unite! University Network for Innovation, Technology and Engineering

Lessons learned from Unite!'s infrastructures for digital learning implementation

The Unite! digital campus implementation

(Cm.2 Digital Campus Report)

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Title	Lessons learned from Unite!'s infrastructures for digital learning implementation. The Unite! digital campus implementation.
Reference	Cm.2 Digital Campus Report (Unite! University Network for Innovation, Technology and Engineering; Project Call ERASMUS-EDU-2022-EUR-UNIV, Grant Agreement 101089731) *This report constitutes the formally scheduled deliverable D2.2 for the referred Erasmus+ project in its preliminary (submitted) version.*
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Date Publication	September 10, 2026 (Status April 30, 2026)
Keywords	Technology, infrastructure, learning management system, European Student Card Initiative, mobility, e-learning, digital teaching, digital learning, joint course catalogue, EDEH, HEIF
Citation Suggestion	Ebner, M., Schön, S., Alcober, J., Andersson, K.; Bertonasco, R., Castro, M.A., Correia, Y., Cruz, L., Diard, J., Fink, J., Francisco, A., Herczak-Ciara, A., Ferrian, C., Gasplmayr, K., Hoppe, C., Järvelä, H., Koschutnig-Ebner, M., Kubik, T., Martikainen, J., Molins, X., Landfahrer-Berglez, K., Petersson, J., Reignier-Tayar, N., Matias, J., Sessler, C., Starzecki, K., Szymańska-Kwiecień, A. and Tadaszak, R. (2026). Lessons learned from Unite!'s infrastructures for digital learning implementation. Unite! digital campus implementation and recommendations (Unite! Deliverable D2.2, preliminary version), Graz University of Technology. DOI: 10.3217/5bxd6-t5857
Funding	Funded by the European Union Funded by the European Union.
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Abstract

The Unite! alliance, comprising nine universities (Aalto University, Grenoble INP graduate school of engineering and management, University Grenoble Alpes, KTH Royal Institute of Technology, Politecnico di Torino, Graz University of Technology, Universidade de Lisboa, Universitat Politècnica de Catalunya/BarcelonaTech, Technical University of Darmstadt, and Wroclaw University of Science and Technology), aims to promote the concept of a European digital campus. This recommendation report builds upon the first report (Ebner et al., 2024), which documented the status and roll-out of the Unite! digital campus across partner institutions. Drawing on the collected experiences and results, success stories, expert-group discussions, cross-partner experience exchanges, and systematic analyses of implementation challenges, the report derives concrete lessons learned and formulates technical recommendations for the digital campus (Task 2.7). It synthesises findings on interoperability, scalability, security, governance and sustainability, and proposes actionable guidance to support the continued evolution, standardisation and federation of the Unite! digital campus infrastructure.

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List of Abbreviations

Aalto – Aalto University (Aalto)

AI – artificial intelligence

API – Application Programming Interface

Cm – Community (organisational unit in Unite!, directly connected to "work packages"), e.g. Cm.2 stands for "Community 2 Digital Campus" (or "work package 2").

CRM – Customer Relationship Management

DG EAC – Directorate-General for Education, Youth, Sport and Culture

DoA – Description of Action (Project Description)

EDEH – European Digital Education Hub

EEA – European Education Area

eID – electronic identity

EWP – Erasmus Without Paper

ESC – European Student Card

ESCI – European Student Card Initiative

ESCN – European Student Card Number

ESC-R – European Student Card Router

Grenoble INP-UGA – Grenoble INP graduate school of engineering and management, University Grenoble Alpes

GDPR – General Data Protection Regulation

HEI – higher education institutions

HEIF – (European) Higher Education Interoperability Framework

IdP - Identity Provider

IT – information technology

KTH – KTH Royal Institute of Technology

NIF – National Identity Federation (NIF)

MMS – Mobility Management System

OER – Open Educational Resources

PoliTO – Politecnico di Torino

SAML – Security Assertion Markup Language

SSO – single sign-on

T - task

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TUDa – Technical University of Darmstadt

TU Graz – Graz University of Technology

ULisboa – Universidade de Lisboa

UPC – Universitat Politècnica de Catalunya/BarcelonaTech

Wroclaw Tech – Wroclaw University of Science and TechnologyAalto

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1. Introduction

Martin Ebner and Sandra Schön

In an era of rapid digital transformation, education and academic collaboration increasingly depend on digital technologies. European universities have responded by forming transnational alliances known as "European Universities," aiming to shape the future of higher education by strengthening European identity, values, and competitiveness (see European Commission, 2023). However, fostering collaboration within these alliances presents considerable challenges. According to the European Commission's description (2023), European university alliances:

- comprise partners from diverse types of higher education institutions and ensure broad geographic representation across Europe,
- develop a shared long-term strategy focused on sustainability, excellence, and European values,
- offer joint, student-centred curricula across inter-university campuses, enabling flexible programme structures and mobility at all study levels, and
- adopt a challenge-based approach where students, faculty, and external partners work in interdisciplinary teams to address Europe's most pressing challenges.

One of these pioneering alliances is Unite! University Network for Innovation, Technology, and Engineering, which was among the first 17 European University alliances co-funded by the European Commission. Initially composed of seven partners, Unite! has now expanded to nine member institutions.

To support the development of a unified digital infrastructure, the Erasmus+ work package 2 — known as Community Digital Campus (Cm.2) — was initiated to design and implement an advanced digital campus framework within the alliance.

In our initial comprehensive report, we conducted a requirement analysis, gathering insights into the technological, organisational, and legal needs for a future-proof European digital campus (see Ebner et al., 2024). These findings serve as the foundation for shaping the Unite! trans-European campus. According to the project proposal, the Cm.2 contribution is to

> *"develop the Unite! Metacampus, integrating IT services of the member universities to provide digital Erasmus-compliant service processes and progressively providing new learning management system functionalities as required by our innovative pedagogies and our communities (WP2)" (citation from the Unite! Erasmus+ project description, internal document).*

Furthermore, the Unite! Mission Statement 2030 (Unite!, 2022) outlines two missions that are particularly relevant for Cm.2:

> *"Unite! creates the hybrid (virtual, physical and blended) and multilingual Unite! trans-European Campus with easily accessible joint educational offerings, shared and pooled resources, efficient services and green mobility.*
>
> *[Unite! creates] state-of-the-art learning opportunities with innovative pedagogies for challenge-based approaches, student-centred learning, and high-quality interaction in digital, hybrid and face-to-face learning environments" (paragraph 3).*

The overarching goal of Cm.2 is to establish a digital infrastructure that ensures students across the Unite! alliance experience seamless access to digital learning and teaching resources offered by all partner institutions.

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Since the launch of the current Erasmus+ funding phase, led by Graz University of Technology, significant efforts have been made to achieve the objectives outlined in the work package.

This report summarises the activities and developments undertaken so far, highlighting key findings, technological advancements, and the associated organisational and legal challenges. Additionally, it seeks to share lessons learned to further enhance the digital infrastructure of European university alliances.

Additionally, following the publication of several reports and publications related to the European Higher Education Interoperability Framework (e.g. EC et al., 2025a, EC et al., 2025b), we will also include their findings and suggestions (based on the information available as of 09/2025).

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2. From work plan to the current state and recommendations

Martin Ebner, Jesus Alcober, Roberto Bertonasco, Jules Diard, Alexandre Francisco, Agnieska Herczak-Ciara, Katharina Gasplmayr, Christian Hoppe, Markus Koschutnig-Ebner, Juha Martikainen, Joakim Petersson and Sandra Schön

In this chapter, we trace the journey from the original work plan to today's operational reality, outlining how the "Digital Campus" model has been built and refined within the Unite! initiative. We will provide an overview of the governance structure, the federated platform ecosystem, partner infrastructures, identified prerequisites (Ebner et al., 2024) and the methodological foundations that underpin the recommendations presented later in this report.

2.1 Overview of the "Digital Campus" working structure within Unite!

As described by Ebner et al. (2024), the Erasmus+ work package "Digital Campus" team (also known as "Community 2") is not responsible for the entire IT infrastructure of the alliance, but focuses on the three key strands Metacampus, Integration Services, and European Student Card during the project period from 11/2022 to 10/2026. The overall organisation of the work package is illustrated in Figure 1.

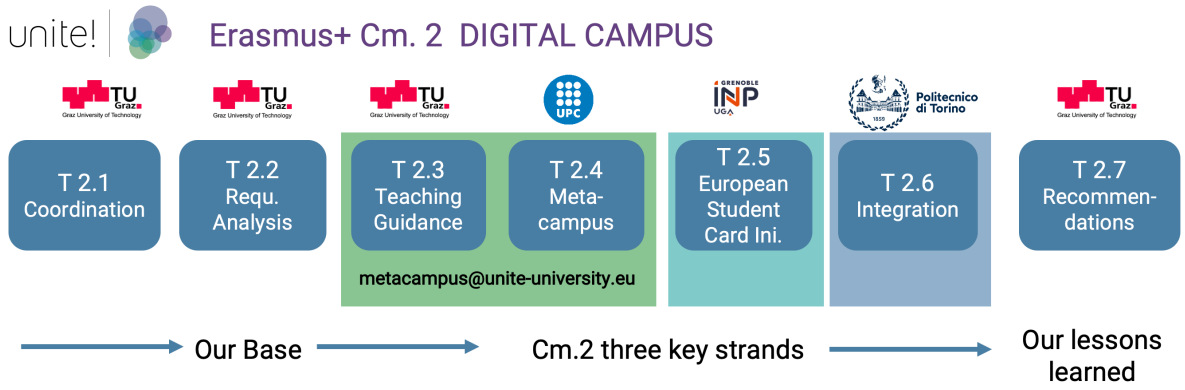


Figure 1: Overview of tasks and responsibilities in Cm.2 Digital Campus

Besides Task (T) T2.1, which is the coordination task, T2.2 developed the requirement analysis (Ebner et al., 2024) and T2.7 is responsible for this report. All other tasks run throughout the entire project timeframe and address the federated learning management system support (T2.3 Teaching guidance) and technical development (T2.4 Metacampus), focus on the European Student Card Initiative (T2.5) or all Integration issues (T2.6, several working groups, as well as for shorter timeframes). Whereas the tasks and working groups have their own organisational structures, such as meetings and communication (e.g. mailing list, CRM system), all Cm.2 members meet regularly at the monthly work package meetings. Biannual "Tech MeetUps" were introduced, and an extended invitation shared with all interested technical staff at partner universities to address topics of specific interest, such as course catalogue development (with Axel Klinger from the EULIST alliance).

The Erasmus+ project is not a single project within all alliance's affairs. So, report 1 (Ebner et al., 2024) already included an overview and responsibilities of the complete IT infrastructure used within Unite! and as well installed a "Technical Commission" to decide on all technical needs that are not strategic but require special efforts (including future costs for maintenance or service).

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2.2 Overview of federated platforms of Unite!

As of January 2024 (Ebner et al., 2024), four platforms are the key platforms of the Unite! alliance (see Figure 2): The **Unite! website** serves as the alliance's public-facing hub. Built on a content management system (CMS), it offers centralised access to information, updates, and communication channels for both internal and external stakeholders. The **Unite! uShare platform** enables efficient document and knowledge management, allowing alliance members to store, organise and exchange key resources securely. **Metacampus**, which is a Moodle installation, functions as the alliance's federated learning management system (LMS), supporting online courses, interactive learning materials, and assessments. It also incorporates LMS interoperability standards, with the long-term aim of becoming a central hub connecting all partner institutions' LMSs, thereby facilitating seamless reuse of shared learning resources and the integration of alliance-wide course offerings with locally hosted courses. Finally, **Agora,** launched in 2023 as part of the aUPaEU project initiated by two Unite! partners in collaboration with the EPICUR university alliance, is a digital collaboration platform based on the Odoo business management system. It is currently being rolled out to enhance communication and project coordination within and beyond the alliance.

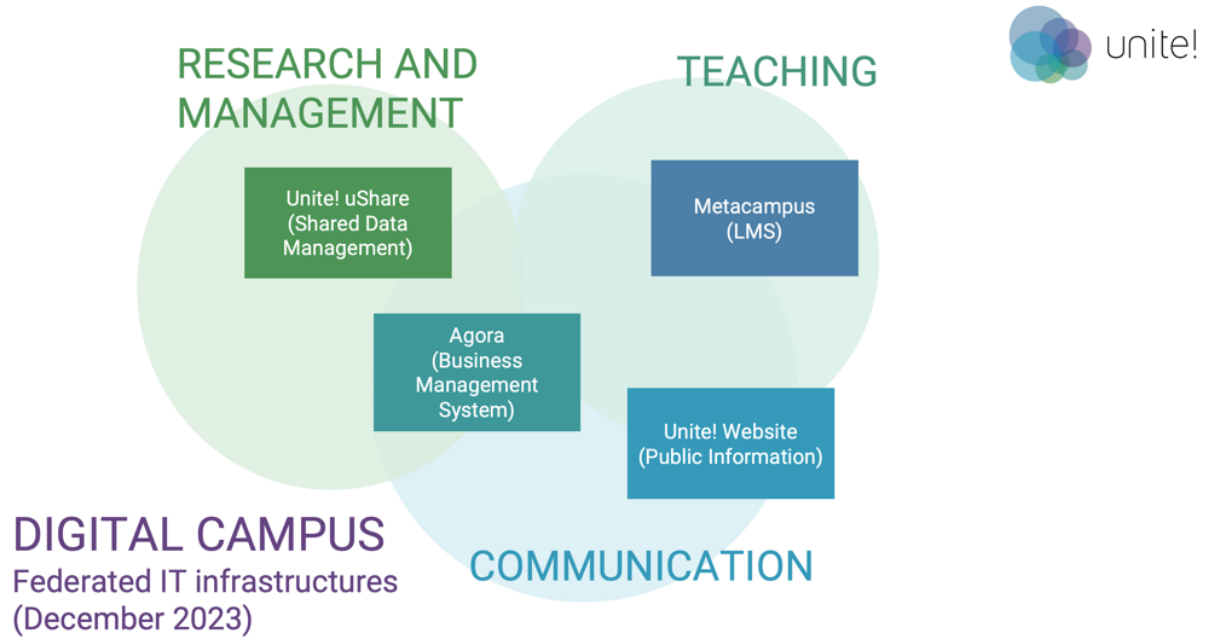


Figure 2: Overview of the Unite! Digital Campus Iinfrastructure: Key platforms and their applications

Together, these platforms form the backbone of Unite!'s digital infrastructure, ensuring effective communication, streamlined data management, and enhanced collaboration in learning and research activities across the alliance. As said, not all these platforms are under the responsibility of Cm.2, as shown in Table 1, which provides brief descriptions.

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Table 1: Overview of IT platforms of Unite! and their purposes, technologies, and funding (September 2025)

	Unite! Website	Unite! uShare	Metacampus	Agora
Purpose	Public information	Unite! Intranet	Interaction among users in Unite! (teachers, students, staff)	Interaction between any user and Unite!
Technology	CMS (content management system)	CMS owned by UPCnet	LMS (learning management system)	BMS (business management software)
Platform	Plone/Zope	Base: Plone/Zope and uShare development	Moodle	Odoo
Licence	Open-source	Base: open-source development; uShare: Owned by UPCnet	Open-source	Open-source
Developer/ Maintainer	UPCnet	UPCnet	UPCnet	UPC
Responsibility	Unite! Communication Coordination (UPC) [WP 9]	Unite! Secretariat [WP 1]	E+ (Cm.2)	aUPaEU
Examples	News, activities, information	Alliance repository (for all projects within Unite!)	Educational activities (courses)	Shared infrastructures, Metacampus enquiries, events, surveys, etc.
Authentication	User account for editors	User account	eduGAIN	User account, eduGAIN
Status	In use	In use	Pilots in use	Pilots in use
Languages	English	English	English + 9 partners' languages	English
Current funding end	10/2026	10/2026	10/2026	12/2027

Beyond the core platforms, the digital infrastructure also incorporates **several complementary tools**. Identity and access management is handled through eduGAIN, ensuring secure and federated authentication across institutions. For recognition and credentialing, the Open Badges framework is employed, allowing learners to earn portable, verifiable digital badges for their achievements. Communication among partners relies on mailing lists, which facilitate coordinated information sharing and discussion.

2.3 Partners' IT infrastructures for learning and teaching

Within the scope of the requirement analysis (Ebner et al., 2024a, 2024b), each partner produced a detailed description of its IT infrastructure for learning and teaching (see Figure 3). This labour-intensive effort has attracted considerable external attention—largely because comparable documentation does not appear to exist—and, more importantly, it has proven invaluable for intra-alliance exchange and mutual understanding. By providing a common reference point, it greatly simplifies the identification of differences and potential challenges across partner environments.

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Figure 3: All Unite! partners described their IT infrastructures for learning and teaching. Source: Screenshots of the IT infrastructure descriptions of all Unite! partners, see Ebner et al. 2024, screenshots from all partners infrastructures.

In Ebner et al. (2024a), the partners' descriptions of their digital learning and teaching infrastructures reveal that, while the functional requirements of the information systems are largely homogeneous, the actual software implementations are highly heterogeneous. Moreover, there are pronounced variations in how self-sufficient or network-oriented the universities are within their national contexts—reflected in differing IT applications and selection policies. We illustrate, as an example, the commonalities and differences in the LMSs used across the alliance in Table 2.

Below is a condensed overview of the current infrastructure landscape, focusing on core learning management systems and their most widely adopted features, which constitute the most consensual building blocks across the partnership.

The descriptions of all partners' digital infrastructures for learning and teaching show that information systems are very homogeneous in their functions, but very heterogeneous in their software implementation. There are also major differences in how self-sufficient or networked the universities are in a national context, for example in terms of specific IT applications or selection policies.

As an overview, the following Table 2Table 2 summarises the current infrastructure perspective on core learning management systems and features, as they are the most common building blocks.

Table 2: Overview of key issues concerning LMS in partner institutions of Unite! (10/2023). Source: Ebner et al., 2024b, Table 16, p. 100.

	Main LMS	Open-Source	Secondary LMS	LTI interface	MOOC platform	EduGAIN
TU Graz	Moodle	YES	-	YES	Moodle	YES
ULisboa	Fenix Platform	YES	Moodle, Open edX	NO (Moodle: YES)	Open edX	YES
UPC	Moodle	YES	-	YES	-	YES
PoliTO	DIDATTICA	YES	Moodle	YES	Open edX	YES
UGA-INP	Moodle	YES	Chamilo	YES	-	YES
TUDa	Moodle	YES	-	YES	-	YES
Wroclaw Tech	Moodle	YES	-	YES	-	YES
KTH	Canvas	NO	-	YES	Open edX	YES
Aalto	Moodle	YES	-	YES	Moodle	YES

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The table shows that nearly all universities use a Moodle-based federated LMS, creating a significant challenge for those with limited Moodle expertise among staff and students. It as well shows that all partners use eduGAIN and nearly all have an LTI interface available.

Building un the Erasmus+ description of action, Ebner et al. (2024a, p. 106ff.) described a blueprint of the steps to be addressed in the following months, including the further development of Metacampus support and resources, updates of the Metacampus, improvement of ESCI services, eduGAIN maintenance and further development, piloting LTI, metadata standard implementation for course description, and general openness to new developments.

2.4 Prerequisites identified as crucial for the evolution of the digital campus

The following passage provides a concise summary of the report by Ebner et al. (2024a, see also Ebner, 2024b, 2024c), highlighting identified requirements for a successful evolution of the digital campus.

As shortly described in the last paragraph, a description of the IT set-up at each partner university, including aspects such as learning management systems, data storage and handling of personal data, enables us to build a solid digital campus together. This lets us create an architecture that follows GDPR regulations, uses strong encryption, and offers clear APIs for custom tools.

By keeping an eye on European higher education standards and new legal requirements, we can stay compliant and prepared for the future. Interoperability is the key idea here. All the different partner systems must work together smoothly, sharing data and services without losing meaning. This requires using open standards, publishing reusable APIs, and matching metadata models with European reference frameworks so that courses, micro-credentials, MOOCs and other learning objects can be exchanged easily. For users, this results in simple, accessible interfaces that work for students, teachers and staff, backed by reliable support and regular, non-disruptive updates.

It also seemed important that the implemented "Technical Commission" handles the governance of the IT landscape. It brings together representatives from each partner so that everyone has a voice, resources are balanced fairly, and decisions are made transparently with a clear cost-benefit analysis. The commission ensures that we support existing tools such as the Metacampus, while remaining flexible enough.

Lastly, we addressed the need for a realistic budget for a federated system. While project funds can cover the initial build, ongoing maintenance, security updates and scaling require a dedicated financial plan that reflects each partner's capacity. Allocating resources for continuous improvement ensures that the digital campus stays functional, secure and adaptable, providing a reliable, interoperable environment that supports the alliance's goal of a united European digital learning space.

2.5 Methodology and overview of this report

2.5.1 Sources for this report

The lessons learned and technical recommendations presented in this report are based on a comprehensive synthesis of input from all Unite! partners and the extensive body of existing documentation. This includes reports, (internal) presentations, publications and presentations by the work package members and colleagues at (inter-)national events and in journals (see references at the end of this chapter, and full collection available here: TU Graz, Unite! Digital

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Campus, 2025) as well as success stories published in a report series (see chapter 3). Draft sections were circulated to the respective stakeholders and reviewed within the framework of the cited references, as well as during the preparation of this report. Feedback was gathered through a combination of synchronous Cm.2 meetings, dedicated working-group sessions, and asynchronous written exchanges in which participants were asked to provide comments, approvals, and revisions. This iterative consultation ensured that the final recommendations reflect a consensus view across the alliance.

2.5.2 Target group for the recommendations

The report addresses peer technical teams from other university alliances, especially those that joined during the latest funding cycle. Nevertheless, it outlines both the overall integration context and broader recommendations that extend beyond purely technical considerations. While written from a technical group's viewpoint, the recommendations emphasise organisational, procedural and cultural guidance alongside the engineering insights.

2.5.3 Structure and overview

Below we outline the report's structure, which explicitly presents the outcomes of Erasmus+ Cm.2 "Digital Campus (11/2022-10/2026). Because other Communities also support technical infrastructure such as the website or cloud, or HEIF developments such as the current catalogue architecture, and because we also cooperate with other EC projects such as the Agora project, this overview does **not fully reflect all technological developments** within Unite!.

As this report also serves as a formal Erasmus+ deliverable, we have adopted the **work package task hierarchy** as the overarching framework. This ensures that readers can easily trace each result back to its corresponding work package activity, improving overall transparency and coherence across the various consortium modules.

Figure 4 shows a summary of all chapters, which generally follow the structure and content outlined in the project proposal, with two exceptions. Chapter 10 deviates by placing a stronger emphasis on copyright and OER than originally anticipated in T2.3, and Chapter 11 introduces the "Technical Commission", for example, which was not foreseen in the original work plan of T2.1.

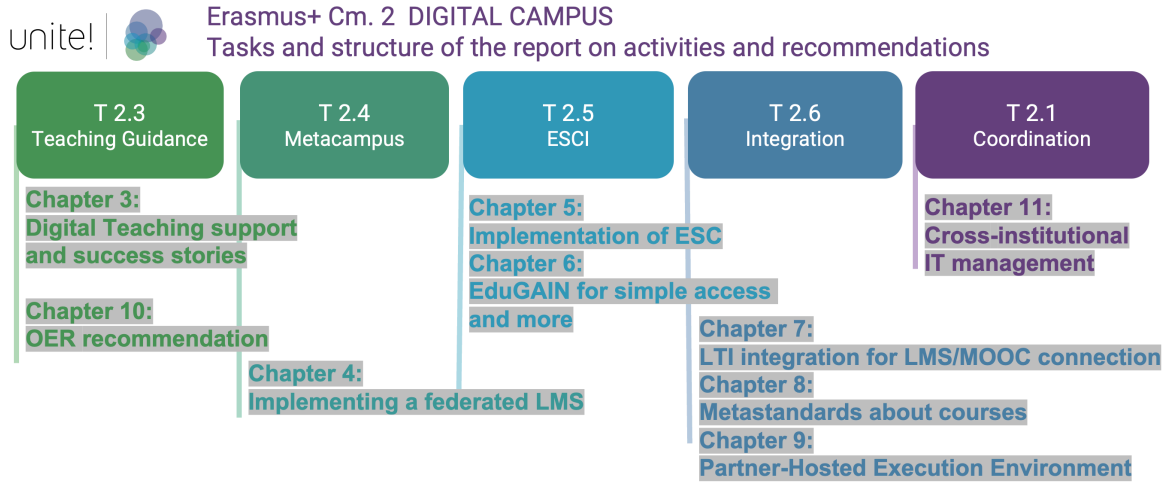


Figure 4: Chapters within this report and their relation to the tasks.

It should be noted that the division into chapters according to separate tasks is somewhat artificial, as most activities involved collaboration across work packages. For example, the working group

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from the Integration task (2.6) was involved in the eduGAIN implementations (T2.5), and the cooperation between T2.3 and T2.4 was likewise very close. Please note that T2.2 was only active for the first report on requirements (Ebner et al., 2024) whereas T2.7 is responsible for the collection of lessons learned and co-development of this report.

2.5.4 Relations to the HEIF (EC et al., 2025)

While not all activities described in this report are directly connected to interoperability, many of them are. Similarly, not all use cases of the Higher Education Interoperability Framework (HEIF), as defined by the European Commission and partners (2025), are purely technical. While the work of Cm.2 was primarily technical, it also provided pedagogical support (T2.3). In practice, technical developments often involve interoperability considerations, which is why we explicitly reference the HEIF (see Table 2). From this perspective, Cm.2's focus lies mainly on the HEIF use cases 4 and 5. However, as the framework demonstrates and as originally planned, there are also overlaps and activities related to several other use cases.

Table 3: Addressing Higher Education Interoperability Framework (HEIF) use cases by Cm.2 activities and this report (see European Commission et al., 2025).

HEIF Use Case	Topics	Related Cm.2 activity, if	Chapter
1: Discover	Metadata standards and mobility offers	The current course catalogue was developed by by Cm.5 "Flexible Educational Offerings" /Cm.4 "Innovative Teaching and Learning" in cooperation with Agora; Cm.2 concentrated on metadata issues for future development	See chapter 8
2: Apply and get recognition	Admission, recognition, micro credentials	(no federated IT service provided by Cm.2)	
3: Access tools	Management and governance of shared resources such as a research tool registry	Unite!'s existing catalogues were developed by other Cm. and projects.	
4: Manage educational resources	Accessibility and mobility of educational resources	Digital teaching support	See chapter 3
		Federated LMS	See chapter 4
		OER activities (T2.3)	See chapter 9
5: Generate data	Exchange of learners' activity data	LTI implementation to connect LMS	See chapter 7
6: Earn a credential	Credentials and its management	Issuing open badges, processes and integration not led by Cm.2	
7: User identity	Interoperability of user identity	eduGAIN integration for Metacampus access	See Chapter 6
		ESCI implementation	See Chapter 5
8: Institutional identity	Framework for trusted institutional framework		

As this overview shows, especially chapter 11, which contains a description of our implemented gocernance IT structures and remarks about the coordination of IT developments in Unite!, does not directly fit into the HEIF.

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3. Digital teaching in Unite!: Developments, success stories to be told and related recommendations (T2.3)

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The following chapter describes activities and recommendations from Task 2.3, which is titled "Providing Learning & Teaching Guidance and Involvement" and is described as "Support of different digital learning and teaching scenarios in strong cooperation with other WPs using Educational Technology Expertise. The focus of this task is the digital transition of first running use cases with all partners of the alliance."

3.1 Empowering users with Metacampus: From how-to courses to success stories

To ensure the effective adoption and utilisation of the Metacampus, a comprehensive set of support resources and training initiatives has been developed. These efforts aim to familiarise students, faculty, and staff with the platform's functionalities while addressing challenges related to navigation, accessibility, and course management. For this description we used existing overviews and updated them (Gasplmayr & Schön, 2024; Gasplmayr et al., 2025).

3.1.1 Online course: How to use Metacampus

A dedicated online course on how to use the Metacampus, "How to use Metacampus", has been developed and is freely accessible to all Unite! members directly on the platform. This course provides an interactive guide to navigating the platform, course enrolment, and utilising key tools (see Figure 5 left). Participants who successfully complete the course receive an open badge recognising their "Metacampus fitness", which certifies their proficiency in using the system.

To further facilitate understanding, a multilingual series of instructional videos has been created, leveraging AI-generated avatars to provide clear and engaging explanations of the Metacampus. These videos are available in all Unite! languages plus English (see Figure 5 right).

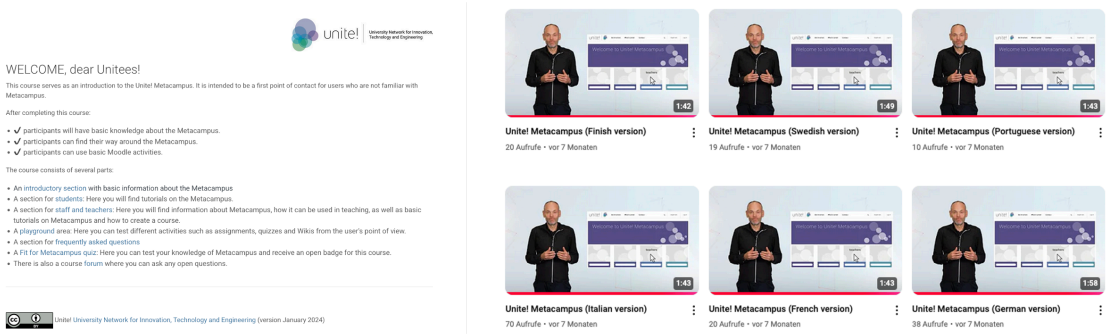


Figure 5: Screenshots of the course "How to use Metacampus"(left) and some of the videos about Metacampus (right). Sources: https://metacampus.unite-university.eu/course/view.php?id=90; https://www.youtube.com/@unitealliance9703/videos (2025-02-13)

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3.1.2 Guidance, information materials, and a decision tree

To help users determine whether Metacampus is the right platform for their specific needs, several different information materials such as flyers, posters, slides, and digital brochures were developed. These materials were distributed both online and physically at partner institutions to raise awareness and provide guidance on Metacampus usage.

The Metacampus support team and all the partner institutions lacked a consistent method for deciding whether a teaching activity should be hosted on the Unite! Metacampus or on a local system. This led to repeated legal, technical, and organisational ambiguities (e.g., certificate eligibility, content ownership, and role-based access).

To address this issue, a comprehensive catalogue of teaching scenarios was assembled, and the principal decision dimensions (origin of instructor, origin of learner, required certification or badge, and location of learning materials) were extracted. These dimensions were formalised into a taxonomy of "Teaching Management Patterns", which were then grouped by compatibility with Metacampus and illustrated in a series of schematic figures. A decision-tree model was built to enable rapid, questionnaire-style triage for support staff, linking each pattern to recommended actions. The framework was validated against three representative use cases to confirm its applicability (see Schön et al., 2024). This approach delivered not only a set of clearly defined Teaching Management Patterns, visual categorisations but especially a decision-tree (see Figure 6) that together provide actionable guidance for Metacampus deployment while exposing remaining legal and technical constraints that require further testing and refinement. The final decision tree was added to the information material about the Metacampus and also shared with all partner support teams.

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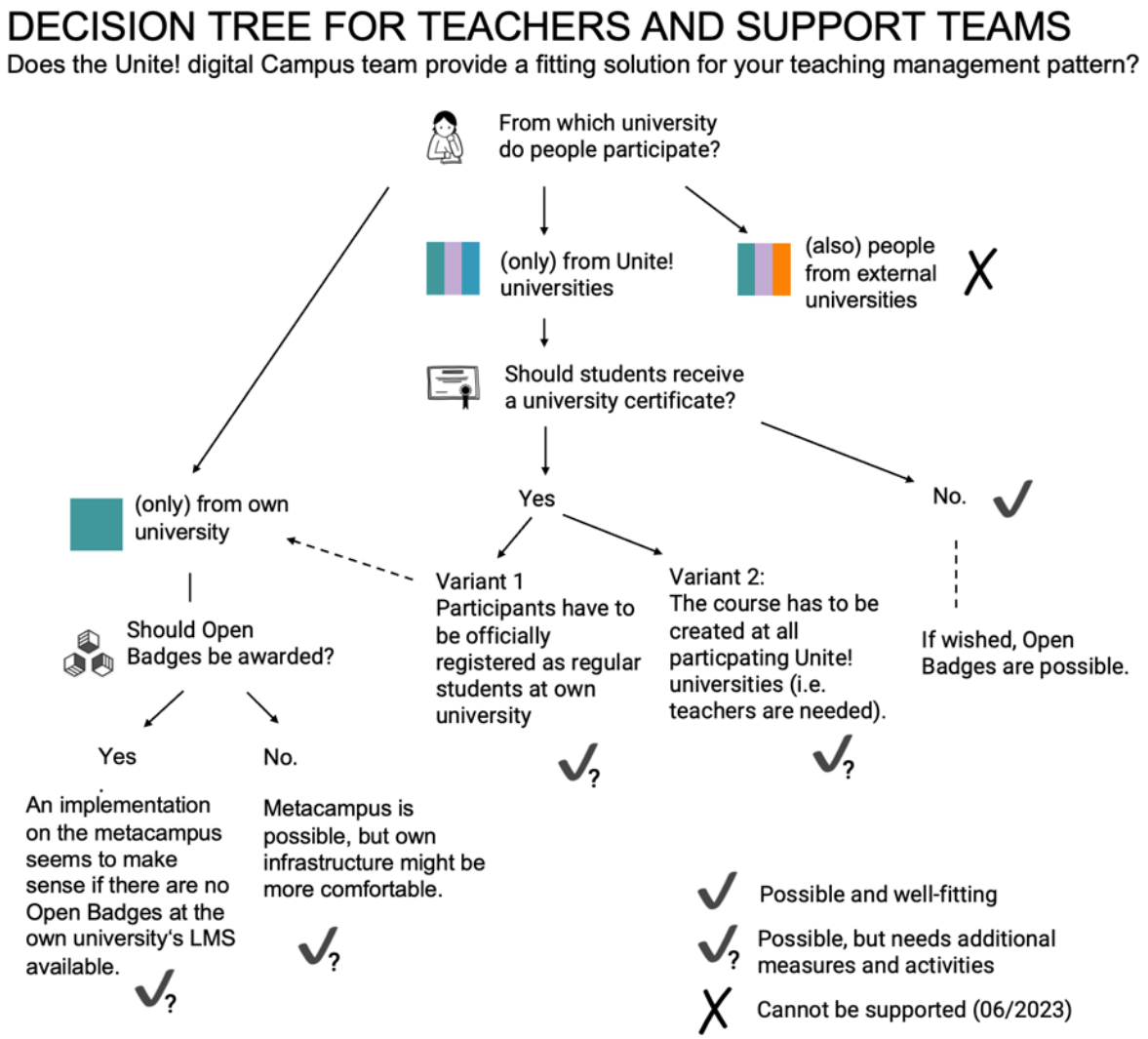


Figure 6: The "decision tree" on if the Metacampus is the fitting platform for teaching within Unite!, Source: Schön et al., 2024, Fig. 9.

3.1.3 Community engagement and training sessions

Beyond self-paced resources, the Metacampus team regularly hosts Meet & Greet sessions, providing an opportunity for faculty, staff, and students to engage with support personnel. These sessions facilitate knowledge exchange, allow users to ask questions, and offer insights into potential improvements.

Additionally, targeted training sessions are available on request, designed to meet the specific needs of faculty and administrative staff. These sessions focus on practical applications such as course setup, content management, assessment tools, and collaborative learning functionalities.

To get attention for this course offer "How to use Metacampus" (see 3.1.1), all those who received the digital badge also received a real badge at the Unite! Dialogue in Graz in March 2024 and little surprises at all "Digital Campus" events (see Gasplmayr & Schön, 2024). Currently, about 150 Unite! members hold the open badge (February 2025).

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3.1.4 Streamlined support, request management and documentation

To simplify technical and administrative support, a request submission system has been implemented. This allows users to submit questions, feature requests, and problem reports in one place, ensuring efficient and well-documented support processes (see as well chapter 10). Requests for new spaces, activities within these spaces, and overall activities on the Metacampus are regularly documented and reviewed (by task 2.4) in Cm.2 meetings, e-learning support meetings, and the Technical Commission.

3.2 Exchange among Unite!: Differences, but high motivation

To continuously enhance the usability and effectiveness of the Metacampus, several initiatives have been introduced to support teaching staff and students. A key development has been the establishment of bimonthly e-learning support group meetings: Regular meetings facilitate collaboration between IT teams, ensuring that technical decisions align with the strategic goals of the alliance while maintaining a user-friendly and scalable digital learning environment.

These sessions provide a structured opportunity to share insights, discuss challenges, and explore best practices in digital teaching. Through this regular bimonthly interaction since 2024, emerging technical and pedagogical issues are identified early, and collaborative solutions can be implemented.

For example, we conducted two surveys to understand (a) how e-learning support teams are organised (September 2023) and (b) how data is stored and deleted in partners' LMS (September 2025). We also received presentations of many e-learning support teams, presentations about their support structure and offers, and shared information about the development of Metacampus, e.g. the LTI pilots (see chapter 7).

3.3 Success stories for digital teaching within Unite!

By December 2025 all partners have leveraged the Metacampus to deliver programs and services for students and staff alike. Below is a list showcasing **a distinct implementation example** of **Metacampus as a learning and teaching platform** for each partner—recognizing that, in practice, many initiatives involve collaboration among multiple partners and shared utilization of the platform that more implementations were carried out than are listed.

- *Aalto – Aalto University:* As part of the organising team, the **Student Video Contest** was held at the Metacampus. In 2023, students from all nine partner universities submitted short "day in the life" videos, and viewers voted for their favourites. The winning videos were then showcased to highlight the alliance's cultural diversity. More than 500 people were registered for the course.
- *Grenoble INP-UGA – Grenoble INP graduate school of engineering and management, University Grenoble Alpes:* The Metacampus platform functioned as the central information hub for the **Unite! Research School 2024**, providing schedules, course materials, speaker bios, and registration details for the five-day event in Autrans. By consolidating all resources in Metacampus, participants—from master's and PhD students to industry stakeholders—could easily access all materials in one secure, institution-linked space.
- *KTH – KTH Royal Institute of Technology*: The Metacampus LMS acted as the secure central hub for the Unite! Blended Intensive Programme **"Competencies for Collaborative Teaching in Joint Programme"**, hosting the online introductory module, distributing course materials, and managing assessments throughout the six-week, multi-site curriculum. By

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linking this private environment with public channels (the KTH website and the Unite! portal), the programme created a hybrid digital model that combined protected collaboration on Metacampus with open communication for schedules and broader outreach. (Acosta-Garcia et al., 2025)

- *PoliTO – Politecnico di Torino*: **"Doctoral Degree? Join us on 8.4.2025 to find out what it means"** was a half-day event for interested students. The Metacampus was used for event registration, to provide information about the event, as well as to share informational materials for PhD studies at all Unite! universities.
- *TUDa – Technical University of Darmstadt:* The Metacampus hosted the self-paced **"Unite! 21-Day Diversity and Inclusion Challenge"**, delivering daily learning units—including videos, readings, reflections, quizzes, and H5P gap-fill exercises—while ensuring accessibility through a dedicated toolkit. Upon completing the interactive activities, participants earned an IDEA open badge, highlighting the platform's role in fostering collaborative, inclusive course design and measurable learner outcomes. (Szczerba & Edelsbrunner, 2025)
- *TU Graz – Graz University of Technology:* As part of the TU Graz lecture **"Open Educational Resources"** offered for Unite!, the Metacampus integrated a multilingual MOOC via LTI, allowing the platform to automatically retrieve and verify students' completion certificates instead of requiring manual PDF uploads. This seamless LTI connection enabled instructors to view MOOC results directly in Metacampus, streamlining assessment and reinforcing the Metacampus's role in supporting interoperable, credential-driven learning experiences. (Schön, Ebner & Gasplmayr, 2024)
- *ULisboa – Universidade de Lisboa*: The three-day **Unite! Student Festival** in summer 2023 was organised with the help of Metacampus, which provided a platform for application, provision of information and documentation.
- *UPC – Universitat Politècnica de Catalunya/BarcelonaTech*: The UPC seminar **"Level up your outreach skills. Power networking and cool communication for students**" was hosted on the Metacampus platform and targeted Unite! students who wanted to improve their communication skills when engaging with non-specialist audiences such as seniors, prospective students, NGOs, and companies. Open badges were issued via Metacampus for successful participation in the seminar.
- Wroclaw Tech – Wroclaw University of Science and Technology: **"Video course on accessibility"** is a training offer of Wroclaw Tech designed for Wroclaw Tech teaching staff and laboratory instructors that was made available via the Metacampus in autumn 2025. The course includes short video lessons on accessibility in the higher education context, followed by knowledge-check questions, a final test and a certificate of completion. The course served as a pilot to test the linking of Wroclaw Tech's local Moodle-based LMS with the Metacampus via LTI, which proved successful and allows for further development of the course to encompass all Unite! Universities.

To share and spread some of these success stories and good practices for digital teaching in Unite! with the Metacampus, a report series was launched in autumn 2024 titled **"Unite! Digital Teaching and Learning – Success Story Report".** The report series is edited by Martin Ebner, Katharina Gasplmayr, and Sandra Schön and published at TU Graz repository (TU Graz, Unite! Success Story Report Series, 2025): By highlighting innovative and effective uses of the Metacampus, educators across the Unite! network can learn from one another and adopt proven strategies. These examples serve as inspiration and contribute to a more cohesive and engaging learning environment across institutions. The first two reports focus on the use of open badges for course certification and the integration of learning platforms via LTI (Gasplmayr & Schön, 2024; Schön, Ebner & Gasplmayr, 2024; see Figure 7).

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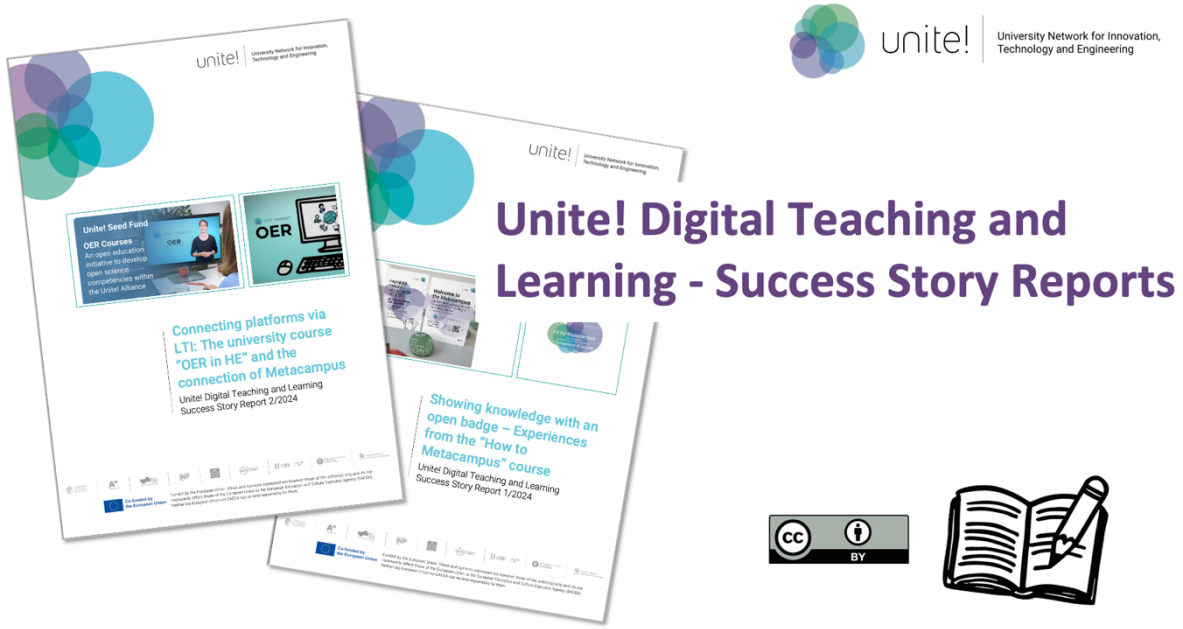


Figure 7: Screenshots of the first two reports of the series "Unite! Digital Teaching and Learning – Success Story Reports".

Three additional stories about "Creating awareness for inclusion, diversity, equity and accessibility (IDEA): The 21 Day Challenge on Metacampus" (Szczerba & Edelsbrunner, 2025), "Metacampus as a Base for a Unite! Blended Intensive Programme (BIP): Competencies for Collaborative Teaching in Joint Programme" (Acosta-Garcia et al., 2025) and a description of the training "Accessibility for academic teaching staff" (Forycka et al., 2025) were additionally published by 12/2025 in the report series "Unite! Digital Teaching and Learning – Success Story Reports" and describe cases where all partners were involved.

3.4 Recommendations

The following lessons learned in Table 4 were generated during the bimonthly e-learning support group meeting in November 2025 and have subsequently been reviewed and refined by the group.

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Table 4: Challenges and mitigation issues when supporting digital teaching in a university alliance with a federated learning management system

Aspect	Challenges	Mitigation Issues (if)
Technical	Partner universities, local support teams and their staff, teachers and students may have different levels of expertise with the selected LMS (Moodle).	Provide trainings for local support teams, sandbox courses for testing, shared information and documentation materials, central LMS support – especially for partners without Moodle expertise
	Metacampus support lacks detailed knowledge of local IT systems and tools, limiting their ability to resolve specific issues (e.g. course import from another LMS or login issues)	Cross-linkage of e-learning support teams and dedicated e-learning contacts at the universities
	Users may have little or no knowledge of the LMS and its functionalities, or if it is suitable for their learning setting .	Development of communication, information and teaching materials for (potential) users, such as the "How to use Metacampus" course and the decision tree
	Differences in functionality (mainly plug-ins) between the partner LMS and the federated system, even when they are based on the same software	Overview of the current plug-ins and extras provided centrally (in the How to use Metacampus course), updates were communicated at the regular e-learning staff meetings
	Some services needed to be piloted to see if they work, particularly LTI.	It is difficult to find teachers who can work with such open situations.
	Identity and access management - user lifecycle synchronisation: Enrolment changes (add/drop courses, staff role updates)	
Legal	Unclear copyright regulations in the countries involved for teaching content and learning resources shared on the federated LMS, which limit future usage (e.g., in Germany: Section 60a of the Copyright Act (UrhG) "Teaching and instruction")	Encourage use of open educational resources (OER) and open licensing (see chapter 10).
	Copyright issues are not typically part of the e-learning and teaching support service, OER are not a common topic at all partner universities	Initiatives to share and develop OER and knowledge about copyright are needed
	It is unclear how much teachers know about copyright and open licenses in a cooperative international teaching setting and whether they are able to work accordingly.	Initiatives to share and develop OER and knowledge about copyright are needed
Organisational	Raising awareness of the federated LMS and that it can be used by other alliance (working) groups	Development of communication about the federated LMS
	Local e-learning teams need to be up to date with the platform developments and changes.	Regular online meetings, updates and shared communication among e-learning support teams
	Federated LMS support is needed for all users	Centralised Metacampus support and processes are needed, but this not always the best solution (e.g. language issues). A single contact point for support (common support address and form) and ticketing system to handle requests
	There is no overview of which teachers are interested in or involved in Unite!-related teaching or teaching at Metacampus.	-
	Regulations on the visibility and availability of courses. Establishment of a course life cycle.	There are first processes implemented on when Metacampus spaces are set to hidden.
	External people and partners do not have access to Metacampus.	Usage of other tools and solutions, e.g. a MOOC platform

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4. Implementation and maintenance of a user-friendly federated LMS and recommendations (T2.4)

Xavier Molins, Jesus Alcober, Martin Ebner, Katharina Gasplmayr, Sandra Schön

This chapter outlines the implementation and ongoing maintenance of a user-friendly, federated Learning Management System (LMS), along with actionable recommendations (Task 2.4).

4.1 General activities and developments concerning Metacampus

A key component of the Unite! digital infrastructure is the Metacampus, a federated learning management system (LMS) based on Moodle, currently version 4.5, designed to support inter-university collaboration in teaching and learning. The development of the Metacampus was driven by the need to overcome institutional barriers and create a shared digital environment where students and educators from different universities can engage in joint courses, access learning materials, and collaborate across institutions (see Alcober & Mohammadali, 2023; Alcober Segura et al., 2021, Ebner et al., 2024, Ebner et al., 2025).

The Metacampus serves several critical purposes, where it cooperates with other Erasmus+ communities, Unite! projects, groups or individuals:

- Providing a federated platform for Unite! courses and training programmes
- Supporting multilingual content delivery and accessibility compliance
- Facilitating streamlined administrative processes through eduGAIN authentication, allowing students and staff to use their home university credentials to access courses
- Update of Metacampus and organisational development of support requests (T2.4)
- Cooperation with Metacampus support (T2.3)
- Cooperation with other technical tasks and groups (especially T2.6, Technical Commission, see chapter 11)

So, several maintenance activities, such as the update to Moodle 4.1 in Summer 2024 and to Moodle 4.5 in summer 2025, as well as developments were carried out within the timeframe of the current Erasmus+ funding (2022-2025), which are described in detail in this report and include cooperation with T2.3 (see chapter 3), eduGAIN implementation and application (see chapter 6) and pilot tests with LTI (see chapter 7).

Metacampus, now in its sixth year of operation, places us among the very few university alliances - just 39 % of which reported having any LMS at all in February 2023, according to the EDEN 2024 paper by Ebner et al. (2024) - that have accumulated the longest-standing experience with a truly federated learning management system.

4.2 Metacampus testing and usability group

To further enhance the user experience on Metacampus, the working group "Usability Engineering on Metacampus" was established in January 2025. The group consists of representatives from Cm.2, including the Metacampus support team, Cm.9 "Strategic Outreach, Impact and Dissemination", UPCnet (which is responsible for operating and maintaining Metacampus), and Cm.5 "Flexible Educational Offerings" who were invited to a meeting regarding course representation and the course list. During sequential online meetings, the group discussed several improvements and adaptations to Metacampus, some of which resulted from the experiences the

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Metacampus team encountered throughout their support tasks. The changes were first implemented in the test environment by UPCnet and, after a review and feedback loop, deployed in the production environment.

Key changes within the working group include:

- A simplified Metacampus landing page that provides essential information about the platform
- An updated main menu with important links (including FAQs and contact information)
- An adapted search function that is now restricted to courses hosted on Metacampus only (since the Unite! course catalogues are now in place to showcase courses from partner institutions)
- All new Unite! users on Metacampus are automatically enrolled in the "How to use Metacampus" course upon their first login, which serves as a first point of contact for those unfamiliar with the platform
- An adapted footer including the most important links
- A refined list of courses and course categories
- Adding site-wide announcements to communicate updates and news to all users

The aim of this working group and its implemented changes was twofold: to make the platform more user-friendly and facilitate its use, and to simplify technical implementations to reduce the workload for future Metacampus updates. To inform other Communities and target groups of the enhancements, the Metacampus updates were presented at a Community Coordinators' Meeting in May 2025, as well as at the regular Cm.2, Technical Commission, and e-learning meetings.

In addition to establishing this working group, it has become clear that collaboration between the platform operators, Metacampus support, and the Technical Commission is essential for ensuring the smooth operation and effectiveness of Metacampus. In this regard, the Technical Commission actively requested certain updates, such as software updates or changes to the platform. Regular checks of the platform by the Metacampus support, for example, after updates or the implementation of new features, helped ensure that the implementations were correctly in place.

4.3 Metacampus' technical adaptations

Several features and functionalities were added to Metacampus as a result of the usability working group or feature requests submitted to the Technical Commission (see chapter 11). Examples include the accessibility toolkit, test accounts for course creators, a new tutor role, Etherpad Lite Plugin, subcourse plugin for grading, and the STACK and CodeRunner question types.

4.3.1 Metacampus extras and current plug-ins

Metacampus offers a range of plugins and integrations that extend Moodle's core functionality, allowing educators to enrich courses with collaborative tools, interactive activities, multilingual support, and accessibility checks.

- External Tool (LTI) – Links to external learning resources and web applications; must be set up by an administrator. (see chapter 7)
- Etherpad Lite (Plugin) – Real-time collaborative text editor for course participants.
- Games (Plugin) – Interactive games such as Crossword, Cryptex, Hangman, Hidden Picture, Millionaire, and Sudoku that pull content from quizzes, questions, or glossaries.
- Subcourse (Plugin) – Automatically retrieves the final grade from another course and imports it as a grade item.

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- STACK – Question type for creating mathematically rich quiz items; evaluates expressions via a computer algebra system and provides feedback. (see chapter 9)
- Multi-Language Content – Filter that displays text blocks according to the learner's selected language using tagged language markers.
- Brickfield Accessibility Starter Toolkit – Analyses course accessibility and offers recommendations for improvements. (see Szczerba & Edelsbrunner, 2025).

4.3.3 Open Badges (Update)

Additionally, Open Badges are implemented. This digital credentialing system allows individuals to earn and showcase recognized achievements, skills, and knowledge in a portable and verifiable format. So, the functionality of Open Badge credentialed courses (Myllymäki & Hakala, 2014) has been employed to deliver courses in a standardised manner to students, faculty, and administrative staff (Alcober & Mohammadali, 2023), and the process of issuing new Open Badges directly through Metacampus was implemented. From a technical point of view, issuing Open Badges through Metacampus has proven to work correctly, and several Open Badges have been issued up to today (see Table 5).

Table 5: Open Badges issued via Metacampus

Open Badge issued via Metacampus - Total	2022/23	2023/24	2024/25	2025/26	Total
for "How to use Metacampus"			154	20	174
for "Open Educational Resources in Higher Education"			13		13
for "Beyond Words: Exploring Non-Verbal Communication in Teaching"			8		8
for "Inspiring young technological talent: Connecting Unite! and high schools for social good"				8	8
for "SURE! Student Engagement Open Badge"		20	13		33
for " Unite! Seed Fund Ideathon"			20		20
for "Level up your outreach skills!"	16				16
for "Successfully Dealing with Interculturality"		9			9
for "IDEA" Badge			5		5
Sum					*286*

There are still some strategical decisions to be made by Unite! regarding the definition of a formal process and aligned criteria for Open Badges in the future.

4.4 Development of the Metacampus usage within Unite!

In this section, some of the user metrics from the Unite! Metacampus since its inception are presented. First, the table showing the number of registered users on Metacampus (current number of users) is displayed. This table illustrates the monthly growth of users from October 2023 to the present.

It can be observed that certain months show significant percentage increases (+10%), which usually coincide with specific activities carried out through the platform that have promoted and encouraged its use. Apart from these months, the average monthly user growth is around 3%. As of October 2025, the total number of users amounts to 14,242 (see Table 6).

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Table 6: Number of users on Metacampus (October 2025)

Month	Users	Variation %
October 2023	6484	0%
November 2023	6745	4,0
December 2023	6888	2,1
January 2024	7153	3,8
February 2024	8169	14,2
March 2024	8575	5,0
April 2024	8690	1,3
May 2024	8764	0,9
June 2024	8838	0,8
July 2024	9220	4,3
August 2024	9530	3,4
September 2024	9674	1,5
October 2024	10064	4,0
November 2024	10180	1,2
December 2024	10247	0,7
January 2025	10379	1,3
February 2025	10548	1,6
March 2025	11918	13,2
April 2025	12187	2,6
May 2025	12441	2,1
June 2025	12569	1,1
July 2025	13003	3,5
August 2025	13539	4,3
September 2025	13859	2,5
October 2025	14243	2,8

The total number of users is divided among the nine member universities according to the following figures and proportions, with PoliTO having the highest participation (23.55%) and KTH the lowest (4.7%, see Figure 8).

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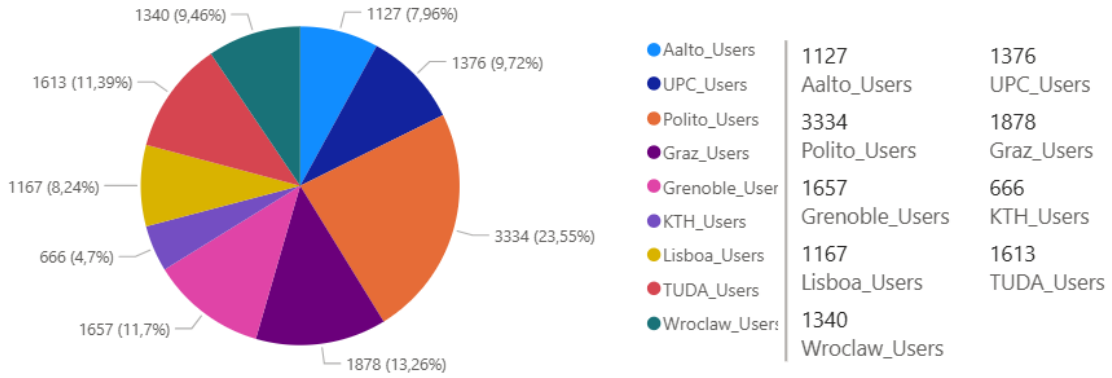


Figure 8: Number of users by Unite! partners (October 2025)

Next, the activity and retention of users within the Moodle-based Metacampus system are analysed. Therefore, a historical record of the metric "Users who were active in the last 3 months" is presented below. This metric is defined as the number of users who logged into the Metacampus at least once during the last three months (see Table 7).

Table 7: Active users on Metacampus per month (October 2025).

From	To	Users	Variation %
June 2023	August 2023	151	-
July 2023	September 2023	294	95
August 2023	October 2023	732	149
September 2023	November 2023	1173	60
October 2023	December 2023	1259	7
November 2023	January 2024	1111	- 12
December 2023	February 2024	1747	57
January 2024	March 2024	2027	16
February 2024	April 2024	1489	- 27
March 2024	May 2024	1002	- 33
April 2024	June 2024	684	- 32
May 2024	July 2024	864	26
June 2024	August 2024	1264	46
July 2024	September 2024	1366	8
August 2024	October 2024	1383	1
September 2024	November 2024	1301	- 6
October 2024	December 2024	1102	- 14
November 2024	January 2025	764	- 26
December 2024	February 2025	738	- 2
January 2025	March 2025	2350	211
February 2025	April 2025	2547	27

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March 2025	May 2025	2677	6
April 2025	June 2025	1976	- 28
May 2025	July 2025	1656	- 12
June 2025	August 2025	1849	10
July 2025	September 2025	1732	- 7
August 2025	October 2025	1722	- 1

As shown in Figure 9, there is a noticeable upward trend, along with a seasonal pattern depending on the months, which aligns with the academic activity cycles of the nine member universities.

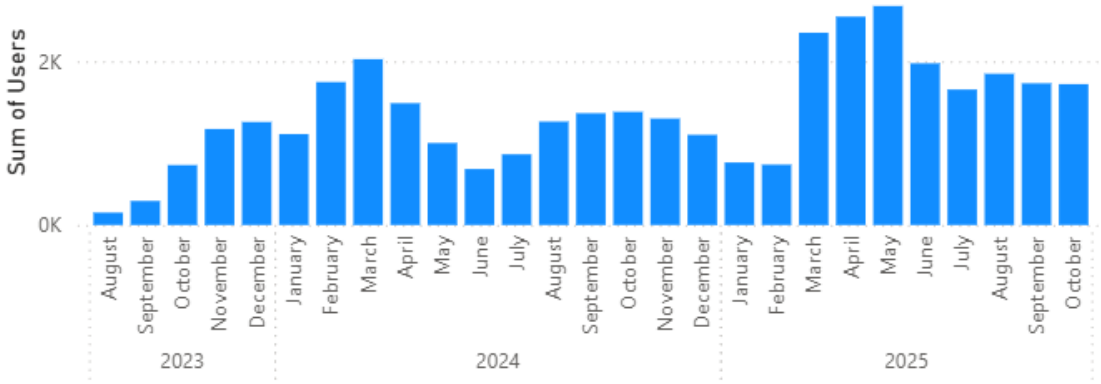


Figure 9: Number of active users per month (October 2025)

Finally, information is presented on the number of spaces created (both visible and non-visible) within the Metacampus. Since the launch of the Metacampus, a total of 171 spaces have been created. As of today, 103 of these spaces are in "visible" mode, meaning that all users can view the course description of these spaces and, in the case of "self-enrolment" spaces, access their content.

Not all Metacampus spaces involve participation from all nine Unite! member universities; in some cases, only a subset of them is involved. For this reason, the level of participation of each university across Metacampus spaces varies.

The following Figure 10 presents the number of Metacampus courses associated with each university, based on the participation of at least one registered teacher or student.

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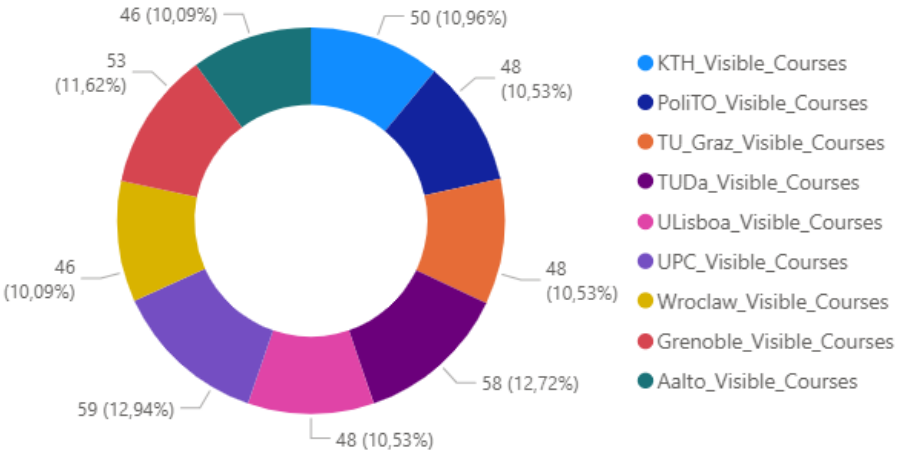


Figure 10: Number of Metacampus spaces with participants from all partners by Unite! parters (October 2025)

4.5 External access to Metacampus as an issue

Operating a federated LMS within a European university alliance entails numerous non-technical challenges that repeatedly surface in practice. Legal divergences in GDPR interpretation, differing curriculum structures, and varying institutional policies create a fragmented compliance landscape that cannot be solved by technology alone. Organisational hurdles—such as aligning incentives for faculty, harmonising teaching workflows, and establishing common academic frameworks like ECTS—require coordinated governance and cultural change. Pedagogical and intercultural factors further complicate adoption, demanding targeted training and awareness programmes. Highlighting these issues underscores how the overall complexity of running a federated LMS extends far beyond pure technical integration.

An issue that was increasingly mentioned and discussed is the following: A substantial number of Unite! projects require LMS resources that must be reachable by participants who are not affiliated with any of the partner universities (e.g., industry collaborators, guest lecturers, or students from non-partner institutions). Providing direct external access to Metacampus raises several critical issues:

- **GDPR compliance** – Personal data of non-member users must be processed under the strict consent, purpose limitation, and data subject rights obligations of the EU General Data Protection Regulation. The current Metacampus data-handling model is designed for intra-alliance users only and lacks the necessary legal basis and audit trails for ad hoc external processing.
- **Identity verification and lifecycle management** – External accounts would require robust identity proofing, continuous validation, and timely deprovisioning. The existing eduGAIN-based federation only authenticates members of the Unite! consortium, leaving a gap for reliable ID checks and automated account hygiene for outsiders.

Given these constraints, the strategic decision by the Unite! management was made **not to plan native external integration** into Metacampus at this stage. Instead, teaching staff may request **guest accounts** from their home institutions; these accounts inherit the institution's GDPR-compliant policies and can be provisioned for Metacampus access through the local identity provider.

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Repeated feedback from project coordinators indicates that this workaround does not fully meet the need for a streamlined, alliance-wide external-access service, highlighting a persistent gap in the current offering that will need to be addressed in future roadmap iterations.

4.6 Recommendation

The Metacampus has made significant progress in enabling federated digital learning within Unite!, but challenges remain. Key takeaways include the importance of technical interoperability, strategic governance, and incentives for faculty to enhance participation. To optimise its development, further efforts should focus on improving LTI integration, establishing a counselling board for strategic decisions, and introducing incentives for faculty engagement. The potential expansion to external users should be carefully evaluated. As shown in Table 8, many of such further developments require decision-making within other instances in the alliances, which are sometimes not established or difficult to established.

Looking ahead, the Metacampus could become the central hub for collaborative digital learning within Unite!, if institutions align their efforts and invest strategically. Strengthening collaboration with other alliances could help address shared challenges and ensure long-term success.

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Table 8: Challenges and potential technical and other solutions for implementing and running a federated learning management system in a European university alliance.

	Challenge	Potential solutions
Technical	Integration of the federated system in the heterogeneous landscape of existing infrastructure	Clarifying existing infrastructures of all partners and identification of incoherence, using standardised APIs, Service-Oriented Architecture (SOA), Identity and Access Management (IAM) and Integration Platforms as a Service (iPaaS)
	Needs to be capable of handling increased loads efficiently while maintaining performance and reliability (Scalability)	Continuous monitoring and performance analytics are vital to dynamically adjust resources and detect potential issues before they affect users.
	Registration and authentication needed	eduGAIN and a working group for authentication issues were helpful.
	Connection with other LMS and services	via LTI (see chapter 7), partner hosted environments (see chapter 9)
Legal	Different copyrights in Europe and possibility to use resources created by others (cf. Congleton & Yang, 2011)	Open licences allow use
	GDPR needs to be respected for a federated LMS	The strictest implementation should serve as a benchmark, an alliance-wide GDPR expert group would be helpful for this.
	Different partner regulations on LMS data retention, anonymisation and deletion	Regulations need to be collected and processes established for federated LMS. We need to collect information about how partner deal with data provided and stored in the Metacampus.
Organisational	Technical decisions about plug-ins and developments need to be made.	We used a contact form to support the development of requests. The established Technical Commission decides on technical issues, potential solutions (plug-in) and their future maintenance (see chapter 11)
	Experiences with the dedicated system vary.	It is not optimal that KTH has only limited experience with Moodle/Metacampus. Additional support is needed for and from this partner.
	Strategic decisions about the usage of Metacampus need to be made and supported.	As decisions are not always technical, processes need to be established that drive strategic decisions (e.g. how to deal with external partners) or accompany developments (e.g. criteria for open badges)
	Needs from alliance stakeholder	Many transversal meetings between Unite! communities were held, analysis of DoA and more was done to identify potential needs.
	Communication and support organisation	see chapter 3
Other challenges	User experience	The design often must cater to the "lowest common denominator" to meet diverse user expectations and accessibility standards.
	Prioritising learners' perspective	Communicating that learners particularly benefit from using a federated system as it reduces their reliance on multiple platforms
	Communication across partners concerning Metacampus issues	Checks, updates and mails required
	Motivational	Incentives to use the platform for teaching (learners should follow)

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5. Activities and implementation of European Student Card within Unite! and lessons learned (T2.5)

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This chapter starts to present the activities carried out and the results achieved for Task 2.5, detailing the implementation and external integration of the European Student Card Initiative. Within the following chapter, first the activities and recommendations concerning EWP and ESC are described, and in the following chapter 6, the focus is on eduGAIN.

The ESC group not only organised multiple workshops (e.g., at the Unite! Dialogue in March 2024 in Graz), but also continuously gathered the ESC status updates from all partners and presented these findings in Cm. 2 meetings (for instance, in detail at the Unite! Dialogue in Darmstadt in autumn 2024). The exchange incorporated experiences and developments from the partners PoliTO and INP-UGA. Based on this data, a report was published in September 2025, which serves as the basis for the following overview and contains additional details (Bertonasco et al., 2025).

5.1 Erasmus Without Paper (EWP) in Unite!

In October 2023, as part of the requirements analysis for Work Package 2 of the Unite! project, data from all partner institutions related to their implementation of the ESCI were extracted from the existing databases (EWP, 2025). These findings were thoroughly analysed and compiled into a report, which was scheduled for publication in January 2024 (Langevin et al., 2024). The data provide detailed insights into the ESCI implementation status across the consortium. However, a check of EWP (2025) and among partners in February 2025 showed some changes and were presented in a report about ESC in December 2025 (Bertonasco et al., 2025).

The Unite! alliance has made solid progress in integrating Erasmus Without Paper (EWP) across its member institutions, with most partners already connected to the central EWP network and using it for the automated exchange of agreements, learning agreement handling, and transcript transfers. However, the data reveal that the EWP implementation is uneven across the alliance, with several partners still lacking full API support or ESC-R connectivity. Implementation gaps persist because each university still operates heterogeneous legacy IT systems and must resolve GDPR-related consent and data protection issues.

5.2 Overview of ESC implementation amongst Unite! members

The report documents a mixed picture of European Student Card (ESC) deployment across the nine Unite! partner universities: PoliTO has fully integrated the ESC into its "PoliTO Students" mobile app. The app has allowed every enrolled student to request, activate, and use a virtual ESC since September 2025. UGA (as one of two organisations combined as Unite! Partner INP-UGA) already rolled out the ESC to all first-time students in the 2019-2020 academic year and now reports roughly 90 % ESC coverage (see below). Other Unite! members (Aalto, KTH, Politecnico di Torino, TU Graz, ULisboa, UPC, TUDa, Wroclaw Tech) have started or are planning ESC deployments, but many are still in the survey stage or in early pilot phases.

A key reason for this is that these partners are **awaiting national-level developments or regulations**. Several universities are waiting for national policy clarifications, especially concerning data protection frameworks and the legal status of the ESC-Router at country level (see Bertonasc et al., 2025, p. 21f).

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5.3 Full ESC implementation at PoliTO and the University of Grenoble Alpes

As just highlighted, PoliTO and the University of Grenoble Alpes (UGA; an affiliate entity of Grenoble INP-UGA) have already rolled out the ESC for their students (see Bertonasco, 2024; Ferrian & Bertonasco, 2025; Reignier-Tayar & Diard, 2025).

PoliTO has fully integrated the European Student Card into its "PoliTO Students" mobile application, allowing every enrolled and active student to request, activate, and use a virtual ESC directly from the app. The implementation follows a harmonised design that places the ESC alongside the university's own digital badge, and the card's QR code grants access to campus services. Technically, the app communicates with a dedicated ESC-handling backend via OpenAPI-defined APIs, which act as a bridge to the ESC-Router (see Figure 11).

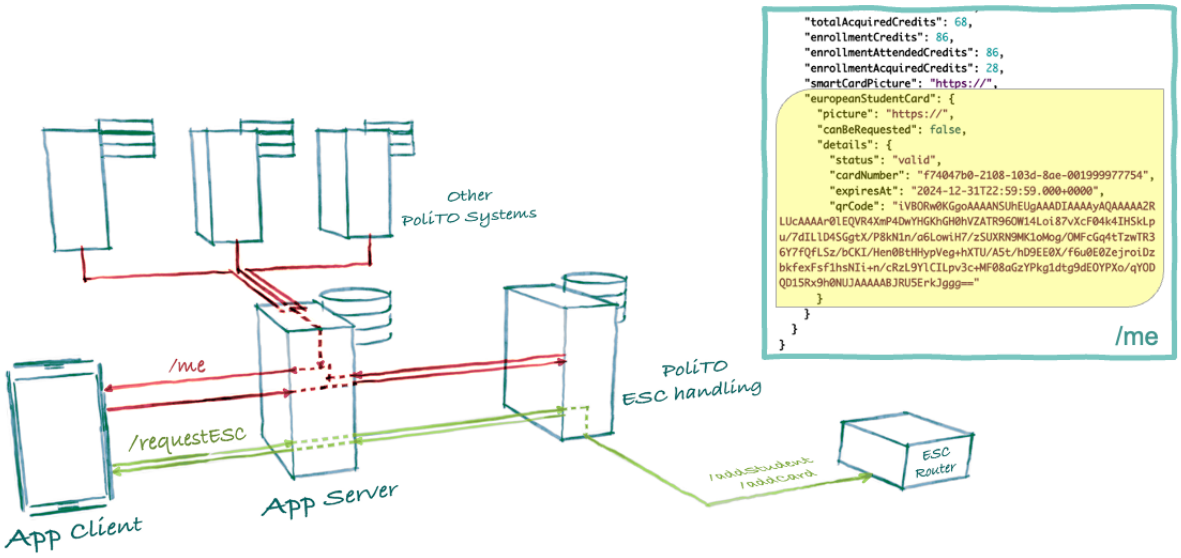


Figure 11: The technical integration of the ESC at PoliTO. Source: PoliTO. Source: Ferrian & Bertonasco, 2025, Figure 16.

UGA began deploying the European Student Card in the 2019-2020 academic year and has since extended the solution to virtually all first-time students, reaching roughly 90 % coverage of its student population of 46,700 (see Figure 12). The implementation was carried out in partnership with the French service provider Cap Monétique, later supported by NTT Data, which handles the printing and routing of the ESC data to the European ESC-Router. UGA placed a strong emphasis on GDPR compliance, obtaining explicit consent from each student before transmitting personal data to the router and allowing students to revoke consent at any time. (Reignier-Tayar & Diard, 2025)

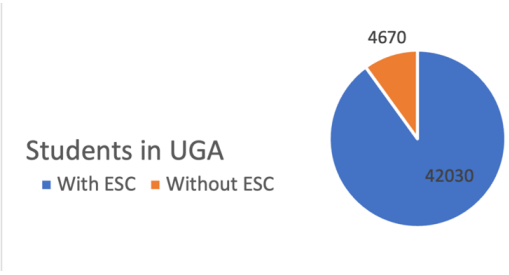


Figure 12: Students with ESC among the 46,700 UGA students. Source: Reignier-Tayar & Diard, 2025, Fig. 17, p. 34

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5.4 Contribution to European ESC development

Unite! partner PoliTO, represented by Roberto Bertonasco and his team, has taken a leading role in the Italian contribution to the Unite! ESC initiative (see Bertonasco, 2024). The university developed the "PoliTO Students" mobile app, which embeds the European Student Card as a virtual credential that every enrolled student can request, activate, and use directly from their phone. By exposing a set of OpenAPI-defined services on GitHub, PoliTO not only connects its internal student information system to the ESC-router but also publishes the integration specifications for other institutions to reuse.

Additionally, partner INP-UGA was one of the first pilot universities in Europe and can now refer to a nearly fully rolled-out ESC, at least for UGA students.

5.5 Recommendations

The following Table 9 describes challenges for the ESC implementation. Although the European Union places considerable emphasis on the ESC, individual universities currently lack a clear vision regarding the potential benefits or existing advantages of employing the ESC, particularly when a card system has already been introduced. Moreover, several partners within the Unite! network are awaiting national-level developments before initiating any ESC-related activities. Consequently, these factors do not foster expectations of rapid implementation in our context.

Table 9: Challenges and mitigation issues when implementing ESC

Aspect	Challenges	Mitigation Issues (if)
Technical	Data duplication issues and the current inability to store student records exclusively at the university	True API-based, real-time data exchange with the ESC-Router is needed.
Legal	GDPR issues	Development of robust consent mechanisms
Organisational	Scaling the ESC across the institution	Political backing and clear governance structures
	(Ongoing) National developments	None.
	The (potential) use of ESC (currently) does not offer any benefits compared to existing methods/cards. Therefore, the motivation is limited.	Proposals about the ESC can do in the future.

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6. Integration of eduGAIN for Metacampus access and visibility (T2.5)

Roberto Bertonasco, Jorge Daniel Sequeira Matias, Jesus Alcober, Xavier Molins, Katharina Gasplmayr, Sandra Schön

This chapter builds upon eduGAIN implementations by Task 2.5 and incorporating contributions from Task 2.6.

6.1 Activities: eduGAIN maintenance for Metacampus access

eduGAIN federation was deployed already before the Erasmus+ funding started in 11/2022, and early implementation confirmed that the technology can support the alliance's privacy-preserving access model and that credential exchange works smoothly when all participating IdPs adhere to the consortium's role definitions (see Alcober & Mohammadali, 2023).

eduGAIN is an infrastructure developed by GÉANT that connects national identity federations, allowing users to access academic and research services with their institutional account. In Unite!'s case, Metacampus operates as a Service Provider (SP) within the eduGAIN network. Therefore, it was necessary to formally register it as an SP, complying with federated authentication protocols based on SAML 2.0 and OAuth 2.0. For integration with Moodle, the platform on which Metacampus is based, the OAuth2 plugin was adopted, which enables authentication through federated providers. This solution permits Unite! community members to access the Metacampus using their native credentials, an aspect that has been greatly appreciated.

At the start of the project, however, two new members (TU Graz and Wrocław Tech) had to be onboarded to the federation. Their integration required the creation of additional entity IDs, mapping of local role attributes to the eduGAIN schema, and the synchronisation of metadata feeds. But even after the onboarding of the new partners, some issues were to be handled, e.g. when updates need to be done – or as shown in the following paragraph – additional developments.

The integration of eduGAIN into Unite! revealed several key challenges, four of which are described in the following to share deeper insights:

- First, intermittent authentication failures occurred because Metacampus identified users solely by their email address, which often changes after institutional or administrative updates. When this happened, the system could no longer recognise the user, leading to login errors that required manual fixes.
- Second, mismatches in attribute mapping caused missing or incorrect user data during the authentication exchange.
- Third, students from ULisboa and IST were blocked by SAML2 signature-validation errors—IST had rotated its X.509 certificate while Metacampus was still using the old one, and a mistake during the metadata update removed ULisboa's entry from the IdP selector. Updating the SAML metadata with the new IST certificate and restoring ULisboa's metadata resolved the issue.
- Finally, learners with etu-iepg.fr addresses (Grenoble Institute of Political Science and Grenoble Architecture School) could not log in because those domains were absent from Metacampus's eduGAIN configuration; the platform is awaiting the necessary IdP metadata from the Grenoble/UGA side.

To mitigate such problems, a dedicated working group was formed within Cm.2. The group meets regularly to share implementation experiences, coordinate metadata refresh cycles, and develop

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joint troubleshooting procedures. By pooling knowledge from all partners, the working group aims to reduce the frequency of eduGAIN-related disruptions and to ensure that future integrations, whether of new institutions or of updated IdP services, can be carried out with minimal impact on the alliance's collaborative workflows.

Notably, Metacampus and this described eduGAIN usage is positively recognised in a report about university alliance interoperability (Berger et al., 2023; see 12.2).

6.2 Implementing eduGAIN role recognition in Unite!

eduGAIN conveys standardised role attributes, such as staff, faculty, researcher, student, and guest, through Security Assertion Markup Language (SAML) assertions, allowing each user's affiliation and entitlement to be recognised across all participating institutions. In a dedicated pilot, the Unite! alliance evaluated whether these eduGAIN-derived roles could be leveraged within its own services. The experiment involved mapping the incoming role claims to internal permission groups and actively enforcing them for access control.

Once the eduGAIN implementation was completed for all partners and its reliability verified in a production environment, the need arose to distinguish users' roles in addition to certifying their identity.

First, a role attribution analysis was done: Identifying the role of users authenticated through eduGAIN required an analysis of the attributes released by the partner universities of the Unite! alliance, revealing variability in their management. Specifically, the following attributes were analysed:

- eduPersonScopedAffiliation (see eduPerson Schema in Internet2, 2020)
- eduGAINPersonAffiliation (see GÉANT, eduGAIN Attribute Profile, 2021)

The findings were as follows:

- Some universities use the eduPersonScopedAffiliation field with a fixed value, such as member@xxxx, and specify the user's role through eduGAINPersonAffiliation.
- Other partners use only the eduPersonScopedAffiliation field to indicate both affiliation and role.

To ensure consistent role recognition, modifications were made to the management of user creation authenticated through OAuth2 in Moodle (see Figure 13). The implementation allowed the system to correctly read and interpret users' roles based on the attributes effectively transmitted by each Identity Provider (IdP) via eduGAIN. Thanks to this configuration, students can now be accurately identified and distinguished from other users on the platform.

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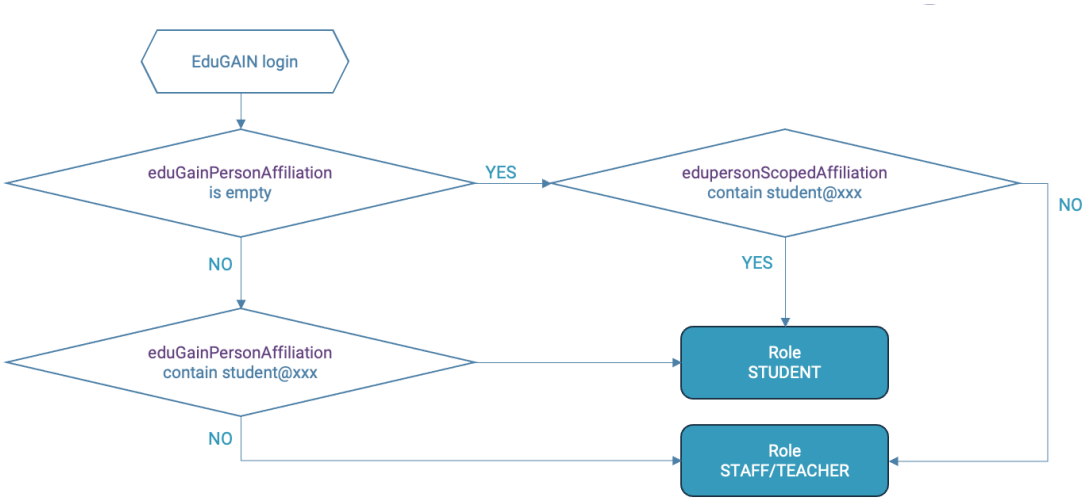


Figure 13: Process to ensure consistent role recognition applied within Unite!

Now, the Metacampus platform can recognise the user's role within their home university.

6.3 Piloting role-related adaptation: course visibility according to roles

One practical use of the newly distinguishable roles is to filter course listings in Metacampus so that courses designated for staff are not displayed to students. This was implemented within the Metacampus in December 2024 after some testing. Figure 14 shows the two different visibilities of courses related to the eduGAIN role of students and staff/teachers.

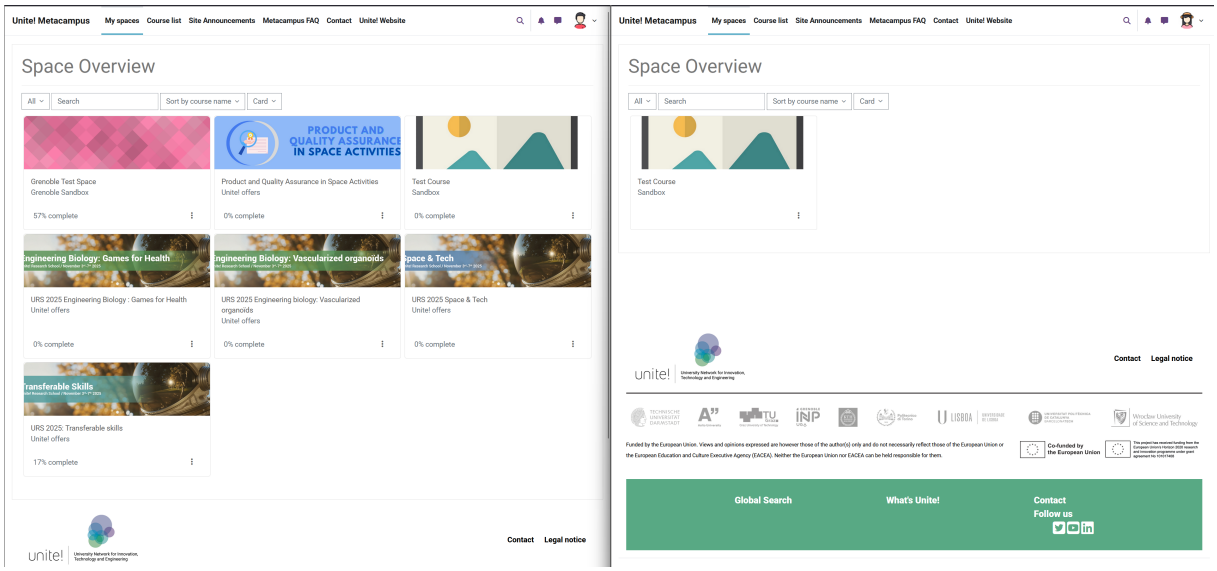


Figure 14: Exemplary view: A screenshot of the Metacampus with a student account (left) and a staff/teach account (right) on the same day (30/10/2025)

The implementation in the production environment demonstrated that role identification is fundamentally feasible and can now be applied to other use cases within Unite!.

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This example was already accepted at the early adopters' call of the European Higher Education Interoperability Framework (HEIF, 2025) by the European Digital Education Hub (EDEH) of the European Commission as Unite!'s case study in autumn 2025.

6.4 Recommendations

The adoption of eduGAIN for Metacampus access has enabled secure federated authentication in compliance with international standards. For the described implementations and maintenance, as well as the described piloting of roles, we collected challenges and recommend mitigation possibilities. As these address different aspects, we divided them into three separate tables.

Table 10 describes challenges and mitigation issues using eduGAIN to authenticate users in Unite!, which involves, for example, a joint initiative and working group of technical experts and user support.

Table 10: Challenges and mitigation issues using eduGAIN to authenticate users in Unite! Metacampus

Aspect	Challenges	Mitigation Issues (if)
Technical	Regular maintenance needed	Working group/partners at all partner institutions and Metacampus should be aware and connected
	Metacampus uses a static configuration of IdP certificates. If a university's eduGAIN metadata changes, (e.g. due to new certificates), the system's metadata must be updated manually.	Cross-linking of Metacampus support and technical experts at partner universities to ensure ongoing operations
Legal	Data deletion related to users must be aligned with partner regulations and according to GDPR.	A process needs to be implemented and aligned.
Organisational	Connection to help desk	Urgent issues need to be addressed by the right people.

Table 11 highlights issues concerning eduGAIN role identification on Metacampus, starting with the lessons learned that the heterogeneity in attribute management among partner institutions required in-depth analysis and adjustments to the Moodle integration.

Table 11: Challenges and mitigation issues concerning eduGAIN role identification

Aspect	Challenges	Mitigation Issues (if)
Technical	Heterogeneity in attribute management among partner institutions	In-depth analysis and adjustments to Moodle integration are required
Legal	(not applicable)	
Organisational	Needs to communicate and understand different roles of partners and how to align them	Expert discussion and data collection

Table 12 refers to the challenges that are related to our unique usage of eduGAIN roles related to the visibility of Metacampus spaces only for targeted user groups.

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Table 12: Challenges and mitigation issues using roles for Metacampus course visibility

Aspect	Challenges	Mitigation Issues (if)
Technical	Courses need to be tagged according to the target group (done by the support team)	Regular checks by admins needed, target groups are not always clear.
Legal	(not applicable)	
Organisational	Administrative accounts only have one role	Students or test accounts need to be involved to check course visibility
	Unusual set-up for users (e.g. restricted visibility for teachers who cannot see their own courses)	It is not easy to expect or communicate that we implemented a limited visibility.
	Overview of courses is not complete after log-in (also applies for management and administration)	The public, non-logged-in version displays all spaces, which needs to be communicated.

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7. LTI integration: First pilots including a MOOC integration (T2.6)

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This chapter builds upon the work of T2.6 on interoperability. Members of 2.6 were already active in the first report and contributed to the description of the partners' infrastructures, where it generally handled service integration (Ebner et al., 2024). In the following chapter, we want to highlight the Learning Tool Interoperability (LTI)-related activities in the following section. T2.6 worked additionally considerations about metadata for a potential future course catalogue (see chapter 8) and integration of partner-hosted environment (see chapter 9).

As it can be shown, we have reached Technology Readiness level 7 (TRL 7), which is defined as "system prototype demonstration in operational environment" (European Commission, 2017), specifically with pilots 2 and 5. The pilots are presented in chronological order of their execution.

7.1 Learning Tool Interoperability (LTI) implementation to connect two LMS

"Learning Tools Interoperability" (LTI) is a standard developed by the IMS Global Learning Consortium that allows different learning systems to connect to external service tools in a standardised way. Connecting two learning management systems through LTI in the manner outlined below represents a novel approach that, to our knowledge, has never been implemented before (Ebner et al. 2025a, 2025b).

Learning Tools Interoperability promises a straightforward "plug-and-play" link between a Tool Provider LMS and a Tool Consumer LMS. This technology can potentially permit students to engage with courses *via* the Metacampus, even when the courses are hosted on the original virtual campuses of their respective professors or vice versa. As shown in Table 2 not all partners are already LTI compatible (see p. 13).

Additionally, the reality often proves more complex. Establishing the initial trust relationship demands coordination between administrators, and the subsequent deep-linking configuration can vary dramatically across platforms, leading to inconsistent behaviour. When a learner initiates an LTI launch, the system must reconcile disparate identity stores; the three possible account-linking strategies (pre-existing accounts, auto-created LTI accounts, or user-chosen accounts) frequently generate confusion and duplicate identities. Moreover, optional features such as participant synchronisation or grade pass-back rely on proprietary extensions that are not uniformly supported, which can lead to risking data loss or mismatched grading. Within the Unite! alliance, the heterogeneous mix of Moodle and non-Moodle systems amplifies these challenges, making it unclear whether LTI can truly deliver a seamless, federation-wide experience without extensive testing and custom development. Consequently, while LTI remains an intriguing option worth exploring, its purported ease of integration warrants careful scrutiny before committing to a large-scale rollout.

7.2 Tests and pilots with LTI within Unite!

There are several ways to link LMSs with LTI within the Unite! ecosystem. The federated Metacampus can act either as an LTI Tool Provider or as an LTI Tool Consumer, and the same flexibility applies to the other platforms that were tested.

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- **Pilot 1** – In first test, a course from TU Graz LMS TeachCenter served as the LTI Tool Provider, while Metacampus acted as the LTI Tool Consumer; the configuration was also reversed, with Metacampus as Provider and the MOOC platform as Consumer.
- **Pilot 2** – The MOOC platform hosted by TU Graz was the LTI Tool Provider and Metacampus, running the course, functioned as the LTI Tool Consumer.
- **Pilot 3** – The OER platform OpenLearning hosted by Aalto was the LTI Tool Provider and Metacampus was the LTI Tool Consumer.
- **Pilot 4** – KTH's LMS Canvas was tested as the LTI Tool Consumer, with Metacampus as the LTI Tool Provider, as Canvas cannot serve as an LTI Tool Provider.
- **Pilot 5** – Wroclaw Tech's LMS ePortal was successfully used as LTI Tool Provider and Metacampus LTI Tool Consumer for a staff training.

It is to be noted that preparatoy tests were conducted at TU Graz, connecting the own LMS with the MOOC platform in preparation for the Unite!-related pilot activities (see Ebner et al., 2025a, 2025b).

7.3 Pilot 1: First tests on Unite!'s Metacampus (Moodle) as LTI Tool Provider and LTI Tool Consumer

Additional tests examined the use of LTI to connect the federated Metacampus LMS with the TU Graz Moodle instance and the iMooX.at MOOC platform. The primary objective was to host a joint course exam on Metacampus as the LTI Tool Provider, maintain a centrally updated question bank, and push grades back to the university LMS acting as Tool Consumer.

- In the first scenario, a full TU Graz course ("Electronic Circuit Technology") was exported to Metacampus; the import succeeded after administrative assistance with file size limits and the installation of missing plugins (e.g., Opencast video blocks, a custom learning-goal widget). Core content such as embedded YouTube videos, Bootstrap elements, and the question bank migrated correctly, while campus management metadata could not be transferred.
- In the second scenario, a Metacampus test course was linked via LTI to both the TU Graz LMS and iMooX, confirming that grades for whole courses and individual activities synchronise every 30 minutes. Account linking worked only in Chrome and Edge, with Firefox usable afterward, but Safari was unsupported. Once linked, students encountered a full-screen provider view lacking navigation, reflecting LTI's expectation that learners remain within the consumer system.

Across both pilots, several practical challenges emerged. LTI functions smoothly when the two systems run the same Moodle version and have compatible plugins, but any missing extension requires manual workarounds. Grade transfer must be configured by instructors or support staff, and each learner must link their account individually—a step prone to user error that support teams cannot easily diagnose, especially when the platforms are managed by different institutions. System outages on either side interrupt the workflow, and troubleshooting becomes cumbersome because support personnel lack visibility into the counterpart platform. Despite these constraints, the tests demonstrate that LTI can reliably move grades between Metacampus, the TU Graz LMS, and iMooX, providing a viable path toward a centrally managed question bank and unified grading across the Unite! alliance. (see Ebner et al., 2025a, 2025b)

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7.4 Pilot 2: Connecting a course at Unite!'s Metacampus with TU Graz MOOC platform

Pilot 2 moved from a test environment to a live course within the OER-courses program offered by TU Graz to the Unite! alliance (see Figure 15). The course, hosted on the federated Metacampus LMS, required participants to enrol in the iMooX.at MOOC "OER in Higher Education," which was embedded in the Metacampus course via LTI (as in pilot 2, phase 2). Access to Metacampus was secured through eduGAIN for all Unite! members, and every lecture participant was asked to hold an iMooX.at account. In total, 83 users - including teachers, administrative staff, and students from all nine partner institutions - registered for the course, and the LTI integration was demonstrated during the first online lecture without immediate problems.

Shortly after the launch, an iMooX.at-initiated Moodle update triggered a temporary disconnection between the two platforms (see MDL-81622). The outage lasted several hours, but the technical team resolved the issue promptly, restoring the LTI link and allowing the course to continue uninterrupted. (see Ebner et al., 2025a, 2025b, 2025c).

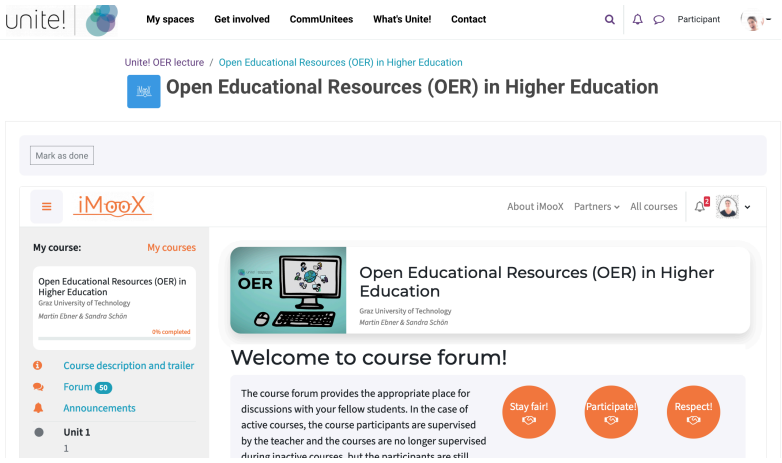


Figure 15: Screenshot: The MOOC is integrated in the course at the federated LMS Metacampus

7.5 Pilot 3: Tests and realisation with Aalto's system OpenLearning and Metacampus

Aalto tested the LTI integration first to prove the concept of the integration and to verify how users and courses were created in each environment. Aalto hosts two Moodle-based LMS services: one aimed at degree-based education and the other serving as the OER environment and a MOOC platform. Due to concerns that the LTI integration creates users, albeit temporarily, in the LMS, the tests and initial implementation were conducted in the OER environment. While this made sense in this case, it also brought some problems related to course creation and management. All LTI tests and production integrations were done with the LTI 1.3 Advantage standard.

As the development environment of the Aalto OER service is IP-restricted to Aalto networks, everything from initial tests to production was done in the production service. The testing included registering OpenLearning as an LTI tool on Metacampus, enabling the LTI enrolment method, publishing a test course as an LTI tool, and adding OpenLearning as an external tool in the test environment of Metacampus. After this, the published tool was added as an external tool to a test course in the Metacampus test environment.

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While the test was technically successful, there was a need for an actual course to use the integration. In this regard, we faced problems finding suitable courses. Since the courses mostly provide credits to Aalto students and the process in the degree-based LMS is mostly automatic, running the course in the OER system would mean more work for the teacher. Additionally, the Metacampus course area also needs to be designed to inform and assist the users taking the course from that platform, which would entail even more work for the teacher.

After discussing these limitations with an interested teacher, the integration was done between OpenLearning and the Metacampus production environment. The course area was hidden from public view, and the teacher was given access to the course to build the Metacampus version. He found the combined work to be too much for his schedule, so in the end, we limited the integration to opening the OpenLearning version of the course to Metacampus users.

This experience taught us that while the technical aspects of the integration work, we need to simplify the process of creating joint courses. This can be achieved firstly by providing an easier way to integrate courses and users from the Aalto degree-based learning platform, and secondly by supporting the teacher more in the creation of the Metacampus version of the course.

7.6 Pilot 4: Tests with KTH's LMS Canvas

KTH uses Canvas as its primary learning management system, while Metacampus and the other Unite! partners use Moodle. To explore interoperability between the systems, KTH conducted tests of the Metacampus LTI integration from within Canvas.

The tests were carried out on KTH's Canvas test instance, with the LTI tool installed at the single-course level, not account-wide. This reflects KTH's general practice of enabling external tools only for courses that explicitly request them, to avoid clutter and confusion for teachers who do not need the tool.

The pilot confirmed that Canvas can technically launch Metacampus via LTI. However, Canvas functions only as an LTI consumer, whereas Moodle can act as both an LTI provider and an LTI consumer. This means that Moodle-to-Moodle integrations can support a two-way "LTI bridge," but such bridging is not possible with Canvas, since Canvas cannot provide LTI services to Metacampus.

Once the LTI tool passes KTH's legal and security review, it could be reused across courses, but each course would still require its own deployment, involving:

- installation by KTH support staff, and
- approval by the Metacampus support team.

This creates predictable workload peaks before teaching periods. KTH is not opposed to LTI, but based on discussions during the pilot, Metacampus currently has limited personnel resources, and full certification of the LTI tool is expected to take significant time. As a result, LTI is not considered a short-term solution.

Because a direct LTI bridge is unavailable, the most practical near-term option is to rely on IMSCC (IMS Common Cartridge) export/import, which is supported by both Canvas and Moodle. Some content may need to be adapted before export, especially elements that are Canvas-specific and have no Moodle equivalent. After import into Metacampus, a simple quality-assurance check—confirming that activities, quizzes, and media links appear as expected—can help ensure the migrated material functions correctly.

Clear documentation for teachers is therefore recommended, covering:

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- which Canvas components are transferable via IMSCC and which are not,
- how to generate an IMSCC export from Canvas, and
- how to import the package into Metacampus.

While LTI integration may remain a long-term goal, IMSCC export/import currently offers a reliable and low-overhead pathway for sharing KTH course material with the broader Metacampus community

7.7 Pilot 5: Connecting a training for staff at Unite!'s Metacampus with Wroclaw Tech's LMS ePortal

Wroclaw Tech uses Moodle as LMS (ePortal) and used the following setting for a first implementation of an LTI connection with Unite!'s Metacampus. An existing course at the ePortal serves as the content provider (LTI Tool Provider), and Metacampus serves as the consumer (LTI Consumer) (see Forycka et al., 2025).

The course at ePortal "Video course on accessibility" was initiated by the Department of Accessibility at Wrocław University of Science and Technology (Wroclaw Tech). Its material builds on earlier video courses created within the EU-co-financed "Polytechnic of New Opportunities" project, which aimed to make the university fully accessible for people with disabilities. Drawing on extensive in-person training and webinars, the project produced five video courses for teaching staff, lab instructors, dean's office personnel, student service teams, and administrative/technical staff (including reception and cloakroom workers).

Preparing the two platforms ePortal and Metacampus for mutual communication begins with registering each system with the other, establishing a security contract between the Tool Provider (ePortal) and the LMS Consumer (Metacampus). For this, the ePortal administrator registers Metacampus as an LTI consumer, generates the necessary LTI credentials (key/secret, client ID, etc.), and securely transmits the connection details, including the launch URL, to the Metacampus administrator. Then, the Metacampus administrator creates an external tool entry for ePortal using the supplied credentials, then sets up an empty course and assigns the organiser role to the ePortal administrator. This delegation ensures that the technical linking of the two courses is handled by ePortal, relieving the course instructor of complex configuration tasks. Finally, acting as Course Organiser, the ePortal administrator publishes the "Video course on accessibility" as an LTI resource within ePortal, defining user-synchronisation settings (for the pilot, users must already have an active ePortal account to launch the course). In the empty Metacampus course, the ePortal admin adds an external link to the ePortal-hosted materials and enables the option allowing Wroclaw ePortal to submit grades to the Metacampus gradebook.

From the user's viewpoint, accessing the course feels like a single "click-and-go" action (see Figure 16). Thanks to the prior eduGAIN SSO login, their identity is already recognized, so no password entry or re-authentication is required. The link instantly launches the encrypted LTI handoff in the background, presenting the full course content as if Metacampus and ePortal were one seamless platform.

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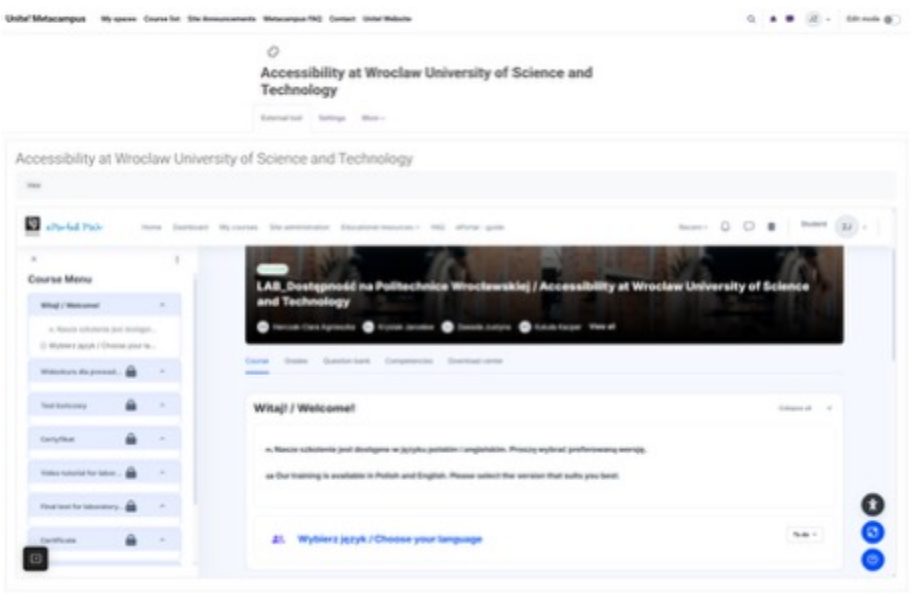


Figure 16: Screenshot showing the layout of the course, with a side menu on the left displaying the list of course activities (language selection, video lesson, final test, certificate)

The pilot aimed to enrol at least 50 academic teachers and gather detailed feedback on both the LTI integration and the course content. Promotion was done via the university newsletter and ePortal notices; although the summer-break timing limited full completion rates, the primary goal—validating the LTI workflow from the user's perspective and obtaining actionable course feedback—was achieved. Technically, the biggest hurdle was setting up the ePortal-Metacampus integration. Administrators should especially ensure security settings allow frame embedding (Site Administration → Security → HTTP security) so LTI tools can appear within an embedded window instead of opening separately. The pilot demonstrated that the integration is indeed possible and functional, but it is important to note that it only works for users who are registered in both systems. In contrast to the pilot by TU Graz, the ePortal allows user provisioning for this purpose.

7.8 Recommendations

Only some of the potential LMS pairings were tested or piloted. Concerning TU Graz pilots, compatible LTI versions across the TU Graz LMS, the federated Metacampus LMS, and the MOOC platform, with authentication based on matching existing user accounts on both systems were available. So, several possibilities with partner systems or alternative authentication (e.g., anonymous LTI-generated accounts) remain untested.

Our initial tests suggest LTI can effectively connect LMSs and improve daily teaching within European university alliances. A key benefit observed is the ability to maintain course material centrally on the federated system or MOOC platform; updates automatically propagate to connected courses (e.g., TU Graz), and assignment results appear seamlessly in students' home-university profiles.

Because KTH's LMS Canvas can only act as an LTI consumer, KTH cannot expose its courses as LTI providers to Metacampus, so we recommend using validated IMS Common Cartridge exports/imports and a streamlined, automated workflow to transfer content while avoiding the administrative overhead of untested LTI integrations.

Additionally, several challenges remain (see Table 13). Technically, missing LTI integration risks losing partners unless robust support is built; browser incompatibilities and account-linking

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problems require better documentation and admin access. Content migration depends on compatible plugins and possible adaptations. Legally, GDPR compliance is mandatory, though anonymous accounts may simplify matters; copyright concerns favour open licences (e.g., Creative Commons) with clear attribution across platforms. Organisationally, responsibility for content and service issues must be explicitly assigned to avoid confusion. In short, successful LTI rollout in European alliances hinges on solid support structures, GDPR adherence, careful copyright handling, and clear role definitions.

Table 13: Challenges and mitigation issues when using LTI to connect LMS in a European Alliance. Source: Originally published in Ebner et al. (2025a, 2025b).

Aspect	Challenges	Mitigation Issues (if)
Technical	LMS with LTI integration are needed	Support development (strategy, budget)
	Users with certain browsers (Safari, Firefox) had issues	Information, support
	Users have issues with the connection of their accounts or visibility of external content	Support, awareness, admin access to connected LMS
	Connection only works when users have existing accounts in both systems, or when the creation of new (LTI) accounts is possible in the provider. Otherwise, the system cannot act as an LTI provider. At Unite!, user provisioning is possible for Wroclaw Tech's ePortal, but not for TU Graz TeachCenter	-
	If content needs to be copied/transferred to another LMS, the same plugins and services need to be available, or content needs to be adapted.	Awareness, support, requirement analysis – perhaps adding plugins
	Canvas can only act as an LTI consumer, so KTH cannot link courses directly to Metacampus (Moodle).	Provide guides on IMSCC export/import with pros, cons, and limitations to simplify content transfer from non-Moodle LMSs.
	Duplication and multiplication of user data across all systems could pose a challenge.	Existing user accounts at both LMS required (but only in some use cases possible).
Legal	GDPR issues tackled	Organise access to data and adapt GDPR policy of connected platforms
	Integration of content from one LMS to another might cause copyright issues, especially when connecting platforms from different countries with differing copyright laws for educational materials	Providers agreeing on "minimal European standard" for networked LMS; using Creative Commons licenses such as CC0 CC BY and CC BY-SA; make copyright information visible to users of both platforms
Organisational	Dependency on external LMS providers challenges digital sovereignty	Organisational and legal cooperation.
	Responsibility for content and service might be unclear	New structures and communication amongst partners with connected LMS are needed.
	Information and training of all relevant stakeholders and teachers of this (complex) new possibilities	Adaptation of support materials, information of partners and support teams, communication to everyone
	Using and integrating LTI to combine LMS is – additionally to the effort of a joint online courses for Unite! – an extra effort for teachers and staff.	Incentives and support, already for pilot activities to test functionalities
	Information and inclusion of e-learning support of all institutions	Competence development, meetings, communication structure
	Content and courses in other LMS might not be available in same time frame	Establishing communication about these issues, bringing together service teams of different LMS
	General issue of losing partners without LTI integration	Support development (strategy, budget)

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Based on the current test results, no definitive recommendation can be made, for example, as to whether Metacampus should function as an LTI Tool Provider or as a Tool Consumer in future integrations in Unite!'s IT landscape. Additional trials, both within Unite! and potentially in other alliances, are needed to determine the most reliable configuration and to gather sufficient operational experience before a concrete direction and implementation can be endorsed.

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8. Metadata standards for course descriptions (T2.6)

Tomasz Kubik, Jesus Alcober, Roberto Bertonasco

This chapter also belongs to Task 2.6 work (see the preceding chapter). First, we briefly describe the current Unite! course catalogue, whose development did not involve Cm.2 - thanks to the strong collaboration with the Agora project and the responsibility of Cm.5 "Flexible Educational Offerings". . We then discuss the metadata considerations for a potential future course catalogue development and usage in greater detail.

8.1 Comment on current Unite! catalogue development

Within Unite!'s Erasmus+ project, several catalogue initiatives were carried out. One key objective was to present the offerings for staff and students in a structured catalogue format. The initial catalogue designs were created by the relevant communities and were intended to be displayed on the Unite! website. Because the Agora partner project, together with their business management system, possessed a suitable tool, the necessary resources, and a strong interest in providing support, the current catalogues were developed independently of Cm.2. Notably, the catalogue and the associated processes built through Agora are designed to be reusable and adaptable for other alliances.

8.2 Metadata for catalogues discussions within Cm.2

Since the project's start, a small, rotating working group has been tasked with envisioning how a future course catalogue should be technically structured, organised, and which features it must provide. To inform their design, the group examined developments from other alliances and invited presenters to the bi-annual Tech Meet-Up. For example, Axel Klinger from the EULIST alliance showcased a lightweight course catalogue approach in March 2025, outlining the specifics of the EULIST model.

Under the leadership of Tomasz Kubik, work began in April 2024 to gather metadata requirements for **course catalogues** and to systematically inventory and compare the existing systems within Unite!. The findings were presented in detail at the Unite! Dialogue in Darmstadt, where participants agreed to compile the outcomes into a written report that was published in December 2025 (Kubik et al., 2025).

Unlike many other publications, this effort adopts a very broad perspective and explicitly references the ECTS Users Guide as a foundational resource: The *ECTS Users Guide* (2015) illustrates how even a narrowly defined domain - course metadata - can generate a rich spectrum of legally required scenarios, including programme design, student-centred learning, teaching and assessment, and the processes surrounding admission, progression, recognition, and certification. In practice, these scenarios translate into the creation, exchange, and publication of numerous official and unofficial documents, both in print and on the web, and involve a wide array of actors (agents and organisations) operating under diverse processes:

- **Study programme** – design, approval, publication
- **Study plan** – design, approval, compilation, publication, search
- **Learning opportunities** – advertising, discovery, exchange
- **Learning agreement** – editing, signing
- **Certification** – issuing, confirming
- **Diploma supplement** – issuing
- **Credit transfer** – exchange, confirmation, mobility assurance

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- **Validation** – record-keeping for quality assurance and formal checks

Current discussions within alliances about course catalogues are dominated by the Enterprise Viewpoint (as defined in the RM-ODP framework). This viewpoint tackles the why: it clarifies the business objectives, policies, system scope, and organisational context that legitimise the catalogue-related processes.

From the working group's perspective, however, a truly comprehensive solution cannot stop at the Enterprise Viewpoint. It must also address the remaining RM-ODP viewpoints to ensure that data models, functional components, allocation of responsibilities, and concrete technical standards are all coherently defined and integrated:

- **Information Viewpoint** – defining the data structures and semantics required for each document and transaction.
- **Computational Viewpoint** – specifying the functional components and interactions that manipulate those data.
- **Engineering Viewpoint** – detailing the allocation of responsibilities, interfaces, and deployment constraints across institutions.
- **Technology Viewpoint** – selecting the concrete standards, protocols, and platforms that will realise the interoperable ecosystem.

Only by addressing all four viewpoints can the alliance move beyond the enterprise-level "why" and deliver a technically sound, legally compliant, and sustainably funded interoperability framework for European higher education.

The report by Cm.2 (Kubic et al., 2025) maps the different access approaches that can be used as a basis for jointly working with other Unite! stakeholders to carefully consider the purpose of alliance-wide catalogues (see the recommendation for Use Case 1 in the HEIF Framework (see European Commission et al., 2025).

8.3 Recommendations

Metadata is data that describes other data, providing context and meaning. Thus, the development of a metadata system intended to describe academic courses may, at first glance, appear to be a relatively straightforward task: it would seem sufficient to collect and organise the attributes commonly used in defining educational offerings, and then structure them within application schemas that would allow for their use in the publication, retrieval, and exchange of information among all interested parties.

However, the reality of building a universal metadata system that addresses the needs of a diverse range of stakeholders is considerably more complex. A more in-depth case study reveals numerous dependencies and contextual factors—visible from various perspectives—which significantly influence not only the structure of the resulting models, but also their semantics, level of formalisation, modes of use and integration within broader institutional processes.

In order to develop a robust metadata model, it is essential to first accurately identify and interpret terms used in the domain of interest. However, the vocabularies used within academic communities vary depending on tradition, culture, and other factors. The internationalisation of their content is not trivial. Not all terms can be directly translated from one language to another, as there are no exact matching candidates.

Thus, the development of a controlled vocabulary (or thesauri), collecting all recognised terms, with their definitions expressed in all languages used within Unite! community, would helpful. Some preliminary steps were already taken within Cm.2 (common terms used in course catalogues were collected).

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The vocabulary can serve not only as a base for "translation", but also as a reference source of matches with other vocabularies and ontologies. In addition, such a vocabulary could be recognised as a technology-agnostic tool. It means that following an idea of Hexagonal Architecture, it would be possible to implement adapters connecting different domains, performing data translations on the fly.

Looking at various sources and taking the technology viewpoint into account, "course metadata" appear as:

- form field labels (used to provide context, for example during data submission),
- headings and sectioning (used to organise presented content),
- hidden annotations (used for SEO),
- parts of the data exchange format (used along with appropriate API) etc.

Having the vocabulary and adapters defined, it would be easier to support such use cases. However, we need to discuss how such terms mapping should be done:

- externally to data sets, (if data are already encoded using custom schema, there might be a tool (adapter) that does specific "conversion" to "human readable form" using "rules" stored in an external "mapper" which would refer to external "academic vocabulary"
- internally to data sets, (if a data format allows assignment of "identifiers of declared terms" to appropriate properties/classes/attributes (annotating them), then a tool could do "conversion" just parsing these identifiers and consulting external "academic vocabulary" for a proper "label" to be displayed).

There is a big difference if the metadata model is used to "present data" or to "exchange data". The simple example of this issue is when someone produces pdf with printed learning outcomes. If these learning outcomes are represented by a pure text, then such definitions are not "uploadable back" to the system due to the loss of important dependencies. To make it clearer, let us consider the syllabus system. In this system, all "persons" are internally represented as "complex objects". After rendering the attributes of such "objects" in pure text form, the "object structure" is lost. The same happens when the printed/published "subject card" shows the name of the 'coordinator' as a string consisting of concatenated name and surname, but without unique references (identifiers) to the persisted data records. Thus, the highlighted issue should be considered when designing and using metadata models.

Table 14 highlights the challenges when considering metadata for a joint course catalogue in a European alliance.

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Table 14: Challenges and mitigation issues when considering metadata for a joint course catalogues

Aspect	Challenges	Mitigation Issues (if)
Technical	Collecting terms commonly used in academic domain	At first, it was helpful to use simple shared spreadsheets, see report.
Legal	Ensure compliance with the existing (European and national) legal frameworks	Several official legal acts and recommendations need to be analysed, see report.
	Ensuring compliance with internal regulations	Several internal documents need to be analysed, see report.
Organisational	Identifying use cases and processes implemented at universities where specific terms are officially defined and used	It would be necessary to consult with administrative staff, faculty members and other Unite! stakeholders, see report Kubic et al., 2025
	Include all relevant stakeholder in a European university alliance	Many stakeholders and people need to be involved to discuss and decide use case, development and more.
	Existing experiences or even how-to's on joint catalogue development does not exist in literature	See report Kubic et al., 2025

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9. Partner-hosted execution environment: Leveraging the Aalto servers for CodeRunner and STACK within the federated Metacampus LMS (T2.6)

Juha Martikainen

Another issue concerning interoperability is the integration of partner-hosted execution environments that is addressed in this chapter. This chapter also belongs to Task 2.6 work (see both preceding chapters).

9.1 Reasons to use partner-executed environment and its architecture

As digital teaching methods evolve, modern blended-learning environments increasingly require the ability to execute code and assess symbolic-math answers directly within the learning platform. Instructors want to embed live programming exercises - such as Python or Java snippets - right into their course material, while mathematics teachers need automated grading of algebraic expressions, integrals, proofs, and similar constructs. Relying on a single, centrally hosted instance for these services could create a bottleneck: it becomes a single point of failure, raises operational costs for every consortium member, and makes it harder to comply with data-sovereignty regulations such as GDPR or local university policies.

To address these challenges, the Unite! alliance adopted a distributed, partner-hosted model (see Figure 17). The server at Aalto University, owned and maintained by our partner, supplies the compute resources required for grading mathematical formulas and provides secure sandboxing for coding exercises. The solutions for these needs are served by open-source plugins for Moodle: CodeRunner for coding exercises and STACK for mathematical formula exercises. CodeRunner receives a student's source code through the LMS, compiles and runs it inside a separate JOBE server in an isolated container and returns the execution result. Similarly, STACK receives the exercise answer in LaTeX, uses a separate Maxima mathematical server to evaluate it against a reference model, and generates detailed feedback. For a federated LMS like Metacampus, utilising partner-provided resources for these separate servers is a logical way to more flexibly add features. When a learner submits an answer, Metacampus parses it, forwards it to the Aalto endpoint, receives the graded response, and presents it to the learner as if the service were native to the LMS.

However, it is important to recognise that deploying this model requires significant resources from universities. Partner universities need to invest in human resources and infrastructure to support server operations effectively and this represents an ongoing cost. Nevertheless, this investment is essential to maintain the quality and reliability of the service, ensuring that the infrastructure can sustain the demand while offering the anticipated benefits to all participating institutions.

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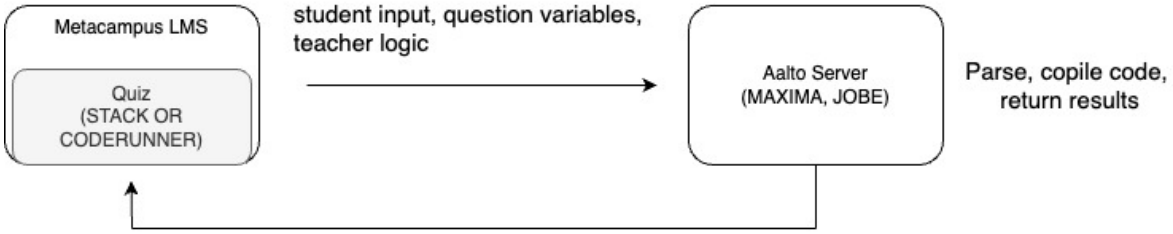


Figure 17: The distributed, partner-hosted architecture of partner Aalto's execution environment at the federated Unite! learning management system Metacampus

9.2 Implementation details and user experience

At Aalto University, the Maxima Computer Algebra System servers needed to run STACK are operated locally on virtual servers that are separate from the Moodle system. Technically, these servers are Linux virtual machines accessed through a load balancer, with Apache used to manage traffic. The versions of Maxima and STACK used depend on the needs of the Department of Mathematics at Aalto, and they are typically updated annually, with security updates performed regularly. In addition to the basic Maxima with STACK libraries, the servers run MaximaPool, a simple pooling service for Maxima designed for high-load environments. This setup allows multiple Maxima processes to run based on an image that includes Maxima and the STACK libraries. Essentially, a Maxima image with the correct STACK libraries, units, and resources configuration is built, which is then used by the pooling software to initiate several processes and scale as needed. Finally, the server uses Apache and Tomcat to serve the Maxima image, which is accessed by the LMS.

The JOBE server for the CodeRunner question type is designed for running small compile-and-run jobs in a variety of programming languages. Technically, a job sent via REST API to JOBE specifies a programming language, the source code, the standard input for execution, and an optional list of supplementary files. Jobe compiles the source code when necessary for the specified language and executes it using the provided input data. It then returns a run_result object that includes various status details along with the output and error output from the execution.

Unlike the Maxima servers for STACK, the JOBE server for CodeRunner is currently run on a Linux virtual server within Aalto's Microsoft Azure tenant. This setup allows for relatively easy updating of the JOBE sandbox with necessary libraries, such as SciPy and NumPy. It also facilitates the automatic scalability and updates of the server. However, operating the server in this manner incurs costs associated with using a cloud service, and Aalto is currently exploring the possibility of running CodeRunner on in-house services.

Both STACK and CodeRunner are Moodle question types, providing functionalities for questions within the core Quiz tool. These differ from regular question types, such as multiple-choice questions, due to the format of the questions created for the quiz.

In CodeRunner questions, the teacher can choose from the available supported languages, provide instructions and templates for the students to use, and specify the expected answer along with test cases and feedback. The actual execution of the student's code within the JOBE sandbox depends on the selected language, and the results are then interpreted in Moodle by CodeRunner.

In STACK questions, the teacher can define variables to be used in both the questions and feedback. The question itself is written in CAStext, which allows the inclusion of LaTeX mathematical notation and CAS commands in HTML. This section includes fields for student input.

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9.3 Recommendation

The integration of Aalto University's CodeRunner JOBE and STACK Maxima servers with Metacampus LMS demonstrates an efficient use of distributed computing resources to enhance educational assessment capabilities. This streamlined interaction enables Metacampus LMS to offer real-time evaluation and feedback without the need to manage a separate sandbox infrastructure, while ensuring data privacy and institutional autonomy for participating entities. This technical framework can easily be extended to additional partners, promoting a collaborative, cross-border educational ecosystem.

However, as with any technical infrastructure, there is a need for maintenance resources within the partner offering the infrastructure, which must be considered. In the case of Aalto's servers, this involves modifying the firewall restrictions and more closely monitoring the server loads due to the added demand. Another factor to consider is end-user support for partner services; realistically, providing support can be challenging with limited resources. In the case of the STACK and CodeRunner services, the versions and libraries used must also be considered, as they need to be consistent between both the providing partner service and Metacampus LMS.

Overall, infrastructure offered by partners is a relatively easy way to introduce features known and needed by teachers into the federated LMS. Even when considering the resources required by the offering partner, this approach demands less than would be needed to install and maintain a separate infrastructure solely for Metacampus LMS.

Table 15 gives an overview of challenges and mitigation issues that were collected in our activities.

Table 15: Challenges and mitigation issues when using partner's servers in a federated alliance LMS

Aspect	Challenges	Mitigation Issues (if)
Technical	Differences in version between partner's server vs. Metacampus LMS	Clear process and communication between partner's server admin and Metacampus maintenance
Legal	Depends on information processed in partner's server	Using partner's servers only for processes not involving personal information
	Services needing commercial licences	Features needing commercial licences cannot be run as partner hosted service, without contracts for licence costs and data governance.
Organisational	Resources needed from partner to maintain or admin the servers	Use of servers already in partner's infrastructure, automate updates and maintenance as far as possible. In the future, allocating some resources for maintenance and administrating for alliance might be needed.

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10. Copyright issues and potentials of OER (T2.3)

Martin Ebner, Sandra Schön, Katharina Gasplmayr, Jesus Alcober, Christian Hoppe, Joakim Petersson

The present chapter stems from the experience gained in T2.3 and from the existing expertise and developments at TU Graz (see also the lead of the Unite! Seed-Fund project "OER Courses"). It highlights the emerging need - particularly within European alliances - to establish copyright-compliant regulations that enable sustainable creation and reuse of shared learning materials. Although this aspect was not outlined in the original work plan, it has crystallised during the last years as a relevant topic. We have observed in Unite!'s own OER initiatives that open educational resources provide a valuable solution. Cm.2 cites OER as a promising development in internal strategy papers, T2.3 recommends OER in the "How to Use Metacampus" guide, and EU documents explicitly reference Unite!'s OER activities (see 12.2; European Commission et al., 2025, p. 23).

10.1 Copyright issues and challenges identified

Teaching in European university alliances like Unite! presents challenges due to the cross-border nature of digital education. Conducting joint lectures and online teaching within a university alliance like Unite! involves significant coordination efforts. There are also challenges related to copyright that affect teaching within the Unite! alliance. For instance, as shown in Figure 18, when an Austrian lecturer uses materials from a UK author (e.g. a chapter from an internationally recognised textbook) in a course and shares presentation slides via the alliance's Learning Management System (LMS), hosted by the Spanish partner UPC, several copyright and jurisdictional issues arise. Students from nine different EU countries - including Germany, Poland, Portugal, Sweden, Italy, Austria, Finland, Spain, and France - access this material, potentially triggering different national implementations of copyright exceptions and licensing requirements.

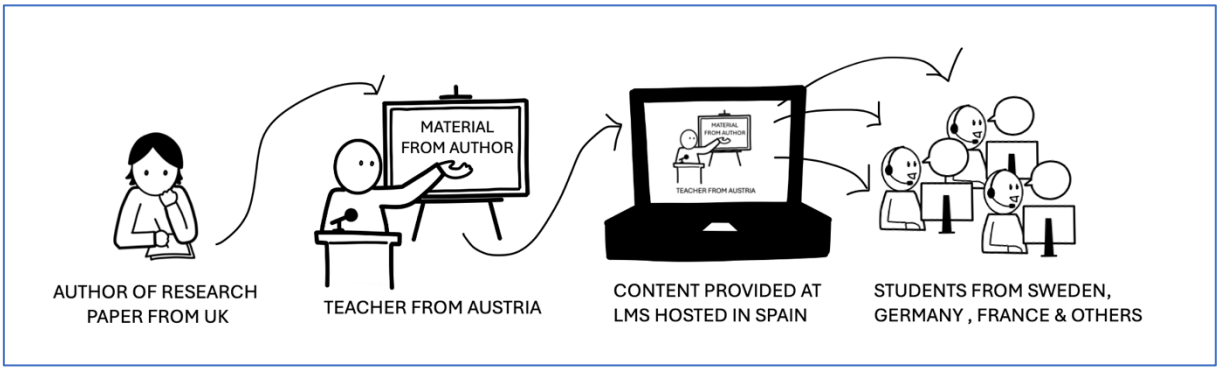


Figure 18: Teaching example and potential copyright implication in a teaching setting within Unite! Source: Schön et al., submitted.

In the European university alliance Unite!, the main copyright rule is the teaching exception introduced by **Article 5 of Directive (EU) 2019/790**, which permits the use of copyrighted works in a secure, non-commercial digital environment for educational purposes, provided the material is made available under the law of the Member State where the use originates. However, the scope of this exception remains unclear when a course involves only domestic participants (it is uncertain whether the EU-level rule applies) or when multiple countries are involved, forcing institutions to comply with the strictest national interpretation. Defining "non-commercial" use is also problematic: tuition fees for non-EU students, fee-based lifelong-learning programmes, or private partners can push a course outside the exception, requiring separate licences. The "secure digital

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environment" condition raises questions about how limited the audience must be – the current Metacampus platform (theoretically) reaches hundreds of thousands of users, and it is not yet settled whether this satisfies the "limited group" requirement. National transpositions further fragment the regime; for example, Austria's § 42g(3) excludes school-level materials from the exception unless a licence is obtained, limiting cross-border reuse. Finally, certain practices are unequivocally prohibited: using copyrighted material without a licence in open-access settings, adapting or translating works without the rights holder's permission, and distributing content to audiences outside the defined learner group (e.g., public MOOCs or videos on YouTube without an explicit licence). (Schön et al., submitted)

10.2. Open licences and OER as a solution

We have repeatedly noted in our reflections on effective teaching within Unite! that Open Educational Resources (OER) and open licences provide a legally sound way to share and adapt teaching material across borders. According to UNESCO (2019), OER are "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open licence that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (UNESCO, 2019). Because these resources are openly licensed, most commonly under Creative Commons BY, BY-SA or CC0, they eliminate the ambiguities that normally accompany copyright negotiations in multinational projects.

This **legal certainty** enables alliance partners to reuse content without fearing infringement, to translate materials into local languages, and to adapt them to specific curricula while preserving attribution. Moreover, the open nature of OER means that a single module created at one university can be deployed across the entire Unite! network, dramatically reducing duplication of effort and saving financial resources. The ability to update and remix resources continuously extends their lifecycle, supporting the **sustainability** goals outlined in the European Green Deal (cf. OER and sustainability Jakob et al. 2025a, 2025b).

Open licences also foster **digital sovereignty**: institutions retain control over their educational content and avoid lock-in to proprietary platforms, aligning with the EU's Digital Strategy. Because OER are freely distributable, they facilitate the creation of shared repositories that serve as a common knowledge base for all alliance members. Their **adaptability encourages collaborative pedagogical practices**, such as joint course design and peer-reviewed content creation, which strengthen the sense of community across the alliance. Finally, the open-licence framework makes it easier to **comply with EU open-science** mandates, linking teaching resources to research outputs and enhancing the overall visibility of the alliance's work.

Taken together, these advantages - legal clarity, reusability, translation ease, sustainability, and digital independence - make OER a strategic asset for any European university alliance seeking to deliver high-quality, borderless education. (Schön & Ebner, 2025; Ebner & Schön, 2026)

We have already seen how successful OER initiatives can be within Unite!, and the Unite! OER Courses project provides a concrete illustration of that experience (Schön et al., 2025): The cross-university effort brought together nine European higher-education institutions to design, translate and launch a multilingual MOOC and an accompanying international OER course, aligning the work with UNESCO's OER recommendations and the Open-Science agenda. Launched in May 2024, the MOOC attracted more than 1,400 participants and was complemented by capacity-building workshops that equipped educators with the skills to embed OER and Open-Science practices in their teaching. The project also generated a suite of openly licensed resources—including translations into Turkish, Indonesian, and Arabic—and reported marked gains in participants' digital-literacy and OER competencies, underscoring the transformative potential of collaborative, open-access education across Europe.

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The "Unite! OER Course" project has already turned OER into a permanent element of curricula – at TU Graz the lecture on OER is now a core module for teacher-training students and, from spring 2025, an OER-focused lifelong-learning offering for external participants, while at KTH, the same MOOC material underpins a 2-ECTS, self-paced course that attracted 53 learners in 2024. Across the alliance, the project seeded Open-Science training at Aalto, prompted a joint publication, and opened pathways for the MOOC's integration into PhD-level research-data-management and Open-Science seminars at PoliTO and teacher-education programs at ULisboa. (Schön et al., 2025)

So, in Cm.2, we also made sure that all **results for work package T2.3** were released exclusively under an open licence, so that assets such as the "How to use Metacampus" course remain freely usable even if a partner or individual leaves the consortium. Because the material is openly licensed, any partner organisation can translate, adapt, or redistribute the content without needing additional permissions, guaranteeing continuity and easy localisation across the alliance.

Since the summer of 2025, the "How to use Metacampus" course FAQ has explicitly stated that authors retain all their rights while we simultaneously recommend the use of open licences.

10.3 Recommendations

The challenges outlined in Table 16 are drawn from our experience across a range of contexts. In particular, the legal challenges are collected addressed specifically in a work by Schön et al. which is not published yet.

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Table 16: Challenges and mitigation issues referring to copyright and open educational resources

Aspect	Challenges	Mitigation Issues (if)
Technical	OER repositories could be connected to the Metacampus	Not requested so far
	Copyright information and OER metadata need to be transferred in LTI/integration cases	Currently not requested
	Access to an OER repository for all teachers within Unite!	Federated OER repository would be an option Usage of European platform such as Zenodo TU Graz allows uploads for all partners who hold the Austrian OER certificate.
Legal	Closed and secure digital environment – uncertainty whether the current Metacampus platform satisfies the "limited-group" requirement of Article 5 of the EU-Copyright Directive	eduGAIN is used for institution-based authentication and role-based permissions Nevertheless, currently there is no generic limitation of access to a "limited group"
	Divergent national interpretations of EU Article 5	Solutions might be: Produce a Legal Compliance Handbook that summarises country-specific nuances for all partners Set up a joint legal counsel (or hotline) within the alliance to advise on concrete cases
	Definition of "non-commercial" - Tuition fees for non-EU students, lifelong-learning programmes, or private partners may push a course outside the exemption.	Solutions might be to offer separate course tracks for purely non-commercial delivery versus fee-based programmes. Roles within eduGAIN would need to be adapted for this.
	Users might encounter (unknown) copyright problems, e.g. when sharing textbooks (not allowed under Austrian law).	Clear advice and expert knowledge needed
	Only open licences (CC BY, CC BY-SA) are helpful to limit copyright issues within international cooperation and must be streamlined for all.	An Alliance-wide recommendation/policy would be helpful.
	OER is not a solution for all possible copyright issues, e.g. differences in public domain rules (in Italy for photos 20 years after death, in Austria 70), citation rules might be different	Knowledge exchange and awareness building
Organisational	OER is still limited in the field of higher education	Supporting the future development
	Copyright in international cooperations and OER knowledge is limited – guidance and support are needed.	Competence development should be fostered, support should be available at all partner universities.

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11. Cross-institutional IT-management for teaching in an alliance (T2.1)

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In this chapter, we aim to highlight our coordination work and potential distinctive aspects and developments of our management approach in the view of the authors of this Deliverable for the E+ project (Cm.2).

11.1 Coordinating IT development amongst nine universities

In November 2022, TU Graz assumed responsibility for the "Digital Campus" work package under the second Erasmus+ funding line for alliances (11/22 – 10/26). Together with Wrocław Tech, TU Graz entered the alliance as a new partner, bringing the consortium to nine institutions from nine countries and eight different languages. The Erasmus+ project proposal had already laid out a detailed focus and a set of concrete tasks for the development of a federated learning management ecosystem, but as the project progressed, the exact scope of many of those tasks remained ambiguous. At the same time, additional initiatives were launched within the alliance—most notably the introduction of the Agora platform in 2023. Agora, built on the Odoo business management system, was added because several partners were also involved in the EU-funded aUPaEU project and needed a robust content management solution alongside the existing Metacampus environment. To keep the **growing list of requirements, integrations and technical constraints visible to all partners**, a formal process and a "Technical Commission" were established in mid-2023 and are described in the following paragraphs.

An important lesson learned is described by Ebner & Schön (2025), who authored a post on a German university blog about the management of the digital campus work package in Unite!. In their contribution, they stress the importance of **avoiding premature conclusions** and instead systematically mapping differences and similarities across partner institutions. Their key recommendation reads: "Do not make any hasty assumptions - systematically work out differences and similarities." The authors note that the challenges they face within the Unite! alliance are mirrored in more than sixty other university alliances. They emphasise the need for open exchange of ideas and experiences, observing that - even when formal standards or European regulations (e.g., data protection rules) are in place - each university interprets and implements them in its own way, a reality that extends beyond purely technical matters. Consequently, they have adopted a routine of first taking stock of each partner's practices, often beginning with clarifying terminology ("What exactly do you mean by that?"). Although this systematic approach can be labour-intensive, it frequently uncovers unexpected insights and reveals the unique characteristics of their own alliance. (see Ebner & Schön, 2025)

Additionally, providing services without a clearly defined need or usage scenario is tricky and often leads to inefficiencies. This problem is especially apparent for the Metacampus, where a sizeable support infrastructure was established despite the expected high demand not materialising so far. This situation arises partly because there are no **formal business process descriptions** that tie the required technical systems to concrete functional objectives, making it difficult to justify the deployed resources. The cross-university collaboration, which involves participants speaking different languages, frequently cause ambiguous interpretations of requirements, so conceptual misunderstandings only become evident later. To address these challenges, we recommend developing comprehensive, standardised business process documentation for each (future) service, and instituting an iterative review cycle to regularly compare actual utilisation against

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forecasts. By adopting these measures, future deployments can better align resources with genuine user needs, reduce unnecessary overhead, and minimise the risk of hidden conceptual mismatches.

As shown by a paper co-authored by a Cm.2 member, there are a lot of **practical implications for topics that should be explored when planning a collaboration in higher education teaching** (Linse et al., 2024) - some examples: Designing digital education collaborations requires clear responsibilities for platform maintenance, defined roles and incentives for teachers, students, administrators, and IT staff, and explicit authority over course creation, enrolment, and credentialing. Additionally, the purpose and privacy implications of learning analytics and the integration of non-university partners for lifelong learning must be addressed. Choosing a model involves weighing these factors against the overall ambition, whether it is a specific shared platform or a broader national-scale initiative.

In addition to the coordination within Cm.2, we can address here the different transversal events and sessions we hosted for other alliance members and Communities during the Unite! dialogues, which are biannual meetings of Unite! people at a partner location. Here, the goal was to create awareness of and inform others about the Unite! Digital Campus as a whole, and to get into discussion with other stakeholders and target groups of the Digital Campus to specifically discuss the needs, evolution, and critical issues. The events include till December 2025:

- 28.02.2023, 16:30-18:30: Open event at Grenoble Dialogue: Digital Campus (Cm.2) market place event for stakeholders from Unite! Communities (E+) and other stakeholders
- 28.02.2024, 09:00-11:00: Transversal workshop at Graz Dialogue: workshop on Unite! Metacampus
- 28.02.2024, 14:30-16:00: Transversal workshop at Graz Dialogue: Cm.2 workshop on European Student Card
- 28.02.2024, 16:30-18:00: Transversal workshop at Graz Dialogue: Cm.2 workshop on joint programmes (closed session)
- 25.09.2024; 11:15-13:00: World Café session during Darmstadt Dialogue: "(Future) needs for the digital infrastructure for Learning & Teaching Unite!"
- 26.02.2025, 18:30-19:30: Transversal workshop during Barcelona Dialogue "Cm2 Future of Unite! digital infrastructure"
- 08.10.2025, 10:00-11:30: Transversal workshop "Mix&Match§ during Aalto Dialogue about business management processes and IT systems/tools for joint programs
- 01.02.2026, 9:00-10:30: Joint workshop with Cm.5 "Flexible Educational Offerings" /Cm.4 "Innovative Teaching and Learning"

11.2 Implementing governance structure: The Technical Commission

Whenever a request cannot be resolved by the first-line support team or demands substantial technical or financial effort, it is escalated to the Technical Commission. This body, composed of **representatives from each university**, evaluates the feasibility of the proposal, reaches consensus on the decision, and forwards any broader implications to the alliance management. An illustrative case was the request to admit external users to the federated LMS - a decision that required careful assessment of security, licensing and budgetary impact before being approved.

If necessary, other stakeholders such as working groups, Communities or the Secretariat are included, especially if strategic decisions are required and if there are broader implications to the alliance management.

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Monthly meetings of the Technical Commission are held to support the decision-making process and keep it fast for those who request it. In summary 21 meetings, 26 feature requests were discussed in total, of which 17 have been implemented (as of September 2025). An illustrative case was the request to allow external users to access the federated LMS. This decision required a careful assessment of security, licensing, and budgetary impact and it was further escalated to the governing bodies of the alliance for a strategic decision. Other discussed requests include, for example, configuring open badges on Metacampus, connecting Metacampus to other partners' LMS via LTI, or adding new features, such as an accessibility toolkit or a plugin for grading. In addition to the feature requests, other current issues that arise during daily business and pertain to the Unite! Digital infrastructure is discussed in the regular meetings.

In order to illustrate the complexity of the entire process, a flow chart was developed showing the individual steps and defining the procedure. This was initially developed in several iterations and then coordinated within the alliance with several stakeholders. The following graphic shows the process representation and thus also describes how the processes around the Technical Commission flow (see Figure 19).

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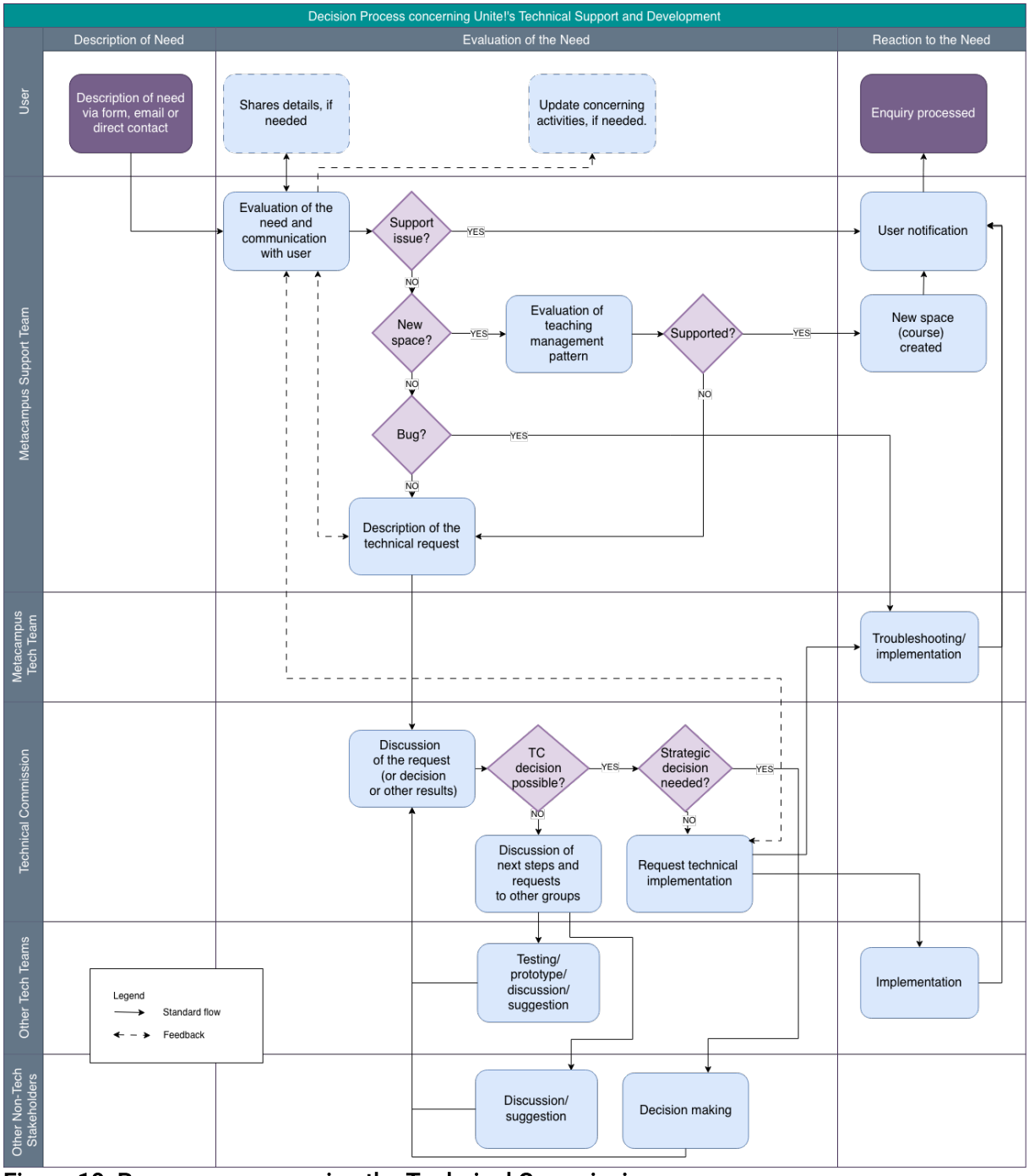


Figure 19: Processes concerning the Technical Commission

11.3 Central form and business processes

In all issues related to IT within the Unite! and to support a fluent reaction and administrative support, a **request submission system** has been implemented. This allows users or groups or projects to submit questions, feature requests, and problem reports in one place, ensuring efficient and well-documented support processes (see Figure 20).

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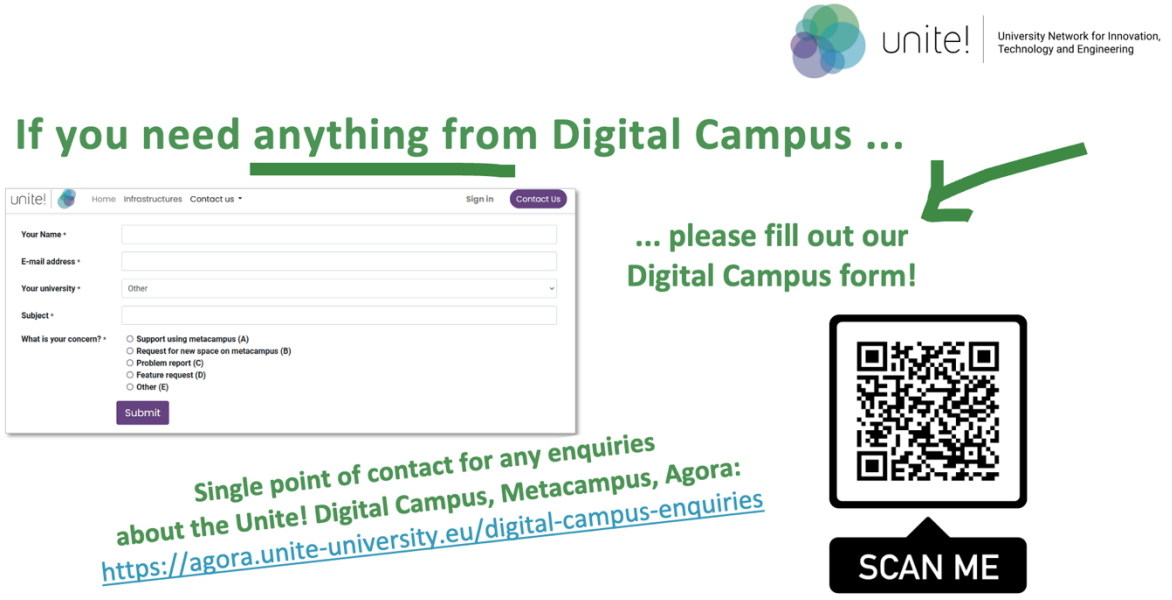


Figure 20: Screenshots of the contact form for any issues related to the digital campus including the Metcampus. Sources: Screenshots https://agora.unite-university.eu/digital-campus-enquiries (2025-02-13)

For requests that are not regular support issues, the implemented Technical Commission plays a central role in ensuring the stability, interoperability, and continuous improvement of the Metacampus infrastructure (see Ebner et al., 2024b). It is responsible for evaluating technical developments, overseeing system integrations and addressing challenges related to platform compatibility across Unite! partner institutions. Regular meetings facilitate collaboration between IT teams, ensuring that technical decisions align with the strategic goals of the alliance while maintaining a user-friendly and scalable digital learning environment.

11.4 Quality assurance processes within Cm.2

To lay the groundwork for reliable project management across the entire Cm.2 community, we outline the key measures and processes that guarantee consistent quality despite personnel changes and evolving project demands concerning quality management (QM).

Ensuring the quality of project management for all participants in Cm.2 has proven to be a fundamental challenge, especially because the project has experienced several personnel changes among the partners throughout its lifecycle. From the very beginning, we addressed this difficulty by introducing a comprehensive **handbook for Cm.2**, which is sent to every new member and is also presented on all slide decks used during the monthly Cm.2 meetings. The handbook clearly outlines the core objectives, extracts from the Declaration of Agreement, the agreed-upon procedures, and the organisational structures, and it dedicates a section to the quality assurance processes defined for Cm.2.

In parallel, we have worked closely with the **Unite! QM team**, as well as the designated contact at TU Graz, to define and continuously refine quality targets and processes; these discussions have led to concrete adjustments that reflect the evolving needs of the community. A crucial source of input for these refinements has been the bi-annual survey of all Cm.2 contributors, an anonymous questionnaire that captures current sentiment, wishes, suggestions for improvement, and perspectives on future work. Conducted every six months, the survey results are evaluated, presented to the community, and debated, guaranteeing that every member has a clear picture of

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our goals and the path to achieve them. This regular feedback loop enables us to react swiftly to timeline shifts or unexpected events, while the Technical Commission, involving all partners, ensures that feature requests are handled with care and that decisions incorporate the views of every stakeholder. Throughout most dialogues, a dedicated slot for QM representatives is reserved to discuss upcoming QM cycles, expectations, and deliverables, and we hold regular meetings - twice per quarter, with additional sessions as needed - with the QM advisor from TU Graz to review community feedback, update on the latest QM developments, and adjust QM cycles and reporting when necessary. All these coordinated actions collectively safeguard the quality of project management across the Cm.2 community.

11.5 Ensuring openness and exchange: Tech Meetup series

At an early stage during the project, we recognised the opportunity to exchange ideas with our project partners by means of a technical meetup (Tech Meetup). Idea behind the Tech Meetup: Short meetups (1 hour with 20-40min input, then questions and discussions) with inputs of partners on a (very) technical base for all who want to join.

Since the start till December 2025, we had 6 Tech Meetups covering the topics:

- Open source in IT services at TU Graz
- Blockchain verified micro credentials in learning
- Agora: Empowering research and education in university alliances with a digital campus acceleration tool
- Use of LTI - experiences at TU Graz
- Approaches to course catalogues in university alliances (external expert: Axel Klinger, Chief Technology Officer, Leibniz Information Centre für Science and Technology, University Library, alliance)
- Navigating generative AI in Higher Education at Aalto

11.6 Recommendations

There are several recommendations we would like to share with other European alliances that are:

- The establishment of a technical commission may be advisable in any case, as the discussion of possible technical solutions is very complex. This is due to various technical possibilities, but also to other approaches or organisational and legal framework conditions.
- Regular meetings are also recommended because all processes that arise in the alliance usually require digital support.
- The use of a technical commission also allows quick access to local experts, as the issues can very quickly go beyond the expertise of the commission and require specialised knowledge.
- It has also become apparent that many questions are not of a technical nature but require other expertise (e.g., data protection), so it is recommended that additional commissions be set up to enable rapid responses.
- In any case, the Technical Commission can also jointly work on general development trends that are central to European educational institutions and to make recommendations (examples include digital sovereignty or the use of open-source systems from a sustainability perspective).

Table 17 summarises challenges and mitigation issues.

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Table 17: Challenges and mitigation issues concerning the coordination of IT related groups in a European university alliance with the help of a Technical Commission

Aspect	Challenges	Mitigation Issues (if)
Technical	Many requirements of varying complexity	Technical Commission can quickly assess these, respond accordingly, or take action (e.g., forwarding to other expert groups)
	Differences in IT infrastructures at partner universities	Overview of IT infrastructure of all partners enhances understanding (see Ebner et al., 2024)
Legal	Different regulations on e.g. GDPR, depending on the country	Forwarding to relevant experts as counterpart within the alliance (if available)
Organisational	Quick and clear coordination between partners concerning technical decisions	Establishment of a technical commission.
	Communication issue; technical issues and decisions are not always easy to communicate, specifically to other alliances stakeholders and boards	Regular meetings
	Implementing a technical as single way for new technical developments and adaptions across several European projects	Communication, potentially a formal agreement

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12. From vision to reality: Unite!'s forward-looking tole in Europe's higher-ed IT landscape

Joakim Petersson, Martin Ebner, Jesús Alcober, Roberto Bertonasco, Jules Diard, Alexandre Francisco, Katharina Gasplmayr, Christian Hoppe, Markus Koschutnig-Ebner, Jaroslaw Krysiak, Agnieszka Szymańska-Kwiecień, Juha Martikainen, Joakim Petersson and Sandra Schön

In the concluding chapter of this report, we outline a forward-looking outlook that highlights the most pressing topics still awaiting attention — such as sustainable financing for the alliance's digital backbone. These emerging issues will shape the next phase of Unite!'s work and should be integrated in the future research, policy, and implementation efforts of a future digital campus team.

12.1 Driving collective innovation: Unite!'s commitment to joint knowledge exchange

Unite! has cultivated a set of core competencies and **pioneering developments** that influence the European interoperability in IT-enabled teaching and learning across university alliances. To mention some of these described in this report as well:

- Unite! is potentially the alliance with the **longest experience with a federated LMS** – Metacampus is now 6 years old - only 39% percent of alliances had an LMS in 02/2023 (Ebner et al., 2024).
- Connecting **LMS via LTI in higher education has never been done** in a similar way before (Ebner et al. 2025a, 2025b).
- To our knowledge, until now, **no other alliance has shared detailed IT infrastructure** for learning plans and descriptions such as in Ebner et al. (2024).
- We did not recognise a similar implementation of a **governance structure** for co-equal IT-related decisions as the **Technical Commission** (at least not in publications referred to in Google Scholar in 09/25).
- Unite! shares details on student card implementation of all partners and exemplarily **ESC implementation** at PoliTO and UNG (as part of INP-UGA, Bertonasco et al., 2025)
- Unite! published an overview of relevant meta data standards and potential issues and soutions when streamlining for a joint course catalogue (Kubik et al., 2025)

Unite! is driven by an ambition that goes far beyond merely keeping its own solutions up to date; the alliance actively seeks to **exchange experiences with other university alliances** because true sustainability and impact can only be achieved through the development and adoption of common standards and shared processes. Over the past three years, Unite! has contributed articles to international journals, presented at leading conferences, and taken a leading role in national forums, all with the explicit goal of fostering interoperable, reusable architectures that benefit the whole European higher education ecosystem (see TU Graz, 2025; references in chapter 1, see Figure 21). By positioning itself as both a test-bed for innovative services and a catalyst for cross-alliance dialogue, Unite! helps ensure that the digital campus evolves as a collective, future-proof infrastructure rather than a collection of isolated pilots.

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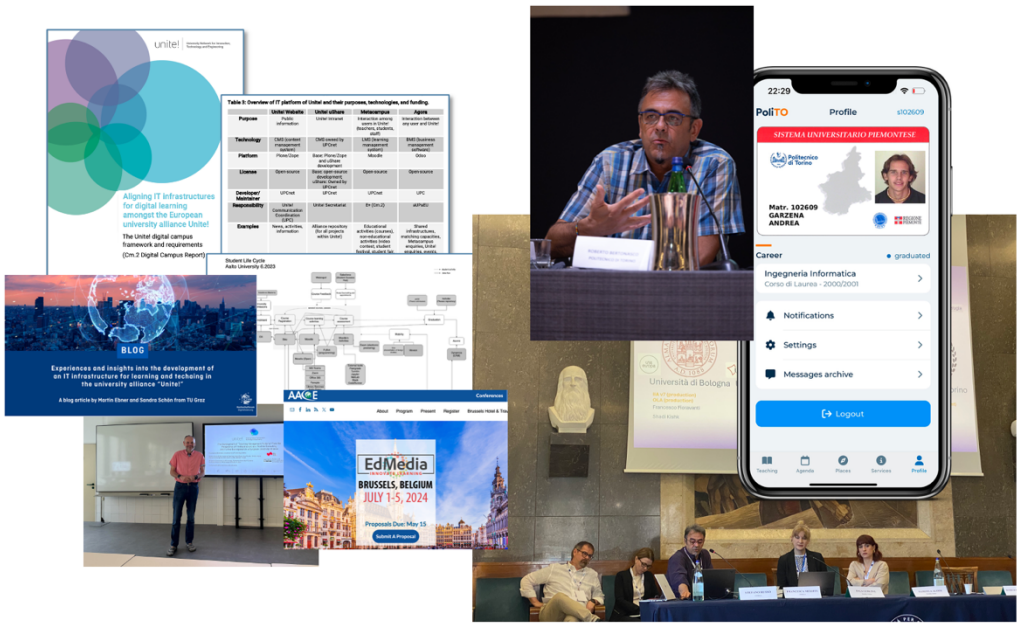


Figure 21: Snippets and photo collection from Unite! digital campus related publication and presentation activities. Please note: © for the photo of Roberto Bertonasco: European Commission, Screenshot of the App © PoliTO

Following the release of this report, we will circulate it widely - most prominently at the **Unite! Dialogue 2026** in late-summer Stockholm - and leverage additional workshops, webinars, and conference sessions to showcase the findings to other university alliances across Europe.

12.2 Evidence of impact: Unite!'s highlighted contributions to European Interoperability Frameworks

Unite! is positioned in two of the most important reports concerning IT developments and interoperability issues of European university alliances as a leading IT innovator shaping the European higher education landscape in the last two years, with several references highlighting its pioneering role in advancing interoperable digital solutions across university alliances.

The report **"Making Interoperability Work"** (Berger, Galati & Witteler, 2023) examines the barriers and solutions for achieving technical, semantic, organisational, and legal interoperability among European university alliances. Through four use case studies - joint course catalogues, joint enrolment, joint learning platforms, and joint micro-credentials - it identifies systemic governance challenges and offers recommendations for policy makers, institutions, and stakeholders to foster coordinated, cross-border collaboration in higher education.

Unite! is listed as one of the twelve selected alliances (see p. 10), and the Metacampus concept is referenced repeatedly—including a description of the Unite!-specific enrolment workflow for courses (see p. 33)—whereas other institutions still rely on manual checks of student eligibility for alliance-wide courses (e.g., the EDUC alliance, see p. 32). An example of how Unite! is mentioned is displayed in Figure 22.

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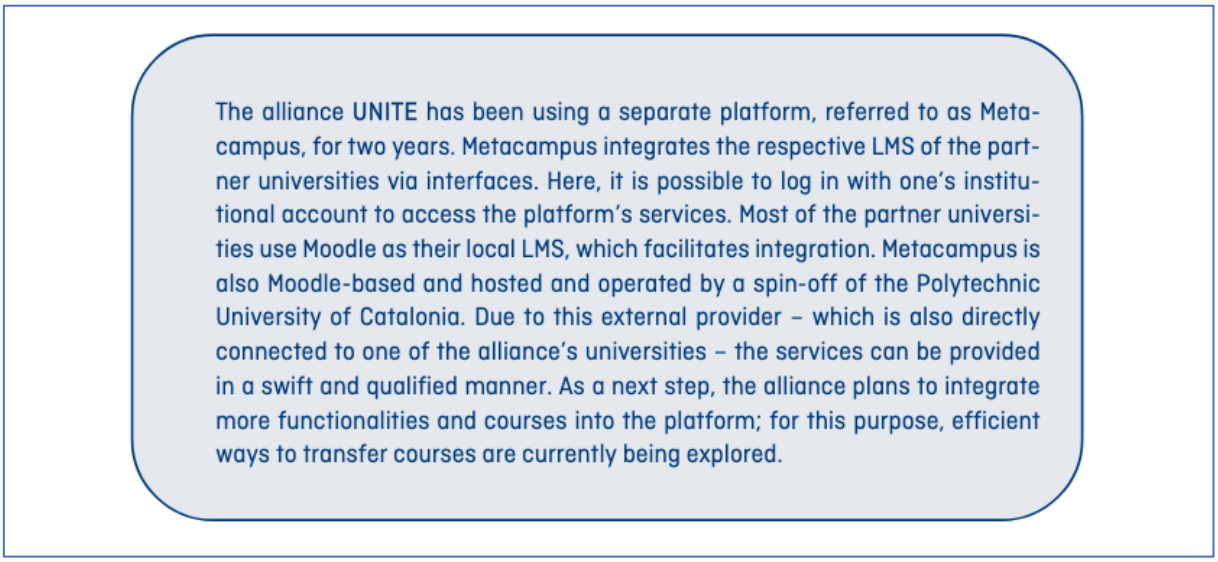


Figure 22: Screenshot of the study by Berger, Galati & Witteler, 2023, where Unite! is mentioned several times. Source: Berger, Galati & Witteler, 2023, p. 40.

Unite! is highlighted in the **Higher Education Interoperability Framework (HEIF) Synthesis Report** (European Commission et al., 2025a) as one of only two alliances singled out for special attention (p. 23):

> *"Unite! has fully implemented existing solutions like Moodle, OpenBadges, and eduGAIN… Many of the solutions in place in this alliance are open-source tools… The alliance has conducted a thorough analysis of the challenges ahead and partially identified solutions. For instance, regarding the differences in copyright rules across European countries and the cross-country use of materials, a solution could be using Open Educational Resources (OER) or further investing in technical means."*

The explicit reference to OER not only acknowledges the broader work of the alliance and Unite!'s OER activities at the European level. This endorsement serves as a clear confirmation of the alliance's progress and provides a solid foundation for expanding OER-focused initiatives in the future.

Remarkably, in this context, the **view count for our first report** "Aligning IT infrastructures for digital learning amongst the European university alliance Unite! - The Unite! digital campus framework and requirements" (Ebner et al., 2024) is noteworthy given its niche focus: as of 09/2025 it had already been accessed 880 times and was downloaded over 450 times (only the key version in the TU Graz repository).

We remain ambitious about fulfilling our self-defined role as a technology-driven alliance. To that end, we are making the data and IT infrastructure of the **EduXS project** (2025) openly visible and are actively contributing to the IT working group of the broader alliance project **FOREU4ALL** (2025). In parallel, we have successfully applied to become an early adopter of the **Higher Education Interoperability Framework (HEIF)** and are closely monitoring the evolving activities of the European HEIF community and the planned multi-stakeholder coordination group on HEIF (see Figure 23). So far this activity resulted e.g. in highlighting the Technical Commission (see chapter 11) within the slides of a **EDEH workshop for European alliances** (EDEH training module 4, mail by Channa van der Brug, Januar 2026). The report by Kubik et al. (2026) was as well as actively **recommended to the EDEH group** as part of communication and work on the HEIF framework. In January 2026, Unite! got invited to present Unite!'s HEIF use cases and related activities in the **HEIF Interoperability Working Group Online Community Conference** (Schön & Bertonasco, 2026).

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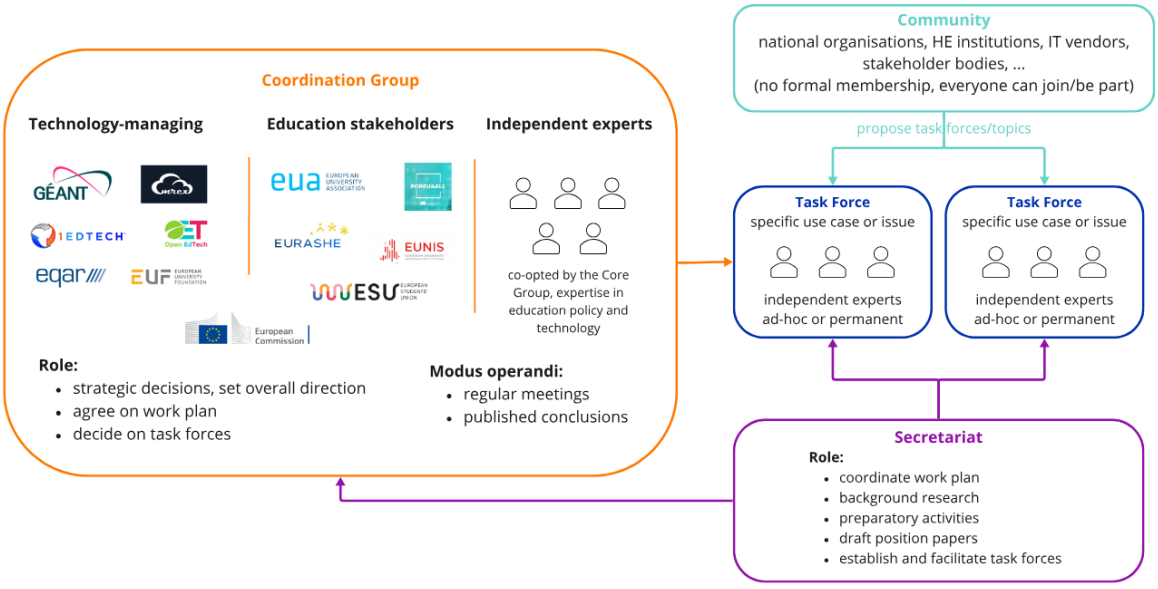


Figure 23: Proposed Coordination Structure for a Multi-Stakeholder Coordination Group on European Higher Education Interoperability. Source: European Commission et al., 2025b, p. 10, Note: © European Commission.

12.3 Securing sustainable funding for the alliance's IT infrastructure

Beyond the life-cycle of the Erasmus+ grant, the digital campus must be kept operational, updated, and administratively managed. The current model relies heavily on project funding and in-kind contributions from partner institutions, but without a dedicated, long-term financing scheme, the high-quality services that were built during the project could not be maintained. A sustainable funding framework - e.g., a multi-year service-level agreement, shared cost-allocation formula, shared infrastructure with joint responsibility and comparable effort, or a subscription-based pool funded by all members - will be required to cover hosting, security patches, staff salaries and governance activities, thereby preventing a collapse of the infrastructure once project-specific cash flows cease.

12.4 Filling gaps in alliance-wide functional infrastructure

While several business processes have been developed across Unite!, key fitting technical building blocks are still missing. A prominent example is the absence of a federation-wide, user-friendly study registration system that can be accessed by all partners. Future technical work-streams might be needed to prioritise the design, implementation, and governance of existing and other missing services, ensuring that the alliance can scale its digital offerings without relying on ad-hoc, partner-specific workarounds.

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