to both VET and HEI contexts.

Cons

- High organisational effort and trainer availability required.
- Quality can vary based on mentoring and supervisor capacity.
- Scaling across regions or companies requires common frameworks.
- Intellectual property or confidentiality issues in company environments.

Tools and Infrastructure

- In-house learning platforms (e.g. TEO at Melexis)
- Production or lab environments for real-world application
- Dedicated mentors or line supervisors with didactic training
- Rotational schedules and assessment tracking tools

Literature & Links

- https://www.melexis.com/en/careers/academy
- https://teo.training/
- https://www.imec-int.com/en/careers/imec-school

2.7 Outreach & Recognition Initiatives

Outreach and recognition activities are integral to raising awareness about microelectronics careers and motivating future professionals. These formats target early-stage learners, the general public, and under-represented groups by showcasing success stories, offering engaging experiences, and making STEM careers visible and aspirational.

Key Characteristics

Such activities are often informal, yet play a strategic role in ECSA's long-term talent development by shaping perceptions and broadening participation.

Partner Examples

- **SEMI:** 20 Under 30 Award Programme: A visibility and networking initiative recognising young industry talents across SEMICON events. Winners are nominated by their companies, receive press coverage and event access, and become role models for early-career engineers.
- **SISAX:** IC Design Career Video Campaign: A short film produced by 15 Saxon companies aimed at motivating students to consider IC design careers. Presented in a narrative format (featuring characters from the future and present), it's used in classrooms and at outreach events.
- **SISAX:** MINT to be Workshops: Gender-sensitive outreach for school pupils, especially girls and non-binary youth. Role models deliver short sessions on careers in microelectronics, robotics, and software, aiming to counteract stereotypes and promote diversity.

Pros

- Increases visibility of STEM careers and success stories.
- Helps tackle gender imbalance and diversity gaps.
- Builds networks between learners, companies, and educators.
- Low-cost, high-impact when combined with media dissemination.

Cons

- Limited in skill development—focus is more inspirational.
- Requires sustained follow-up to lead to enrolment or training.
- Impact may be harder to quantify or track longitudinally.

Tools and Infrastructure

- Video production and social media tools
- Outreach websites or landing pages (e.g., "MINT to be")
- Nomination and evaluation platforms (e.g., SEMI awards)
- Role model training and classroom presentation kits

Literature & Links

- https://www.semiconwest.org/special-features/semicon-west-20-under-30

2.8 Project-Based Learning & University Collaboration

Project-based learning (PBL) involves learners solving real-world problems, often in team settings and with support from mentors. These initiatives foster creativity, collaboration, and applied skills—all essential in the microelectronics sector. They also serve as authentic recruiting and networking platforms.

Key Characteristics

PBL activities in ECSA are closely tied to university-industry cooperation, often around high-visibility engineering competitions or student innovation initiatives.

Partner Example

- **Melexis:** Electric Car Projects (Formula Student & SAE): Melexis donates sensors and supports student teams at KU Leuven, Thomas More University, and Brazilian institutions. Students integrate Melexis tech into racing prototypes (e.g., pedal sensing, brake disc temperature), combining engineering with teamwork, marketing, and fundraising.

Pros

- High learner motivation due to tangible outcomes.
- Bridges technical and soft skills (communication, leadership).
- Industry gets early access to talent and use-case feedback.
- Strong fit for cross-disciplinary engineering education.

Cons

- Resource-intensive (hardware, time, supervision).
- Not always credit-bearing in university curricula.
- May favour learners already in engineering tracks.

Tools and Infrastructure

- Lab and prototyping environments
- Access to industrial components and data
- Mentorship or sponsorship models (company advisors)
- Presentation and showcase events (e.g., races, expos)

Literature & Links

- https://formulaelectric.be/

2.9 Challenge-Based Learning and Award Progammes

Challenge-Based Learning (CBL) is an active learning methodology that places learners in the role of problem-solvers tackling real-world tasks. Within ECSA, this format can be applied both in education and in recognition programmes.

Key Characteristics

CBL offers a structured framework in which learners are given a set of requirements or specifications and must design a working solution. They receive direct feedback based on objective test cases or expert assessment, and in many cases, the process is gamified—through scoreboards, peer comparisons, or awards. These programmes are particularly suited for enhancing design, analysis, and critical thinking skills in technical domains such as electronics, systems design, and embedded applications.

Partner Example

- **TU Graz:** Challenge-Based Learning System for Circuit and System Design: TU Graz developed an online CBL system that allows learners to upload their own circuit designs (e.g., operational amplifiers) and receive automated feedback based on test benches and simulation-based measurements. The system includes a high score list for comparison and motivation and is based on a Python API using LTspice, a web frontend for challenge interaction, and a central database for submissions. Teachers define test cases and constraints, while learners compete to meet or exceed specification targets.
- **SEMI**: 20 Under 30 Award Programme: SEMI's award programme recognises outstanding young professionals under the age of 30 who have demonstrated innovation, leadership, and community engagement in the microelectronics sector. Candidates are nominated by their employers, and winners are selected by an expert panel. The award ceremony takes place during SEMICON events, providing access to international visibility and networking. The initiative helps build role models for the industry and showcases diverse pathways into microelectronics careers.

Pros

- Promotes hands-on application of theoretical knowledge.
- Learners receive immediate feedback and benchmarking.
- Supports multiple levels of difficulty and learner autonomy.
- Can be scaled for competitions, recruitment, and peer sharing.

Cons

- Requires upfront effort from teachers to define test cases and challenge logic.
- Evaluation must be carefully aligned with learning objectives.
- Learners may initially struggle with open-ended problem formats.

Tools and Infrastructure

- Simulation tool (e.g. LTspice)
- Web-based UI for challenge interaction
- Python-based automated testing framework
- Scoreboards and performance visualization
- Optional gamification or certification

Literature & Links

- Zupan, Eberl, Pluns, Deutschmann et al., "A Challenge-Based-Learning System to Improve Education in Circuit and System Design," IEEE, 2026 (accepted at ISCAS 2026)
- https://www.semiconeuropa.org/special-features/20-under-30

2.10 Student Ambassador Programme and Mentorship Programmes

To foster long-term engagement and diversity in the microelectronics talent pipeline, ECSA collaborates closely with the European Chips Diversity Alliance (ECDA) in implementing two complementary initiatives: the ECSA Student Ambassador Programme and the ECDA MentorCHIP Programme. While developed under separate projects, both are strategically coordinated to avoid duplication and ensure alignment in objectives and outreach

ECSA Student Ambassador Programme

The ECSA Student Ambassador Programme is a flexible initiative that empowers students to actively shape educational content, promote events, and represent ECSA at universities and online platforms. Ambassadors are encouraged to tailor their involvement to their interests, ranging from reviewing course materials and creating promotional content to interviewing industry figures, contributing to social media, and organising student-led clubs or awareness events.

The programme offers both virtual mobility (e.g., online networking, digital outreach, Discord channels) and physical mobility (e.g., open house days, ambassador summits, and campus-based activities). Ambassadors participate on a voluntary basis, but financial support is available for travel to in-person events.

ECDA MentorCHIP Programme

The MentorCHIP Programme, run by ECDA, offers structured mentoring for students and early-career professionals, particularly from underrepresented groups. Participants are matched with experienced mentors from academia or industry for multi-month guidance, covering technical skills, career development, and personal growth. ECSA supports the dissemination and visibility of the programme through its communication channels.

Pros

- Builds leadership, visibility, and peer-to-peer learning among students.
- Supports inclusion and retention through personalised mentoring.
- Encourages both online and campus-based engagement.
- Strengthens links between education, industry, and community.

Cons

- Mentor–mentee matching and programme sustainability require coordination.
- Volunteer-based roles depend on individual motivation.
- Careful project coordination is needed to avoid overlap between initiatives.

Tools and Infrastructure

- Application portals and onboarding materials
- Mentoring platforms and communication tools (e.g., Discord, Zoom)
- Outreach materials and templates (social media, event kits)
- Financial support mechanisms for in-person participation

Literature & Links

- https://diversityinchips.eu/mentorchip-program/
- https://chipsacademy.eu/uncategorized/join-ecsa-student-ambassadors/

2.11 Career Guidance

Career guidance activities are essential for bridging the gap between education and employment, particularly in a rapidly evolving and highly specialised sector like microelectronics. Within ECSA, partner organisations support initiatives that help students navigate career options, understand workplace expectations, and build meaningful connections with potential employers.

Key Characteristics

Career guidance formats vary across partners but often include mentoring programmes, career panels, company visits, and guidance on job applications and recruitment practices. These activities are especially valuable for international students and underrepresented groups, offering both orientation and integration into the European labour market.

Partner Example

- **Okmetic:** Career Guidance via Aalto International Talent Program: Okmetic participates in the Aalto International Talent Program, coordinated by Aalto University in Finland. This group mentoring initiative connects international master's and doctoral students with companies and alumni, aiming to support career orientation and networking. The programme includes a kick-off session, three themed mentoring sessions (e.g., work culture, recruitment, industry insights), and an on-site company visit. Companies provide feedback on student CVs and introduce the specific career paths within their field, such as the semiconductor industry in Okmetic's case. This format helps international students build networks, learn about Finnish working life, and prepare for job applications

Pros

- Offers practical insight into workplace culture and recruitment practices.
- Builds direct links between learners and potential employers.
- Strengthens soft skills like networking and communication.
- Increases retention of international talent in Europe.

Cons

- Coordination effort required from hosting institutions and companies.
- Effectiveness depends on mentor engagement and group dynamics.
- Limited number of participants per cycle.

Tools and Infrastructure

- Online conferencing platforms (Zoom, Teams)
- Standard presentation tools (e.g., PowerPoint)
- CV review templates, feedback forms
- Support from university coordinators

Literature & Links

- https://www.aalto.fi/en/career-design-lab/aalto-international-talent-program

2.12 Hands-On Training

Hands-on training remains a cornerstone of effective technical education in microelectronics. It allows learners to apply theoretical concepts in realistic environments, develop practical skills, and gain experience with measurement equipment, tools, and design software. In ECSA, hands-on activities complement digital and theoretical learning by reinforcing core engineering competencies, especially in areas where system behaviour must be experienced rather than simulated.

Key Characteristics

These formats are particularly valuable in fields like electromagnetic compatibility (EMC), PCB layout, analogue design, and measurement techniques, where physical setups and debugging practice are essential for skill mastery.

Partner Example

- **TU Graz:** Workshop on EMC fundamentals: TU Graz developed and delivers a compact, practice-oriented workshop focused on electromagnetic compatibility (EMC). Aimed at industry professionals with a technical high school background, the training includes real-world measurement setups. Learners build and test example circuits, perform EMC measurements, and analyse the impact of design decisions on radiated and conducted emissions. The workshop is embedded within the university's laboratory courses and includes pre-lab preparation, guided experiments, and group-based troubleshooting tasks. The format builds confidence in using lab equipment and interpreting measurement results. It is easily adaptable for other universities or VET providers.
- **Tyndall**: Clean Room Fabrication Course - Attendees are introduced to the state-of-the-art fabrication facilities and equipment available in Tyndall National Institute. Through observation of the processes involved, attendees will learn how to safely undertake the process steps involved to fabricate a laser.

Pros

- Strengthens understanding through experiential learning.
- Familiarises students with real lab tools and test equipment.
- Supports learning outcomes related to safety, debugging, and tolerance.
- Can be integrated into existing lab courses or offered as a standalone module.

Cons

- Requires physical lab infrastructure and trained supervisors.
- Scheduling and equipment availability may limit scalability.
- Not suitable for fully remote delivery.

Tools and Infrastructure

- Signal sources (e.g. signal generators)
- Oscilloscopes, spectrum analysers, current probes
- PCBs and soldering tools
- Semiconductor fab tools (CVD, lithography, metal depos)

3. Mobility

In this section, we describe various types of mobility, that we plan to offer in the Alliance. We describe some already established and ongoing initiatives, as well as planned activities.

Mobility refers to the movement of individuals across geographic locations for the purpose of education, work, travel etc. Usually this is done to gain experiences, to grow personally and to connect and engage across borders. There are two types of mobility that we offer within the Alliance: physical mobility and virtual mobility. We explain both types of mobility in the following sections

3.1 Physical Mobility

Physical mobility refers to the actual relocation of individuals. Individuals can gain tangible in-depth experience influenced by spatial and economic factors. Based on the duration one can distinguish between short-term mobility (less than a month) and long-term mobility (more than a month).

Long-term mobility refers to relocations of individuals for more than a month (up to several years). This allows for deeper integration, stronger relationship-building, and greater professional or educational impact. However, it is usually very cost-intensive for participants to relocate to another country for such long periods of time. As a result, many participants in long-term mobility initiatives heavily depend on grants and scholarships (e.g. Erasmus+, company scholarships, etc.). In most cases, only a certain portion or a lump sum is funded, rather than the entire stay. Furthermore, such long-term mobility grants are intended for only a few participants per year and are more expensive per capita. However, within the Alliance, we want to reach out to as many students and learners as possible and not just a few. Thus, we focus on short-term mobility to be able to leverage the funding more effectively.

Short-term mobility refers to the relocation of individuals for up to a month. Participants typically focus on specific, time-bound objectives like training, workshops, or short projects. Short-term mobility generally provides less immersion but increases flexibility and accessibility. In this case, the centre of life usually does not change. This form of mobility is therefore more cost-effective for participants and funding providers. As a result, the costs incurred can often be funded in full rather than only in part. This enables the Alliance to reach significantly more students, thereby ensuring more effective use of the provided funding.

3.2 Virtual Mobility

In contrast to physical mobility, virtual mobility enables similar opportunities for learning, communication, and collaboration but it does so remotely via information and communication technologies. This allows participants to connect and engage across borders without changing their physical location. This process is generally faster and more accessible. It requires less time-commitment and less logistical costs. Virtual mobility was particularly important during the COVID-19 crisis. Nevertheless, even after the crisis, it has remained an effective means of offering opportunities for exchange and networking. A major advantage of this form of mobility is the low costs, as there are no travel or accommodation costs involved. In addition, participants who do not have time for other mobility activities, for example due to care responsibilities, can also take part, making it more inclusive.

3.3 Blended Mobility

Blended mobility combines the advantages of physical and virtual learning. The virtual mobility component can be used to prepare students for short-term physical stays or it can be used as a follow-up activity afterwards. The ERASMUS+ programme supports blended mobility with the so called Blended Intensive Programmes (BIP) Initiative[2]. BIPs need to be implemented by at least three HEIs from at least three EU member states, give at least 3 ECTS, whereas the physical mobility has to be between 5 to 30 days. Within the ECSA project, a BIP can e.g. be implemented within a summer school, allowing students to prepare beforehand and making it easier to follow in the presence part.

3.4 Activities Involving and Promoting Mobility

In the Alliance we plan to provide a mix of physical and virtual mobility initiatives to address as many students and learners as possible. With regard to physical mobility, we will mainly focus on short-term mobility, as this is more cost-effective per capita. One part of the short-term mobility will focus on training, reskilling and upskilling initiatives, while the other part will promote networking opportunities. In addition, there will also be individual internship opportunities offered by members. These may be considered as short-term or long-term mobility depending on their duration.

Currently we offer the following mobility initiatives within the Alliance:

- Electronic Components and Systems (ECS) Summer School
- Student Ambassador Programme
- Mentorship Programmes (MentorChip within the European Chips Diversity Alliance, ECDA)
- INFRACHIP Research Infrastructure Project

We explain each of these initiatives in the following sections.

3.4.1 Electronic Components and Systems (ECS) Summer School

The Electronic Components and Systems (ECS) Summer School is a recurring annual event and mainly organised by the ECSA project partner Aeneas. It offers science, technology, engineering, mathematics (STEM) students a comprehensive introduction to the field of microelectronics through lectures, demonstrations, and interactive activities. The summer school covers key topics such as semiconductor technology, integrated circuit design, digital systems, embedded intelligence, and integration. The program focuses on technological innovations and future applications that microelectronics enable in areas like telecommunications, automotive systems, and biomedical devices.

The summer school is an in-person event that lasts about a week. We try to achieve a good mix of participants. This applies to gender aspects (gender balance among the participants is strictly enforced) as well as to the nationality of the participants. To enable easy physical participation from students from all over Europe, the attendance is fully free of charge, without tuition fees and with all meals and accommodation provided for free to participants. This support compensates for eventual travel costs and ensures that students can attend regardless of their actual place of residence, promoting cultural exchange and international networking in microelectronics every year.

3.4.2 Student Ambassador Programme

The ECSA Student Ambassador Program is a flexible initiative that empowers students to help shape educational content, promote events, and amplify the presence of the Alliance across university campuses and online platforms. Ambassadors can tailor their involvement to match personal interests and commitments. Possible activities range from reviewing course materials and creating promotional content to hosting social clubs, interviewing industry figures, and participating in career awareness

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[2] https://wikis.ec.europa.eu/spaces/NAITDOC/pages/95553249/Blended+Intensive+Programmes

events. The program also offers unique opportunities, such as collaborating on event ideas, accessing networking sessions with industry leaders, and connecting with peers throughout Europe.

This program provides both physical mobility, through in-person involvement in university open house days, Student Ambassador summits, and social activities organized across European universities and virtual mobility by offering online networking, event promotion through campus and social media, engagement in panel discussions, and digital community-building through newsletters, podcasts, or dedicated chat servers like Discord. Through these activities, ambassadors can participate and collaborate regardless of location, encouraging meaningful connections and learning both on campus and online. In general student ambassadors work on a voluntary basis, but they receive financial support when participating in in-person events.

3.4.3 MentorChip Programme

The European MentorChip Exchange Programme[3] of the European Chips Diversity Alliance (ECDA) project is a cross-border mentoring initiative that connects mentors and mentees from academia and industry in Europe's microelectronics ecosystem to advance diversity, equity, and inclusion (DEI). It aims to support underrepresented talent by creating structured one-to-one mentoring relationships, fostering role models, and enabling knowledge exchange on both technical careers and inclusive workplace practices. Through this programme, participants build networks across countries and organisations, gain guidance on career development, and contribute to a more inclusive semiconductor talent pipeline.

3.4.4 INFRACHIP Research Infrastructure Project

INFRACHIP is a European research platform for the sustainable development of next-generation and future semiconductor chips coordinated by Tyndall. A Research Accelerator training programme is offered through INFRACHIP which gives early career researchers an on-site introduction to the technology/facilities available through INFRACHIP. INFRACHIP also sponsors PhD students and early-career postdoctoral researchers to attend advanced nanoelectronics technology training courses. This is to give them a clear insight into nanofabrication and outline how they can benefit from semiconductor technologies to accelerate their own research.

[3] https://diversityinchips.eu/mentorchip-program/

4. Micro-Credentials, Certification & Competence Synchronisation

Micro-credentials represent a key factor in the Alliance's educational strategy. They allow learners to acquire focused skills and knowledge in short, modular/stackable learning units that can be recognised and certified. This model supports lifelong learning, reskilling, and flexible workforce development—especially relevant in fast-evolving sectors like microelectronics.

Within the Alliance, we provide micro-credentials based on the European Skills, Competences, Qualifications and Occupations (ESCO) framework. Whenever possible, the learning outcomes of all educational activities are mapped to knowledge, skill and competence entries represented in ESCO. At the same time, these entries are also mapped to micro-credentials. If a learner proves, that they have mastered a specific knowledge, skill or competence, they receive a micro-credential. Therefore, we define a micro-credential to certify, that a learner acquired a specific knowledge, skill or competence. However, simply introducing micro-credentials is not sufficient. In order for them to be recognised by other stakeholders, they must be designed in a way that is comprehensible and transparent.

In the following subsection, we describe the types of certificates, that we offer through the Alliance and how the assessment for each of these certificates looks like. Further on, we explain how to develop modular curricula for flexible learning pathways and describe the main tools developed by the Alliance. Finally, we summarise the advantages of using micro-credentials.

4.1 Types of Certificates

In a questionnaire in March 2024, we evaluated, how much experience the partners have in designing and implementing micro-credentials. We show and discuss the results in the following.

In Figure 1 we show that seven partners have experience with micro-credentials. Six partners, mostly HEIs and VET providers indicate, that they can legally provide micro-credentials and they already do so. Based on this, we can conclude, that these partners will be primarily responsible for providing micro-credentials. Nevertheless, within the Alliance we want to involve all industry and research partners in the development of micro-credentials within the scope of our partners' capabilities. Therefore, we develop two types of micro-credentials in the Alliance: a **full micro-credential** that meets all legal requirements of the respective member state the partner is located, and a **certificate of attendance** that is not regulated by law. The certificate of attendance is based on control and trust within the partners in the microelectronics community. In section 2.5 of deliverable D5.1 ("ECS-Academy Pedagogic Model, Guidelines and Learning Outcomes") we have therefore developed two flows to assure the quality of specialized trainings. In the proposal stage the independent Educational Board needs to accepts course proposals. Later, in the delivery stage the pilot courses are validated. If the validation is positive, courses can be recognised within the micro-credential community. If validation is negative, courses can be either improved by the provider or the courses are removed from the platform.

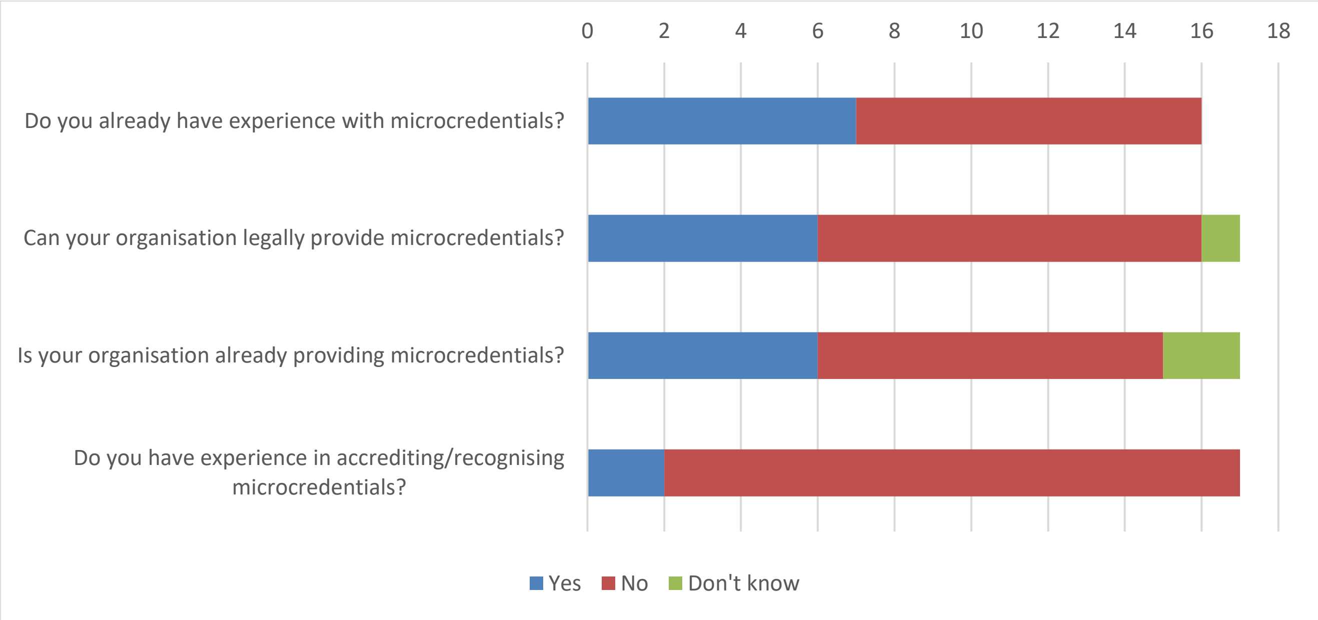

Figure 1: Questionnaire on partners' experience with micro-credentials.

4.2 Types of Assessments

Based on the two types of certificates, we determined which certificates would require which type of assessment. In Figure 2, we summarise the outcomes of a survey among all consortium partners on characteristics of the assessment of the educational activities. A certificate of attendance is given to learners who participate in activities (e.g. online courses, summer schools, etc.). The assessment (if applicable) is mostly unsupervised, asynchronous, online, written and will mainly contain closed questions. The assessment is therefore usually evaluated automatically. This assessment is carried out by the organisers of the respective activity (course provider, summer school organizer). The full microcredential (full certificate) is awarded to learners who pass a full examination. In this supervised examination the students show, that they have understood the content and can verify that they have acquired these respective knowledge, skills and competences. The examination and issuing of the full certificate is not carried out directly by ECSA, but in a decentralised way in co-operation with project-internal and external education partners (HEI, VET) and certifying institutions.

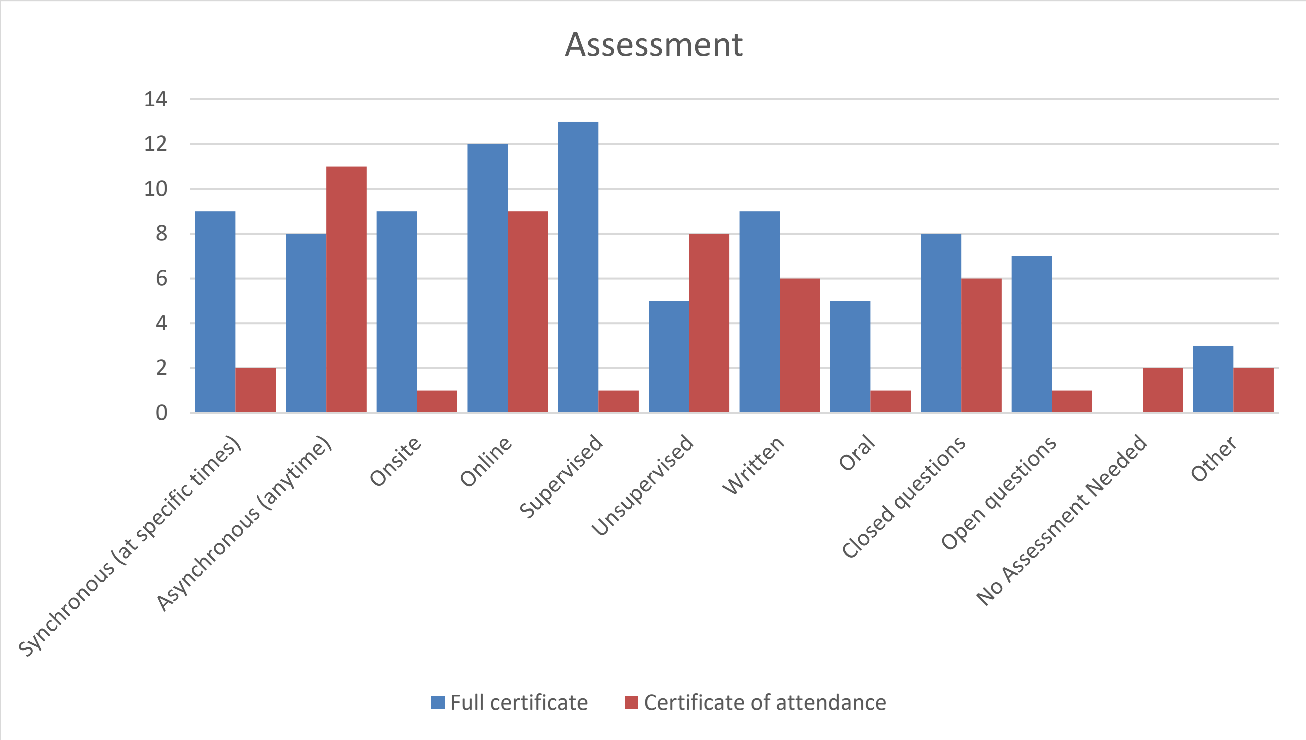

Figure 2: Questionnaire on assessment based on different types of certificates.

Within the Alliance, we provide micro-credentials based on the European Skills, Competences, Qualifications and Occupations (ESCO) framework. Whenever possible, the learning outcomes of all educational activities are mapped to knowledge, skill and competence entries represented in ESCO. At the same time, these entries are also mapped to micro-credentials. If a learner proves, that they have mastered a specific knowledge, skill or competence, they receive a micro-credential, that approves that. In this way we ensure, that micro-credentials are portable and recognisable by other stakeholders in the microelectronics industry.

4.3 Modular Curricula and Learning Pathways

Using the micro-credentials concept, we encourage modular curriculum design and innovation by linking courses to knowledge, skills, competences and occupations from ESCO. This concept can be used in two ways:

- In a top-down approach, learners can go for a specific occupation. This occupation suggests the most relevant knowledge, skills and competences that are needed. Based on the needed knowledge, skills and competences, we can then suggest suitable courses for the learners. To give a simplified example from Figure 3: A learner would like to become a “microelectronics designer”. Therefore, the ESCO framework suggests that the learners acquires the skill/competence of “Design Circuits Using CAD” and knowledge about “manufacturing processes”. Based on these skills we can then suggest to the learner to take the courses on “CAD tools”, “Basics of Microelectronics and “Basics of Manufacturing”.
- In a bottom-up approach, learners can provide which information on the courses they completed successfully. Based on these courses we can identify the knowledge, skills and competences that the learners acquired and finally provide learners with information on how suitable an occupation is for them. To give a simplified example from Figure 3 again: A learner

has passed the courses on "Basics of Manufacturing" and "Advanced Materials Science". Based on these courses the learner acquired knowledge on "manufacturing processes" and the skills and competences to "apply advanced manufacturing" and to "abide by regulations on banned materials". Based on this information, the system can suggest that the learner focus on an occupation such as a "Microelectronics Smart Manufacturing Engineer" rather than becoming a "Microelectronics Designer".

In this way we can provide individual learning paths and curricula based on the needs and previous skills of learners.

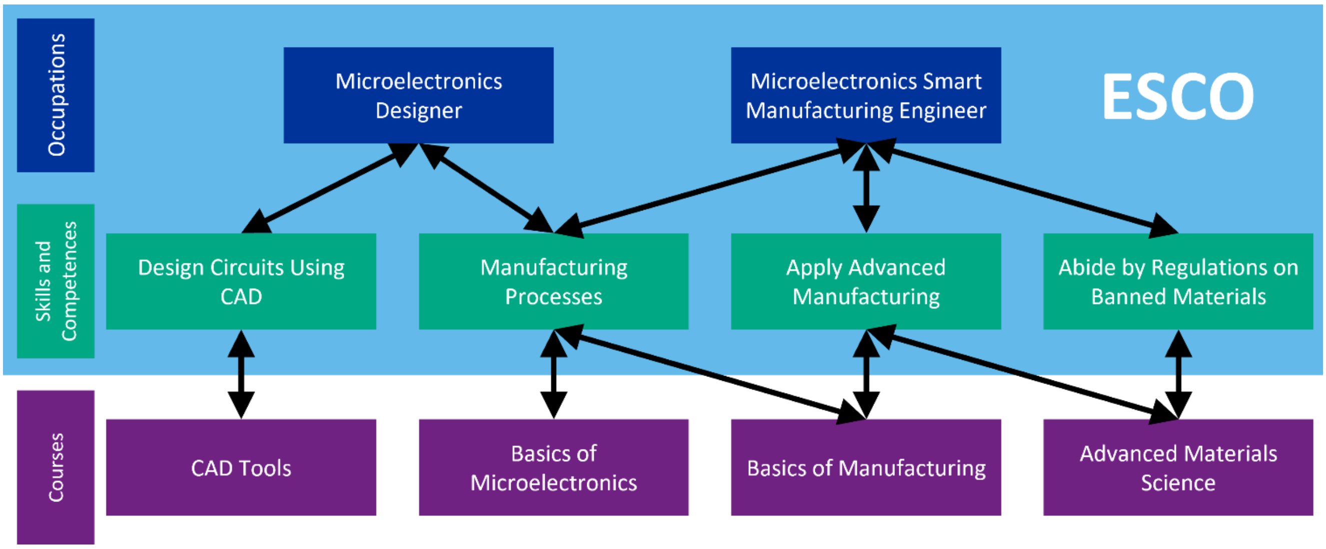

Figure 3: Examples on linking courses with knowledge, skills, competences and occupations in ESCO.

4.4 Tools

The certificates for the full micro-credentials, as well as the certificates of attendance, are stored in the learning and networking platform, as well as in the Skills Hub, that is connected to the learning and networking platform. The stored certificates can then be used to suggest individual learning activities for each learner by checking what students already acquired and what is left to complete.

As a gamification aspect the learning and networking platform and the Skills Hub provide badges for each of the certificates. Gold badges are issued for full micro-credentials, whereas grey badges are issued for certificates of attendance. The badges can subsequently be imported into EUROPASS and used for automated skills-based matching on the EURES platform.

We provide information on the Alliance platforms in deliverable "ECS-Academy digital architecture, website and Open Educational Resource (OER) Platform" (project identifier: D4.1). Further on, we provide information on all EU tools used within the Alliance in deliverable "ECSA Operational Features and Tools" (project identifier: D3.4).

Credentials can be provided through a sharable "wallet" integrated directly into the Skills Hub. Credentials can be shared publicly via links or QR codes, making them easy to present and verify.

The European Digital Credential (EDC) system in Europass enables secure storage and sharing of verified digital diplomas and certificates. However, in practical implementation it is still relatively complex and not always stable, with technical and operational limitations. In addition, using EDC sealing introduces extra requirements, such as obtaining and renewing certificates from a public certification authority for the issuer. We are therefore exploring integration, but we must ensure it is viable and sustainable for the Skills Hub implementation.

4.5 Advantages

With the implementation of micro-credentials, as we described before, we support all stakeholders within the microelectronics industry. We improve the recognition of the certificates by transparent guidelines and course proposal and delivery flows. Additionally, the developed tools (learning and networking platform, and Skills Hub) allow to store and share acquired credentials. Further on, the micro-credentials system enables the Alliance to develop and implement flexible learning formats based on the needs of the industry and supports lifelong and just-in-time learning. This is especially important when providing specialised and customised curricula and learning paths.

5. Conclusions and Next Steps

In this deliverable we described educational, pedagogical and networking aspects of the activities in the Alliance. Therefore, we summarise best practice examples on in-person learning events, online courses, internships, research-based internships, study visits, work-based learning, etc. Further on, we explain mobility opportunities in the Alliance. Another important aspect is the definition and certification of micro-credentials. Therefore, we define prerequisites for full certificates (micro-credentials) and certificates of attendance to ensure broad recognition among the industry.

The next step is the project milestone “Launch of ECS-Academy” in February 2026. The launch will be based on the educational and pedagogical aspects described in this deliverable D3.5 and on the deliverables “ECSA Institutional Arrangements (Governance and Functioning)” (project identifier D3.3), “ECSA Operational Features and Tools” (project identifier D3.4) and “ECSA Implementation and Validation Plan” (project identifier D3.6). After the launch, partners will make use of the best practice examples and the certification procedure is put in place.

Appendix A – Best Practice Template for Alliance Activities

In the following we provide the template, that we used to collect best practice examples by all project partners. We adapted the template from a template of the Steirische Hochschulkonferenz[4] (translation: Styrian Higher Education Conference).

Activity – Partner

Description

Description

General Information

Social Form

Multiple selections are possible.

☐ Individual Work	☐ Partner Work	☐ Teamwork	☐ Plenary

Group Size

Multiple selections are possible.

(1 Participants)	(2-25 Participants)	(26-50 Participants)	(>50 Participants)
☐ Individual Person	☐ Small Group	☐ Large Group	☐ Mass Course

Time effort

Preparation for Teacher/Trainer	Execution for Teacher/Trainer	Follow-Up for Teacher/Trainer	Total effort of participants
X hours	X hours	X hours	X hours

Detailed Description on Time efforts

Time efforts

[4] Steirische Hochschulkonferenz https://e-campus.st/

Levels of Learning Objectives

Multiple selections are possible.

☐ Remember	☐ Understand	☐ Apply
☐ Analyse	☐ Evaluate	☐ Create

Advantages/Reasons for Use

Advantages

Technical Infrastructure/Tools for Realisation

Infrastructure

Role of the Teacher/Trainee

Roles

Challenges/ Tips for Realisation

Challenges

Legal Aspects

Legal Aspects

Example

Example

Further Literature

Further Literature

Appendix B – Best Practice Examples on Partner Activities

This appendix includes all the best practice examples on educational activities, that were summarized by the partners. These best practice examples serve to exchange experience and ideas on various educational activities and therefore represents an important part of the pedagogical aspects of the ECSA activities.

The following partners have provided best practice examples:

- P1 – Semi Europe
- P2 – TU Dresden
- P3 – TU Graz
- P4 – BME
- P5 – VSB
- P6 – IAL-FVG
- P8 – imec
- P9 – ANCCP
- P10 – Infineon
- P11 – Melexis
- P12 – Okmetic
- P13 – Aeneas
- P14 – Silicon Saxony
- P15 – Knolys
- P17 – CIMEA