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Abstract	This document is an update of the previous blueprint created for the Pilot phase of EDUC. It contains new infrastructure proposals, updated strategies and procedures, and it includes new requirements from all the tasks that require digital services in their work packages during the starting period of EDUC II.
Keywords	Infrastructure, digital, blueprint, resources, computing, services, EDUC.







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I. Introduction

The current version of the EDUC Technical Blueprint has been designed primarily to cater to the diverse needs of four distinct readerships who are target groups of EDUC 11:

- 1) Steering Committee members
- 2) Task Leaders/groups
- 3) Pedagogical engineers, project managers, community managers and EDUC staff in general
- 4) IT Experts (involved in T1.3 and T2.1).

Each chapter has been crafted with these users in mind, ensuring that all the relevant information is presented in a manner that suits their specific requirements.

For the steering committee members and task leaders, an overview section at the beginning of each chapter provides a high-level understanding of the updated EDUC IT infrastructure, its improvements, and their relationship with work packages and the needs of specific tasks. This means they can quickly grasp the project's progress and any anticipated needs for development and strategic decision-making in the future.

A more detailed section emphasizing the more pragmatic aspects of the implementation is aimed mainly at pedagogical engineers, project managers, communication managers, and EDUC staff in general.

Finally, the IT Experts involved in T1.3 and T2.1 will find a section covering technical aspects in depth in the chapters that require detailed specifications to be provided for each component of the EDUC Digital Infrastructure (EDUC DI), including architecture, software, hardware, and infrastructural/networking requirements.

This document can also be seen as a roadmap to obtain an overview of the achievements attained during the EDUC Pilot Phase (Oct 2019 - Dec 2023), the Transition Phase (Jan - Dec 2023), the EDUC II - medium-term rollout (Jan 2024 -Jun 2025) and EDUC II – long-term rollout (Jul 2025 – Dec 2026).

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In the "Foundations" section, we detail key features of the EDUC DI as they were established during its pilot phase. Following this, the document outlines the transition phase. During this time, the Universitat Jaume I and the University of Cagliari assumed the primary responsibility for developing the EDUC DI, taking over from the University of Potsdam, which led the initiative during the pilot phase. Finally, the document outlines the subsequent stages: the medium- and long-term phases, which cover the conceptualization, development, and implementation of the EDUC DI throughout the EDUC II rollout period.

II. EDUC I: the pilot phase

The central goal of work package 4 in the EDUC I stage was to create a jointly used IT infrastructure and portfolio of web services for international learning and teaching activities within the alliance. This IT infrastructure and the IT services offered to students and staff within EDUC needed to be interoperable with the local IT systems of the consortium member universities.

Automatized data exchange methods created opportunities for a joint authentication of the EDUC IT services based on usage of home credentials, to provide a new type of a user journey from local IT services to the use of the EDUC services and innovative EDUC functionalities, such as an EDUC catalogue of virtual and physical course mobility. Common architecture and data standards needed to be established for the components of the EDUC ecosystem that interacted with each other across institutional and national borders. In its next step, the EDUC portal aimed to offer a growing portfolio of web-based IT services to EDUC students and staff via a central point of entry. These services could be centrally hosted by the EDUC alliance or shared (federated) by the partner universities via the EDUC portal. The paradigm of sharing and collaborating guided the development of the planned federated IT infrastructure.

1. Foundations: final status of the EDUC I digital infrastructure

A range of core services were defined as part of the development of EDUC I. This included the creation of various services under the umbrella of the EDUC portal:





Sustainable EDUC V	irtual Campus				
	Web	opage			
EDUC Portal					
Social Netwo	ork Fede Identity Manag	erated & Access gement	Course C	atalogue	Project Management
Shared IT Serv	/ices	-	Share	d LMS	Tools (e. g. Wiki for
New Admin. Services Tools	Existing Services		Media Server	Micro Credentials	Intern. Offices)

Figure 1: Graphic representation of the EDUC Portal.

Due to external circumstances and limitations, not all requirements could be implemented. However, the basic system design created the structure for further developments. The technologies and frameworks used provided the foundations. As illustrated in the pilot phase, it was not possible to implement everything.

2. Users' roles and responsibilities

The following list of roles was defined and integrated during the development of EDUC I services.

Teachers

Teachers are educators from the members of the consortium who would like to give lectures at the digital university. They have an average technical skill set, including a basic knowledge of common online learning tools. They usually have their preferred learning tools, and specialize in using them.

They usually own a user account in at least one of the EDUC partner universities. As they are giving lectures within EDUC they are probably interested in physical or

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virtual mobility within the alliance. In their teaching, they use their individual university's learning management system and perhaps some specialized tools provided.

Researchers

As one of the principal groups working at universities, researchers are key stakeholders in the building of integrated European Universities. As such, they were addressed specifically via the EDUC-SHARE (H2020) funding leg of the European University Alliances. As the two funding schemes complemented one another and needed to rely on joint infrastructures, we have listed researchers as users here in order to provide a comprehensive overview of our alliance.

Researchers do not only give lectures and seminars within the parameters of the EDUC digital university campus, but they are also keen on networking, finding opportunities for inter-institutional cooperation and joint applications to calls in the European Research Area (ERA), which was further addressed within EDUC-SHARE.

They have a highly diverse technical skill set, and their usage of digital networking and teaching tools vary depending on their discipline. We have found that they usually have preferred and established networking tools (such as ResearchGate, Academia, and to some extent LinkedIn). As they possess a user account at least one of the EDUC partner universities, they can principally access the EDUC digital campus components, primarily EDUC Moodle and also in the future, the EDUC OpenUP networking platform via SSO.

Students

Students are enrolled in one of the EDUC partner universities, and therefore own a user account at that university. Like teachers, they possess an average technical skill set with a basic knowledge of online learning tools. They are interested in participating in learning opportunities with students or teachers from other European universities, and they may join the physical or virtual mobility programmes offered by the alliance.

Pedagogical Engineers





Pedagogical engineers provide help to members of the first two user groups in the event of problems with the digital infrastructure or usage of the platform. They should be located close to the infrastructure's users, and speak their native language to mitigate communication problems. Some knowledge of foreign languages may be expected as they may act as points of contact for mobility students. They have advanced technical knowledge of the platform's components.

Administrators

System administrators ensure the availability and security of the EDUC IT platform components. They were located at the University of Potsdam, which was responsible for the development and the operation of the technical infrastructure. Administrators possess a professional technical skill set, and are knowledgeable about the infrastructure's technical details.

Developers

The developers are distributed among the EDUC partner universities, and are responsible for the different parts of the joint digital EDUC infrastructure. They work closely with the administrators and the pedagogical engineers. The developers can also run central EDUC infrastructure components during the agile development process, and act as links between the administrators and the pedagogical engineers. The development tasks in an agile way.

3. Core services

Identity and access management

Services running in the IT infrastructure must support authentication using the credentials of the user's home HEI. This has been achieved by using SAML-based authentication as provided by the eduGAIN network. Each service running in the system was required to use its own service provider. Service providers have been shared among several instances of one service. Single Sign-On related pages have visibly communicated the relation to EDUC.







Services have enabled special root accounts used for administrative tasks and support staff. Administrative accounts have not been mixed with normal user accounts.

All partner universities have been operating a central Identity Provider (IdP) and Identity Management system to handle authentication, access, rights and roles for the IT-services offered to their academic staff and students. SAML was the most common protocol used by the IdPs. A Single-Sign-On (SSO) was either in place or in preparation at all the partner universities.

The SSO allows users to login and authenticate themselves only once at one of the university's web-based IT services or a central website, and then use all the connected web-based IT-services for the rest of the day. All the universities were registered with the "eduGAIN" global authentication service, preparing them to link their local Identity Providers (IdPs) to the EDUC IT services available through eduGAIN. This was a requirement for implementing an SSO for EDUC IT services. The SAML 2.0 protocol was used for Identity & Access Management. For the course catalogue and the EDUC portal, we use SimpleSAML as a SAML Service Provider to handle incoming authentication and authorization requests. The Shibboleth Service Provider is used for EDUC Moodle. The identity providers of all EDUC alliance members are now part of the metadata files.

Website

The EDUC alliance website serves as a cross-institutional representation of the European University Alliance, for the distribution of information about the alliance's activities to its target groups (students, teachers, researchers and staff), as well as to external stakeholders and supporters. It also acts as a platform for communication and promotion of the EDUC and EDUC-SHARE programmes, in addition to functioning as a digital archive.

The website was an in-house development based on a proprietary solution. No stateof-the-art Content Management System was in place during the pilot phase of EDUC. The website had to be relaunched at the beginning of the EDUC rollout. The former website was implemented by using Vue.js¹ and built as a Single-Page-Web-Application using the Model-View-ViewModel (MVVM) pattern and NPM². That

¹ https://vuejs.org/

² https://www.npmjs.com/

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website was a standalone application, which did not require any APIs or dependencies. The former website was running on a dedicated virtual machine.

Social Network: OpenUP

Fostering research collaboration and tackling key global challenges with joint forces is one of EDUC's primary ambitions. Researchers and transfer units are key stakeholders in the building of integrated European Universities. As mentioned above, they were addressed specifically via the EDUC-SHARE (H2020) funding leg of the European University Alliances. As the two funding schemes complemented one another and needed to rely on joint infrastructures, we provide a brief overview of the OpenUP platform and integration of research and transfer.

The alliance was developing its digital infrastructure in a modular way, enabling the integration of the services needed to address its different tasks and to be able to adapt quickly. Having considered various options for the connection of research services, researchers and research technical assistance services, the EDUC-SHARE alliance chose the OpenUP platform, developed by the University of Pécs, to provide and facilitate the environment for researchers and transfer units to the network.

During the EDUC pilot phase, the University of Potsdam tested and adapted the Internationalization.App, a tool designed to chart EDUC's global collaborations and partnerships. Although it delivers a strategically important overview, this overview was static, and required researchers and transfer offices to add data without a direct networked opportunity. Despite its significance for the alliance's strategic positioning, EDUC-SHARE decided to implement a more collaborative tool, OpenUP, which allows for:

- Interdisciplinary interaction (by feed, groups, direct messaging).
- International collaboration (by profile, direct messaging).
- Continuous exchange beyond EDUC events and initiatives.

OpenUP has allowed researchers and colleagues in tech transfer units and research assistant services to set up their respective profiles and link to their respective fields of expertise. The OpenUP feed can handle interaction, displaying projects, technologies and research facilities. A guide has also been produced to facilitate

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usage. The functionalities will be expanded within the rollout of EDUC, and they will be interlinked with the anticipated virtual campus.

NOTE: Internationalization.App has been deprecated, and is no longer available in the context of EDUC II.

Portal

The EDUC portal acts as a single-entry point to the EDUC infrastructure for the whole EDUC community. It provides access to the main services: Moodle and course catalogue are accessible through Single Sign On.

More services will be added during EDUC II. The portal will allow users to manage their EDUC journey. Based on their user role they will have an overview of the most important information on their dashboard. There they will see when one or more services require their attention. In that respect, the portal is one of our tools for personalizing the user's experience within EDUC.

The portal can be accessed at https://portal.educalliance.eu/. Its home page displays all the links to the public information repositories (websites) available in the Alliance's various languages, with links to our shared social media channels. General announcements and resources that do not require a login to access will also be published on the portal's home page.

As the EDUC shared course catalogue, the EDUC portal is a self-developed application. The portal and the course catalogue are both documented within a private GitHub repository belonging to the EDUC alliance.

The EDUC portal was implemented using PHP, and used Composer³ for handling dependencies. The portal used the UMVC framework⁴ simple web-application framework implementing a model-view-controller pattern. The portal is wrapped in a Docker container, and deployed across the three virtual machines within the production environment.

³ https://getcomposer.org/

⁴ https://github.com/uhi67/umvc

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Course catalogue

The shared course catalogue provides a virtual space for EDUC Students to find open learning opportunities and apply for them by filtering, e.g. by discipline, leader university, mobility format, language, etc. The catalogue contains the virtual, blended and intensive short programmes offered by the EDUC alliance.

The catalogue provides a detailed view of each course (e.g. the full description of the course content and further information including ECTS, capacity, teacher, admission requirements, the platform used, the academic/administrative email contact person, and the application/registration link.

The catalogue has a function to filter courses that are aimed at specific universities (not all the courses are always available at all EDUC universities). To use this function, students should log in and then click on "only accessible courses". If they do not log in, choosing this option will show all the courses with a deadline that is still open for applications.

The technology inventory showed that a there is a central course catalogue database with a web front end at all partner universities, either as part of a central Campus Management System or as a separate service. At least two partner universities had previously created or were creating an API for automatic requests for course catalogue information from the database. The implementation approach of the data models used varied, and they needed to be harmonized for the implementation of a central EDUC course catalogue.





Approaches to Teaching Grammar in 21st century Europe in Pre Education / New Englishes	e-service Teac	her ×
Languages Virtual Masaryk University Master Year 1 English 1 semester	Code	ANGA0608
More Info: Information Contact: <u>@czs.muni.cz</u>	ECTS	5
Application Deadline: 2022-02-13 Manage Application: Closed Application deadline has expired	Language/s	English
Application Contact: @czs.muni.cz	Level	B2
Permalink: https://courses.educalliance.eu/course/91	Capacity	30
Description Pre-requisites	Teacher	
The purpose of this course is to aid the students in refining/developing their use of English for use in the classroom setting as well as to develop skills in English for educational/professional purposes; this process	Starting Semester	2nd
goes hand in hand with the students' teaching practice and draws on their observations. By the end of the course students should be able to create lessons which bear in mind the language development of their	Mode	Mixed
students and should also be aware of time management and be able to make reasoned decisions about their time in their professional lives.	Platform	EDUC Moodle

Figure 2: Course view in the EDUC Course Catalogue.

The EDUC course catalogue was implemented using the same technology as the portal. The data is stored in a dedicated MySQL database. Pedagogical engineers and project managers are also able to log in and add new courses via a backend site. A course view offers detailed information as required.

Learning Management System (EDUC Moodle)

EDUC Moodle is our shared virtual learning environment for hosting online and blended learning experiences provided to the members of the Alliance. In addition to the generic service requirements shown above, the learning management system complies with the following requirements:

- EDUC Moodle supports inline videos in lectures through Panopto integration.
- The videos for the EDUC Moodle are hosted by the University of Potsdam.
- The videos have auto-captioning (Panopto generates captions automatically, which can be edited by authors manually).
- The videos on the platform can support closed captioning in various languages, allowing multilingual transcripts to be added.

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- Users can see the duration and size of the videos.
- The videos are streamed at different bandwidths depending on the user's connection.
- Panopto lets users create videos in the browser directly, with no need to install extra software, but free software for MacOS and Windows is available if the user wants it.
- Panopto has a Screen casting function with/without webcam.
- If a presentation is screencast, Panopto automatically generates smart chapters for the final video, using the titles from the presentation.
- Panopto can create interactions within the video to give the users automatic feedback.
- Panopto is compatible with H5P for creating interactive videos.
- Panopto has a webcasting function that allows teachers to generate a link beforehand, which they can share within their courses in order to conduct online sessions. These sessions are recorded and can be accessed on demand later.
- The videos cannot be downloaded as they are the legal property of the authors (teachers), who have only granted EDUC exploitation rights.

EDUC Moodle supports different standardized layouts for:

- Small Private Online Courses.
- Web-Based Training.
- Massive Open Online Courses.
- Users cannot create courses by themselves. They need to ask the local pedagogical engineers, who are responsible for requesting the creation of a new course or a copy of an existing one from the admins via the support email. Courses can be searched by teacher, date, discipline, and title.
- EDUC Moodle provides a course overview that can be used to promote courses. The course overview is accessible without the need to log in.
- EDUC Moodle provides a dashboard that shows upcoming events and deadlines for the user's courses.
- EDUC Moodle provides a core set of plugins that gives teachers considerable flexibility to tailor the virtual learning environment to the specific learning

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objectives of the EDUC programmes. Additional plugins can be requested as needed, but the alternatives already available should be considered first. Users wishing to have extra plugins installed can do so by contacting EDUC support.

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rányítópuit Naptár Saját állományaim Tartalombank Kurzusaim Kurzusok	,	Elkövetkező események Research-based teacher tra May, 23., Monday, 16:15 > 17:45 Resu uniformed teacher trai May 30. Monday, 16:15 > 17:45	ining at UPN ing in Hungary from September 2022		Cidai testreszabása Online felhasználók 5 belépett felhasználó (utolsó 5 perc)
Portálkezelés		Áttérés a naptárhoz			
					Globális keresés
		Kurzusáttekintés	T Mind (a rejt	ettek kivételével) 👻 📔 🕶 🎫	• Keresés Q
		5142570			Tags 3 reparsing 7 with the academic levels adjectives adv of frequency Advice Alphabet Appointment
		Continuous Courses	Mathematics and Natural S FUNDAMENTAL	Continuous Courses Linguistic	Art ask someone to repeat asking for Asking someone repeat bad line behaviour Birth date books capital CE Cinema

Figure 3: EDUC Moodle Dashboard

Since most universities in the alliance host their own Moodle installations, most of the teaching staff are familiar with it. We have consequently chosen Moodle as the learning management system for EDUC.

In order to integrate Moodle into the EDUC infrastructure, we encapsulated Moodle within a Docker container. A unique requirement of Moodle was the need for a batch job to execute every minute, which posed a challenge we needed to address within the containerized environment. Authentication for the Moodle instance was facilitated through the SAML single sign-on mechanism provided by a separate Shibboleth Service Provider container. Moodle also needed to connect to a database, which in this case was a MySQL database hosted at the University of Potsdam's data centre. The same was true for the shared network-based storage, which utilized an NFS mount on the machine. For email communications, Moodle leveraged the mail relay service available at the Potsdam data centre.





The platform was customized to align with EDUC's visual identity, incorporating a suite of course templates and an overview feature that enhanced course promotion capabilities.

As it was hard to anticipate the required plugins for the system, we started with a minimum set of standard plugins, and installed new plugins when requested to do so by teachers or students. Nevertheless, the plugins currently installed let us create diverse and flexible learning scenarios.

4. Collaboration tools

A diverse pool of collaborative tools is established locally at each of the EDUC universities. The task of providing a common solution which fosters a more efficient and meaningful way of collaborating within the diverse groups in our Alliance is still pending completion.

The version of EDUC Moodle deployed had very limited collaboration tools, which were basically the Wiki activities and a plugin to provide Video conference facilities for small groups via Jitsi⁵. We had not set a priority to improve this because all the partners had their own solutions (Zoom with a virtual whiteboard, Microsoft Teams, Miro, Klaxoon⁶, etc.) In the next versions of Moodle, the advantage was the integrated Big Blue Button⁷ activity, which would include collaborative notes, virtual a collaborative whiteboard and a couple of synchronous feedback tools. This was a great new asset to improve collaboration until we could establish a more robust set of tools for our different target groups.

A range of external collaboration services was defined to ensure effective communication among the various users and roles. These services encompassed video conferencing, cloud storage, chat features, blogging, and additional collaborative tools.

The following tools were also used in the context of EDUC:

⁵ https://meet.jit.si/

⁶ https://klaxoon.com/

⁷ https://bigbluebutton.org/

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- Video conferencing: Zoom, Cisco Webex.
- Cloud storage: Nextcloud.
- Chat software: Rocket chat.
- Blog farm: Wordpress, Drupal.
- Collaborative writing tools: Etherpad, Nextcloud/Collabora.
- Video streaming platform.

Finally, as a complement to the collaborative tools predominantly offered through the Microsoft Teams Suite, various requirements for conferencing, diagram and model creation, and video support were also explored.

5. Interoperability

The project aimed to enhance interoperability among higher education institutions across Europe, enabling them to connect and share resources more effectively. By establishing a standardized open API, the initiative would facilitate access to a variety of educational services and platforms across the EU, fostering collaboration and resource sharing among universities. This approach would support the exchange of course catalogues and other academic materials, thereby enhancing the range of education available to students and staff. The integration would involve creating connectors to ensure seamless communication between different university systems, although the specifics of these developments would depend on the underlying technical frameworks.

6. Support tools

The support team performed various administrative tasks for the platform and its services, providing timely assistance for a range of user inquiries. Users were able to initiate support contact by emailing support@educ-alliance.eu.

Maintaining comprehensive documentation was crucial for addressing frequent queries efficiently. Pedagogical engineers curated a shared virtual space, with FAQs, tutorials, and manuals accessible to all support personnel, aiding with the quick resolution of common queries.

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A proactive approach was vital in minimizing support requests. Pedagogical engineers also offered guidance to teachers on implementing their learning concepts effectively, addressing potential technical issues proactively, and providing targeted technical training to prevent future problems.

The support framework was particularly focused on the course catalogue and EDUC Moodle. As teaching activities within the EDUC alliance increasingly leveraged EDUC Moodle, there would be new requests for features and functional enhancements.

Support was structured across three levels:

- First-Level Support: provided directly by course-leading teachers who managed the learning process within EDUC Moodle, addressing immediate and straightforward issues.
- Second-Level Support: provided by pedagogical engineers for more complex issues that first-level support was unable to resolve. The administrative teams would step in to provide assistance if pedagogical engineers were unavailable.
- Third-Level Support: managed by teams of administrators who deal with advanced technical issues, using a ticket system operated by the data centre (ZIM). This system organized requests, which were then addressed by ITtrained student assistants under the guidance of a pedagogical engineer from Potsdam.

Pedagogical engineers held bi-weekly meetings to discuss technical issues and solutions, ensuring a unified understanding and approach to problem-solving. Additionally, they met with developers every four weeks to strategize how to address and resolve identified issues.

For the course catalogue, which was primarily student-oriented and designed to be intuitive, an FAQ section was readily available to address users' common questions and guide interactions with the system.

III. From EDUC II (rollout phase) until Dec. 2023: the transition phase





One of the pivotal decisions in the proposal for the EDUC rollout was transferring the ongoing responsibility and leadership for development of the EDUC DI from the University of Potsdam to Universitat Jaume I. Given its years of experience in managing digital infrastructure in the cloud, coupled with favourable local labour market conditions, Universitat Jaume I's leadership is expected to significantly enhance the progress made in this ambitious project.

Transferring knowledge and insights from the pilot phase to a new partner presents significant challenges, as does joining a project that has already gained momentum. These factors combined to make the transition more complex and prolonged than anticipated, with additional challenges arising from fluctuations in our IT Human Resources during this phase.

1. EDUC Moodle and Course Catalogue

At the time of writing, the EDUC Moodle and course catalogue remain hosted at the Potsdam data centre. However, the analysis and initial tests for transferring the test and production environments of the EDUC infrastructure to the cloud, managed by Universitat Jaume I, have already been completed.

Throughout the transition phase, the primary focus of Potsdam's IT Architect involved maintaining and upgrading both the EDUC Moodle and course catalogue systems. Significant enhancements were made to the user interface and functionalities of our learning management system between January and December 2023. We simultaneously developed a new version of the course catalogue, addressing numerous bugs and enhancing the backend user interface. Moreover, during the first quarter of 2023, we outlined the next version of the course catalogue, with development tasks specified and prepared for transfer to GitHub for further development and testing. This information can be found in Annex I of this document.

The development of new features for the course catalogue was halted due to the departure of one of the two key developers and an internal change of post by the other at their university. These changes have restricted progress on the task up to the present time.

After the summer, we began to develop a framework to capture the technical requirements of the various EDUC task groups. This approach aims to clarify the

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potential future sub-tasks within T2.1 and assist in prioritizing these needs relative to our available IT human resources.

The initial gathering of user roles and use cases was completed in November 2023, with the subsequent analysis and clarification interviews for the needs identified concluded by mid-February 2024. Further details on the methodology and the significance of this process in creating a comprehensive technical blueprint - a valuable document for guiding future work - will be discussed in the next chapter: 'Technical Needs Requested by Task Groups'.

Unfortunately, the project faced a setback at the end of this phase due to the departure of the IT Architect at Potsdam, who played a crucial role in conceptualizing the collaborative tools (T1.3). To prevent delays until a new architect could be appointed, task groups T1.3 and T2.1 reorganized the related tasks internally into two categories: technical and functional. The technical tasks encompass maintenance, updates, and development of the infrastructure, while the functional tasks involve configuring and adjusting the services to meet users' requirements. The former category will be overseen by partners with IT expertise in their teams, and the latter by those without. The pedagogical engineer from Potsdam will continue to oversee the functional administration of EDUC Moodle, and will also serve as the Product Owner for the EDUC DI.

2. Website Relaunched

The new website is now in production. It was developed by an external company outside the infrastructure, and the repositories were provided by the alliance. The plan is to migrate the website to the final production infrastructure when it is ready, and integrate the source code in the alliance repositories in GitHub.

In order to simplify the integration process, the plan is to convert the application into a Docker container before beginning the whole process.

3. OpenUP

From 2023 January the EDUC OpenUP platform has been developed to fit the needs of the:

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- 1. Research infrastructure
- 2. Researcher interaction
- 3. Entrepreneurship course selection
- 4. Internal and external communication needs of the EDUC alliance within the framework of the EDUC Share project.

A dedicated engine has been developed to organize open calls to share research infrastructure facilities among young researchers in order to enhance the utilization level of the infrastructure within the alliance. A pilot project was conducted in the spring of 2023, with 6 projects being undertaken by young researchers at facilities in other institutions. Within the framework of the second project, interaction engines were put in place to boost matchmaking among researchers in the network to facilitate joint research. An entrepreneurship course catalogue for doctoral students and young researchers was designed and implemented, and member institutions also uploaded their own courses that can be offered to researchers in the network. The fourth project aimed to put communication tools in place to enhance internal and external communication among the alliance's internal and external stakeholders. A Newsletter and podcast engines were developed and implemented and are also accessible to non-member users.

IV. EDUC II: Technical needs requested by task groups

Building on the foundation established by EDUC I, EDUC II has been designed to provide the necessary support for the additional institutions joining EDUC and to expand the services and capabilities developed during EDUC I.

Evolving a system requires a clear definition of needs. To address this, the EDUC team has instituted an annual process for collecting use cases, aiming to capture the requirements of various tasks. This section will outline these new requirements, identify roles and responsibilities, and describe how the current architecture will be adapted to support these changes effectively.

1. Product management and development workflow







Product workflow and roles

Product management and development are conducted using agile methodologies, with the Product Owner playing a pivotal role in driving product discovery and definition. This role serves as a bridge across various tasks, facilitating the identification and collection of essential requirements from diverse users to ensure their cohesive integration.

The Product Owner will spearhead an annual use case gathering process, during which all task leads present their functional requirements. The Product Owner then evaluates and organizes these proposals to construct a comprehensive impact map of all use cases on the EDUC Sustainable Virtual Campus.

The process of reviewing and clustering the use cases will end up in a list of epics that has to be prioritized and then discussed among the task leads, pedagogical engineers and the working group of T1.3 and T2.1. When the review process is complete and any concerns have been addressed, the product owner will meet the developers of the respective team to translate these requirements into development tasks in GitHub. This is the starting point in the development process, which will be driven by refinements and technical discussions for a better understanding of the impact of the features and their final implementation.

The pedagogical engineers are responsible for the validation and quality assurance (QA) processes, focusing on identifying bugs, pinpointing problems, and suggesting potential improvements. They notify the developers of these findings, who then iterate on the solutions to ensure everything functions as intended.

Once the iterative improvements meet the necessary standards, the finalized solutions are deployed to the production environment.

2. Summary of outcomes after first round of need requests

Most requests from the task groups will affect a core service: the course catalogue. In EDUC I, this service primarily facilitated the promotion and management of applications for virtual and physical mobility projects. However, with the expansion of activities in EDUC II, the course catalogue must now encompass a wider array of educational opportunities. This expansion will include not only student courses and

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mobility programmes, but also training sessions, tutoring and mentoring opportunities for staff, and outreach initiatives targeting the wider community.

The good news is that these new needs do not necessitate drastic changes to what we have already planned in Annex I.

Another significant development was recognizing the necessity for communication between our EDUC Moodle and the course catalogue. This link is crucial for sharing essential information about the educational components that both platforms require at different stages in their lifecycle. Typically, the course catalogue provides details to promote learning opportunities, and this information is subsequently needed by Moodle in order to issue the EDUC Certificate. This process currently requires manual entry of information on both platforms, and this redundancy could be streamlined.

Centralizing the entire administrative process in a seamless manner was also identified as part of the needs. Administrative staff require a comprehensive overview of the entire process, whether accessed through the course catalogue or Moodle. They need panels and dashboards that provide detailed information for each educational component, discipline, university, or type of component. This feature is crucial for statistical analysis and for facilitating the management of the complex administrative processes associated with each learning opportunity.

Some task groups identified a specific need for the automatic generation of the essential documents used during various processes, such as the Online Learning Agreement and Transcript of Records. Additionally, there was a call to align our existing digital EDUC Certificate with the EuroPass or Open Badges framework, ensuring it aligns with the European Scheme for Microcredentials. Enhancing the interoperability of administrative processes is crucial in the long term. This would involve enabling our EDUC DI to connect and exchange information with local Campus Management Systems, or aligning our mobility processes with the EWP network. Linking our EDUC course catalogue with local catalogues will also be essential for the seamless promotion of learning opportunities in the future.

The last significant modification requested was the development of a "Guest User" concept for our EDUC DI. Given the diverse activities of EDUC II and their varied target audiences, not all prospective users will possess credentials from one of the eight partner universities. They will therefore require alternative access if they are to participate in certain EDUC DI-supported activities. This new user category will

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accommodate not just our associated partners, but also members of civil society engaged in outreach, blended and hybrid events, and external institutions participating in internships, among other scenarios. Additionally, this change has legal implications concerning our Data Agreement, necessitating close collaboration with Task Group T1.5 in order to address these needs properly.

V. Functional needs for EDUC II

The main goals of EDUC II in terms of functionality are consolidation and collaboration. The current services available must be consolidated by improving their functionalities, keeping them flexible enough for future scenarios not considered to date to give us room for manoeuvre if needed, but with a clear focus on improving the functionalities to cover the requested needs in the Tasks summarized in the previous section.

Collaboration needs not only to be fostered among users, but also between our services. In this regard, interconnecting our current services, and interconnecting them with local ones and external ones will be crucial during the rollout of EDUC.

1. EDUC portal

One of our priorities will be to improve the EDUC portal. This service will interconnect the others by offering a personalized dashboard of applications that each user will be able to customize based on their profile and interests in EDUC.

We are planning to use Nextcloud Hub⁸ for this purpose because it is an open source⁹ platform. It is becoming consolidated consolidating as one of the better onpremises solutions for collaboration, and the functionalities that it offers are very useful for fostering a more efficient collaboration amongst the diverse actors within EDUC.

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⁸ https://nextcloud.com/

⁹ https://docs.nextcloud.com/server/latest/developer_manual/index.html

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There are many open-source applications¹⁰ available for Nextcloud that match the expectations and requirements of our intercultural collaboration. Furthermore, the availability of each application can be customized for specific groups of users, giving us the opportunity to adapt the EDUC portal to the real and meaningful needs of the end user.

The EDUC portal might be the entrance for all our users, regardless of how they want to begin their daily journey within EDUC. Students will find new open learning opportunities shown in the dashboard Course-Catalogue-application, as well as notifications of their current application processes. They will have an overview of the upcoming activities in the courses they are currently participating in through the EDUC-Moodle-application. Teachers and researchers will be able to receive notifications from both systems and from OpenUP to stay up to date on their social interactions with their colleagues within EDUC.

For EDUC Staff in particular, but for all users willing to collaborate digitally in general, the EDUC portal will provide a set of tools to facilitate this experience. They will read their priority inbox¹¹, organize meetings and events¹² through shared calendars¹³ with their colleagues¹⁴, follow-up tasks¹⁵ of their collaborative projects on Kanban boards¹⁶, work together on collaborative documents¹⁷, have synchronous and asynchronous video and messenger conversations¹⁸. All the activities within the EDUC portal could be Al-assisted by an on-premises-ethical Al-Assistant¹⁹.

Collaborative experiences will be smoother and more efficient due to using a common digital technology rather than the current mix of local services from each partner, which are not able to be connected in a seamless manner. Nevertheless, if a partner decides to continue to use some of their own tools (e.g. MS Teams²⁰) we would probably be able to connect them to our shared EDUC Nextcloud Hub.

- ¹³ https://apps.nextcloud.com/apps/calendar
- ¹⁴ https://nextcloud.com/groupware/
- ¹⁵ https://apps.nextcloud.com/apps/tasks
- ¹⁶ https://apps.nextcloud.com/apps/deck
- ¹⁷ https://apps.nextcloud.com/apps/richdocuments
- ¹⁸ https://apps.nextcloud.com/apps/spreed
- ¹⁹ https://nextcloud.com/de/blog/first-open-source-ai-assistant/
- ²⁰ https://apps.nextcloud.com/apps/sendent

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¹⁰ https://apps.nextcloud.com/

¹¹ https://apps.nextcloud.com/apps/mail

¹² https://apps.nextcloud.com/apps/polls

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2. Epics and Services

We believe there will be three main epics:

- 1) Educational components lifecycle
- 2) General promotion and communication
- 3) Collaboration, to be supported by our 5 services: website, Moodle, course catalogue, OpenUP and the portal, which we are planning to improve.

Please see the tables below for a better understanding of the main areas of improvement:

	E1 LIFECYCLE OF EDUCATIONAL COMPONENTS
SERVICE	AREA OF IMPROVEMENT
S1. Website	N/A
	1.2.1 Implement a workaround for the short term to centralize the application and selection processes by using the functionalities of Moodle.
	1.2.2 Alignment of EDUC Certificate with EuroPass, Open Badges and European Scheme of Microcredentials
S2. EDUC Moodle	1.2.3 Management of users' performance information for statistical and evaluation purposes
	1.2.4 Evolutive maintenance of the Teachers' Journey, a virtual space created to support teachers in the process of creating learning opportunities for students within EDUC. Collecting of user feedback to improve the user experience/usability. Review of the workflow of the Virtual Mobility (VM) projects as well as new types with task groups T2.3
S3. Course	1.3.1 Adaptations for the new requirements of Task Groups, diversity of disciplines, formats, etc.
Catalogue	1.3.2 Centralization of administrative processes, new roles for the system, generation of required documents: learning agreements, transcript of records, etc.
S4. OpenUp	1.4.1 Explore the usefulness of its functionalities in the context of some of the phases in the lifecycle
S5. Portal	1.5.1 Personalized notifications on the portal's dashboard based on the role of actors involved in the lifecycle, e.g. students: notification of new learning opportunities, updates on open applications and administrative processes; teachers: reminders on selection process deadlines; EDUC Staff: notification of different phases of the lifecycle where action is needed.
S6. External services	1.6.1 Harmonization with EuroPass, Open badges, EWP, microcredentials, ESC, etc.
	1.6.2 Interoperability with local course catalogues and local campus management systems

Table 1: Epic 1. Lifecycle of educational components'

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	E2 GENERAL PROMOTION AND COMMUNICATION
SERVICE	AREA OF IMPROVEMENT
S1. Website	2.1.1 Distribution of content management amongst different actors, mainly EDUC staff: creation of roles and administration
	2.1.2 Subsection for a "Public Knowledge Repository" about the Experience of PhD Students
	2.1.3 Promotion and visibility of the many and diverse offer of activities within EDUC
	2.1.4 Launch of EDUC Newsletter
S2. EDUC Moodle	2.2.1 Improvements to the use of the advertising tiles on the Moodle homepage
S3. Course catalogue	2.3.1 Implementation of the community manager role for easier promotion of current learning opportunities
	2.3.2 Improvements to the front end for improved usability based on users' feedback
S4. OpenUp	2.4.1 Explore the concept of personalized dissemination of EDUC activities on the feed based on profile interests, keywords, etc.
S5. Portal	2.5.1 Recent news block for the portal's dashboard
S6. External services	N/A

Table 2. Epic 2. General promotion and communication





	E3 COLLABORATION (INTERCONNECTION AND INTEROPERABILITY)			
SERVICE	AREA OF IMPROVEMENT			
S1. Website	3.1.1 Develop the way to share EDUC-News with other services like EDUC portal and OpenUP			
	3.2.1 Use shared EDUC portal files as a repository in the Moodle ²¹ tool to foster more collaborative activities within educational components.			
	3.2.2 Use Collabora ²² documents in Moodle by installing mod_collabora plugin ²³			
Moodle	3.2.3 Evaluate the activation of BigBlueButton in Moodle for a better experience in synchronous virtual sessions.			
	3.2.4 Evaluate the implementation of a MoodleNet ²⁴ instance for being able to share Moodle content among local Moodle instances of alliance partners.			
S3. Course	3.3.1 Improve collaboration in administrative processes by centralizing them into the			
catalogue	course catalogue			
	3.4.1 Add OpenUP to the EDUC SSO and determine how to enable it between students and doctoral students and professionals (external stakeholders). GDPR and Data protection must be observed and agreed upon with T1.5.			
S4. OpenUp	3.4.2 Harmonization of OpenUP "Course Section" with the content of the official EDUC course catalogue			
	3.4.3 Evaluate possible meaningful connections amongst similar features between OpenUP and other EDUC Services (e.g. News, Events, Groups).			
	3.4.4 Evaluate possible integration of OpenUP functionalities into other EDUC Services (e.g. Mentoring matchmaking, Projects, Jobs/Internships)			
S5. Portal	3.5.1 Improvement and relaunching of EDUC portal based on a Nextcloud instance.			
	3.5.2 In the short term, connecting our EDUC Github with the EDUC portal via this Nextcloud application ²⁵			
S6. External services	3.6.1 Evaluation of changing from Github to GitLab for our long-term collaborative development platform.			
	3.6.2 Interoperability of the local campus management systems with the EDUC DI in order to collaborate efficiently (e.g. administrative processes, cross-promotion, etc.)			

Table 3: Epic 3. Collaboration (interconnection and interoperability)

²¹ https://docs.moodle.org/402/en/Nextcloud_repository

²² Collabora will be needed for running into our Nextcloud instance:

https://www.collaboraoffice.com/nextcloud/

²³ https://moodle.org/plugins/mod_collabora

²⁴ https://docs.moodle.org/dev/MoodleNet

²⁵ https://apps.nextcloud.com/apps/integration_github

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Figure 4: Graphic representation of the EDUC Sustainable Virtual Campus

3. New user roles

After the first iteration of collecting technical requirements from the task groups, we identified new user roles, which we have yet to detail. They are: doctoral students, staff (employees) as trainees, mentors and mentees, EDUC staff (project managers, local controllers, mobility managers and communication managers), and external stakeholders (guests, youth, third parties, industry, associated partners, etc.)

4. New stories (visions)

Due to these new user roles and some possible changes in the original ones, we need to work on creating those new stories to have a clearer vision of how we want to solve those requirements related to the new user roles.

Some stories are clearer than others, e.g. the vision of the student's journey is quite clear - we simply have to work on improvements to some of the stages or processes involved in it.



Figure 5: Student's Journey

For teachers and researchers who are interested in internationalizing their teaching, we started to work on a new vision at the beginning of EDUC II, and we implemented an initial technological solution to support it. We will begin to analyse the first outcomes and modify the digital space created in Moodle in order to improve their journeys. Collecting feedback and being open to modifying the strategy is essential at this stage, as this is a very diverse group of users.



Figure 6: Teacher's Journey

Some of the Tasks which requested new technical solutions will be implementing their activities for the first time during the months to come. Accordingly, we will try to provide effective solutions based on our current EDUC DI, but always considering the feedback from the first users to find out if the technology is good enough, or if we need to think about modifications to our services or even add new ones. Some new stories will appear in the near future.

VI. EDUC II technical overview

1. System requirements

In this section, the information collected during field analysis will be used to provide system requirements for the EDUC digital infrastructure. We start by defining the generic requirements that apply to every service on the platform.

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The target design goals are:

- **Security**: the EDUC DI will ensure the safety of user data and will not impose security related risks upon its users.
- **Reliability**: the EDUC DI will provide a reliable service with minimal downtime and will prevent data loss.
- **Extensibility**: it must be easy to extend the functionality of the EDUC DI to anticipate future user demands.
- User-Centric Design: each system must feature a responsive design to ensure optimal usability across various devices. In addition, the system's appearance should be consistent with the corporate identity of the EDUC alliance.
- **Interoperability**: the EDUC DI must integrate seamlessly with the essential local systems of the partner universities to facilitate unified administrative processes, supporting the alliance's digital strategy.
- **Portability**: the EDUC DI will enable straightforward exporting of documents, recognizing user participation across activities and ensuring compatibility with services like Europass and OpenBadges.

The EDUC digital infrastructure must ensure the high availability and swift responsiveness of its services. It is crucial that the system is designed to handle peak traffic without service interruptions. Regular software updates must be seamlessly integrated without downtime, and the architecture must enable new services to be added at any time.

To achieve high availability, system modifications such as upgrades, deployment of new service versions, or adjustments to system resources must be executed without causing downtime. This requires a robust redundancy strategy for services and comprehensive testing capabilities.

Service Redundancy

To prepare for sudden surges in user requests, the portal must support the ability to run multiple instances of services simultaneously, ensuring no risk of data loss or corruption. This capability facilitates load distribution across various physical or virtual machines. With the right orchestration tools, the system can dynamically adjust the number of active services to meet the infrastructure's current demands.

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The infrastructure:

- Must support running multiple instances of each service.
- Must support load-balancing user requests to any service instance.
- Should support scaling service instances according to performance needs on demand.
- Must allow for the temporary removal of single hardware machines for maintenance of these machines.
- Must allow hardware machines to be added and removed on demand.

For services to be supported by this kind of setup, they must meet the following requirements:

- Services must support running in a parallelized setup. This means access to shared resources as databases and disk storage takes place in a synchronized way and the services are stateless.
- Automated service provisioning and shutdown must be possible.
- Storage back-ends such as database or disk storage must be accessible from all instances of a service.
- A load balancing reverse proxy must act as an entry point to the infrastructure to distribute the load over all instances of a service.

Test System

A dedicated test infrastructure is crucial in reducing the likelihood of downtime resulting from system changes. This infrastructure should enable changes to be tested in isolation from the production environment. While it should mirror the production environment's architecture, it may be smaller, given its lower load requirements. Importantly, to eliminate the risk of inadvertently affecting the production environment, the test infrastructure must be entirely separate and not share any services with production.





Monitoring

To prevent shortages of computational capacity, the infrastructure requires close monitoring and the implementation of appropriate automated alerts. These measures enable staff to proactively address potential issues, averting downtime or system lag. Monitoring tools and log files are crucial for diagnosing errors, enabling system problems to be identified and resolved quickly. Effective monitoring encompasses both the underlying hardware and all internal and external services.

- Monitoring should encompass all parameters across the infrastructure, including each machine, the services operating on them, and any external services critical to the system's functionality.
- All collected information should be presented in a visual form that enables changes in tendencies of dynamic parameters to be spotted easily.
- Monitors and alarms for critical system parameters should be established to promptly notify administrative staff of any issues. The key parameters to be monitored include but are not limited to free disk space, RAM usage, CPU usage, processing time per request (for each service), request count (for each service), and network interface workload. Thresholds for these alarms should be set and continuously adjusted based on operational experience.
- The monitor dashboard must not be reachable by non-administrative users.

Storage

Data can be generated in different stages and stored in different formats and devices across the infrastructure, but a set of minimum requirements must be met:

- Data must be stored in an encrypted way, avoiding the usage of platform managed keys.
- Data must be available and durable, and storage services are expected to guarantee an availability of at least 99.9%, as outlined in their Service Level Agreement (SLA).
- Data must be regularly backed up to facilitate recovery when necessary.

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Load balancing

The services designed for EDUC should scale elastically to meet increasing demand. While load balancing helps manage traffic influx, additional strategies include:

- **Replication**: ensures service availability through redundancy.
- **Failover**: enables service recovery in alternate availability zones or regions, preventing data loss.
- Elastic Scaling Groups: facilitates service expansion in response to growing demand.

Other service requirements

In addition to the requirements listed above, each service must meet the following requirements:

- Design Compliance: the services must implement the user interface according to the EDUC Design Manual.
- Multilingual Support: the services must offer multi-language support, with localization enabled for all the languages of the alliance as well as English.
- Mobile Accessibility: the services should be optimized for mobile access to maintain a seamless user experience.

2. Architecture of the technical solution for the core services

The new architecture for EDUC II as compared to that shown in Figure 1 of Section II.1, will be cloud-based, and will take advantage of the elasticity and the availability of the resources in the cloud. The production environment will be hosted on Amazon Web Services (AWS) and will use as many managed services as possible included to reduce maintenance costs:

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- AWS Elastic Container Service²⁶: Amazon Elastic Container Service (ECS) is a fully managed container orchestration service that helps you to more efficiently deploy, manage, and scale containerized applications. It deeply integrates with the AWS environment to provide an easy-to-use solution for running container workloads in the cloud and on premises with advanced security features using Amazon ECS Anywhere²⁷. As many containers as needed can be executed without physically provisioning any virtual machine. Fargate²⁸ will be used as the runtime for those services. Two different clusters can be created to separate the containers running in production from the rest in the test environment.
- AWS Elastic File System²⁹: Create and configure shared file systems simply and quickly for AWS compute services—no provisioning, deploying, patching, or maintenance required. It's an NFS service with automatic storage allocation.
- AWS Relational Database Service³⁰: RDS is a collection of managed services that makes it simple to set up, operate, and scale databases in the cloud. It supports eight popular engines, including MySQL.
- AWS Elastic Compute Service with auto-scaling groups³¹: Amazon Elastic Compute Cloud (Amazon EC2) provides a comprehensive and extensive computing platform, featuring more than 750 instance types. It allows users to select from the latest processors, storage options, networking technologies, operating systems, and purchasing models, enabling them to tailor their resources to their workload requirements optimally. Additionally, it enables the creation of virtual machines designed to scale automatically in response to increases in traffic or system demand.
- AWS Application Load Balancer³²: Elastic Load Balancing automatically distributes incoming traffic across various targets, including EC2 instances, containers, and IP addresses, across one or more Availability Zones; it ensures traffic is directed only to healthy targets by continuously monitoring their status. As your incoming traffic fluctuates, Elastic Load Balancing adjusts the scale of your load balancer accordingly. This feature is designed to accommodate the vast majority of workloads, enabling automatic scaling to meet demand.

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²⁶ https://aws.amazon.com/ecs/

²⁷ https://aws.amazon.com/ecs/anywhere/

²⁸ https://docs.aws.amazon.com/es_es/AmazonECS/latest/developerguide/AWS_Fargate.html

²⁹ https://aws.amazon.com/efs/

³⁰ https://aws.amazon.com/rds/

³¹ https://docs.aws.amazon.com/autoscaling/ec2/userguide/auto-scaling-groups.html

³² https://docs.aws.amazon.com/elasticloadbalancing/latest/application/introduction.html

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3. Proposed architecture for EDUC II

New improvements for the new cloud-based architecture will be applied and categorized in three different areas:

- **Availability**. All the managed pieces of the infrastructure will now be elastic and scalable, including file systems, load balances, caches, etc.
- **Isolated**. The provisioned environments for test and production will be separated from the ground up, including system services, storage and configuration.
- **Maintainability**. Using managed services significantly reduces the workload for infrastructure administrators.

As shown in the diagram below, two different and separated environments will be provided. In both of them, it is possible to choose between running the services in VMs or deploying them to the docker orchestration service (ECS).

The bastion host will provide a single access point. This host will act as a bridge between the public network and the internal EDUC services. Access to this resource will be restricted to a small subset of Ips, and access will only be possible by using an SSH key and configuring two-factor authentication.

Another benefit will be the separation of the file system used in test and production environments, segregating the access patterns of the different services to provide a more specialized file system.

Finally, there will be several common services that will be applied to all the resources provisioned in the cloud:

• **Backup**: All the infrastructure elements will be backed up with a centralized set of custom policies.





- **DNS and domain registration**: All the domains available for accessing the EDUC services will be managed and configured in Route53 DNS zones.
- **Security**: All the volumes will be encrypted using a customer managed AWS KMS key.



Figure 7: Architecture design for infrastructure services in EDUC II

4. Sustainability

Innovation is key in advancing sustainability goals, addressing challenges from the decarbonization of operations to water conservation through transformative technologies. AWS enables the development of various sustainability solutions, including carbon tracking, energy conservation, and waste reduction. Organizations can use AWS services to ingest, analyse, and manage sustainability data efficiently. AWS offers the most comprehensive set of capabilities in artificial intelligence, machine learning, the Internet of Things, data analytics, and computing.

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AWS provides knowledge and tools for organizations of all sizes and across all sectors to build and implement solutions that meet their sustainability goals³³.

AWS has contracts for renewable power from utility scale wind and solar projects that add clean energy to the grid. These new renewable energy projects support hundreds of jobs, while providing hundreds of millions of dollars of investment in local communities. They choose to support these grids by purchasing environmental attributes, including Renewable Energy Certificates and Guarantees of Origin, in line with our Renewable Energy Methodology.

In 2022, the electricity consumed in the following 19 AWS Regions was 100% attributable to renewable energy: U.S. East (Northern Virginia), GovCloud (U.S. East), U.S. East (Ohio), U.S. West (Oregon), GovCloud (U.S. West), U.S. West (Northern California), Canada (Central), Europe (Ireland), Europe (Frankfurt), Europe (London), Europe (Milan), Europe (Paris), Europe (Stockholm), Europe (Spain), Europe (Zurich), Asia-Pacific (Mumbai), Asia-Pacific (Hyderabad), China (Beijing), China (Ningxia).



2022 Year in Review

Figure 8: AWS 2022 public sustainability report ³⁴

³³ https://sustainability.aboutamazon.com/products-services/the-cloud?energyType=true

³⁴ https://sustainability.aboutamazon.com/2022-sustainability-report.pdf

⁴³

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Ireland is the region selected for operations, as it provides the most innovative services and access to hardware preview resources in the European Union. It is also one of the 19 regions globally that are 100% green, as it is fully powered by renewable energy.

5. Cloud security

All the information in the EDUC II infrastructure will be encrypted to preserve the integrity and security of the data stored in AWS. Moreover, to guarantee that Amazon has no access to the encrypted data, the private key that will be in place will be managed by the customer³⁵. That means that only the EDUC alliance has access to the key that would be able to decrypt the stored data³⁶.

6. Continuous integration, continuous delivery and release management

CI/CD is an umbrella term that encompasses several key phases of DevOps. Continuous Integration (CI) involves regularly integrating code changes into a shared repository, often multiple times a day. Meanwhile, Continuous Delivery (CD) automates the integration of code changes, facilitating rapid and reliable software release cycles. Continuous Deployment, another aspect of CD, goes a step further by automatically deploying all changes directly to end users. Regular CI/CD testing significantly minimizes the occurrence of bugs and defects, underscoring its importance in any DevOps workflow.

Continuous deployment is a strategy in software development in which code changes to an application are automatically released into the defined environment. This automation is driven by a series of predefined tests. Once new updates pass those tests, the system pushes the updates directly to the software's users. All the changes should be continuously deployed to the testing environment in order to simplify the process of QA review of the new features.

In the current phase, all source code, development artifacts and assets for EDUC are hosted on GitHub. Various continuous integration pipelines implemented using GitHub Actions are responsible for building, testing, and packaging these assets for storage in the GitHub artifact repository. This setup enables us to merge, build, and

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³⁵ https://docs.aws.amazon.com/kms/latest/developerguide/concepts.html#customer-cmk

³⁶ https://docs.aws.amazon.com/kms/latest/developerguide/data-protection.html

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test our software artifacts efficiently. However, deploying these artifacts to production systems still requires manual intervention.

VII. Data protection

All the services, processes and data flows will be designed in accordance with the current European, national and regional laws regarding personal data protection. All the work done will be subject to the Regulation (EU) 2016/679 of the European Parliament and of the Council, of 27 April 2016, on the protection of natural persons regarding the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (General Data Protection Regulation, or GDPR).

Each partner shall be considered the data controller of the data that is processed in their own institutions. The Alliance shall have a joint controller agreement to define responsibilities and procedures for the shared data among the Alliance partners.

As regards the information to be provided where personal data are collected from the data subject, all services designed by the Alliance that collects personal data for a purpose and for the first time will provide information about the conditions and characteristics of the data processing in accordance with article 13 of the GDPR. When data is not obtained directly from the data subject, the information to be provided will be that stipulated in article 14 of the GDPR.

Each service or group of common services will have a legal notice regarding the privacy policy of that service, and shall identify the Alliance's responsibilities as a joint controller.

If there is a need for third-party subcontracting and when the third party will process personal data on behalf of the Alliance, the third party shall be considered a data processor and its work must be regulated by a data processing agreement, in accordance with articles 28 and 29 of the GDPR.

The use of cloud resources described above is in accordance with the GDPR and national laws. All the resources deployed by the Alliance shall be deployed in European regions, and no data transfer to third countries shall be designed in the Alliance's services. It is designed to use the Amazon Web Services cloud, which is

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currently subject to an adequacy decision by the Commission, in case an automated transfer to a third country such as the USA, not within the Alliance, should take place. Should this decision be cancelled, the Alliance shall find legitimation for the transfer in any of the legal grounds in articles 46-49 of the GDPR.

VIII. Security considerations

The services and functionality in the context of EDUC II are provided from the consortium infrastructure and based on the interaction with each partner's information systems. It is the duty of each partner to monitor the security of their own systems, and this document sets out the security measures and controls that create a safe operating environment in the Alliance's common infrastructure.

Security must be understood as an integral process consisting of all the human, material, technical, legal and organizational aspects related to the information systems, and includes several principles:

- **Risk-based security management**: risk management will allow the maintenance of a controlled environment, minimizing risks to acceptable levels.
- **Prevention, detection, response and conservation**: the security of the system shall minimize its vulnerabilities and ensure that threats do not materialize or if they do, do not seriously affect the information it handles or the services it provides.
- **Existence of lines of defence**: there will be organizational, physical and logical measures in place that permit an appropriate response to incidents that have not been prevented and minimize their final impact.
- **Continuous monitoring**: this will enable the detection of anomalous activities or behaviours and a timely response to them.
- **Periodic re-evaluation**: security measures shall be regularly reassessed and updated, and their effectiveness adjusted as risks evolve.





1. Risk Management

Each partner shall carry out its own risk management. The alliance shall manage its own risk by analysing and processing the risks to which the systems are exposed. A widely accepted methodology shall be used.

The measures taken to mitigate or eliminate the risks must be justified and there must be proportionality between them and the risks in all cases.

2. Authorization and control of accesses

A formal authorization process covering all elements of the information system concerned shall be established.

Controlled access to the information systems must be limited to duly authorized users, processes, devices and other information systems, and only to the permitted functions.

A minimal access policy shall be applied, granting the minimum privileges necessary and ensuring that only authorized persons have access, from locations and devices that are also authorized. The ordinary use of the system must be simple and safe, so that unsafe use requires a conscious act by the user.

The information systems and their associated communications infrastructure must remain in controlled areas and have adequate and proportional access mechanisms based on risk analysis.

Access control mechanisms shall balance the user-friendliness and protection of information and services, with priority given to security.







3. Protection of stored and in transit information

Information stored or in transit through portable or mobile equipment or devices, peripheral devices, information media and open network communications shall be protected.

The systems shall have backup copies, and the necessary mechanisms shall be put in place to ensure continuity of operations if the usual operating methods are lost.

4. Recording of activities and monitoring

Users' activities will be recorded, retaining the information strictly necessary to monitor, analyse, investigate and document improper or unauthorized activities, enabling identification of the person concerned at all times.

Each user accessing the information system must be uniquely identified, so that information about holders of access rights, the type of access rights they are granted, and individuals carrying out a particular activity is available.

Users' activities shall be recorded in accordance with the provisions of the General Data Protection Regulation and complying with the principles of purpose limitation and data minimization.

Activity in the system shall be monitored, and predetermined actions shall be executed depending on the situations compromising security identified in the risk analysis. This may include generating real-time alarms, ending the process that is causing the alarm, disabling certain services, disconnecting users and blocking accounts.

The interconnection of the system with other systems (from the Alliance members or from third parties) shall be analysed and points of connection monitored.







5. Security audits

The information systems will undergo regular and continuous audits, as well as spontaneous audits when significant changes occur that could impact the required security measures. This ensures that all modifications to the information systems are adequately assessed in terms of their impact on security.

6. Authentication mechanisms

Authentication services provided by EDUC Alliance shall primarily use EduGAIN federation identities, as well as any other authentication scheme established under national or European laws that must accepted by EDUC partners.



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Annexes







1. Annex I. Next version of the Course Catalogue

Introduction

Purpose:

- Convert this collaborative document into development-oriented tasks.
- These tasks are not necessarily independent of one another and may need further simplification (e.g. before they are copied into GitHub Issues). Furthermore, a parallel implementation of these tasks can lead to merge conflicts that it may be better to avoid (by simplifying the tasks or not implementing them in parallel).
- The bullets in the task description can be viewed as steps/sub-tasks, if applicable.

Notes

- CC = Course Catalogue
- PE = Pedagogical Engineer
- New specifications that do not exist in the original collaborative document have also been added to the current document.

Access Control component

Expectations

- RBAC (Role-Based Access Control Component) implemented as part of the CC, and later moved into the framework for use in other applications.
- A general component to handle an inheritable/hierarchical role-based access control and permission check.
- Uses easily editable configuration structure to describe the roles and permission hierarchy.
- Can check controller/action access automatically.
- Stores user-role assignment in a database table; allows multiple roles.

Tasks

- AccessControl interface and its real implementation ('Rbac' component)
- can(user, permissionName) -- computes if the user has the permission (or role)
- roles() -- name of assignable roles (but not the permission items)
- AccessItem interface and its real implementation, with 'role' and 'permission' types.





- Extend UserInterface with new can(permissionName) method
- Implement automatic assignment of special roles (logged-in-user and notlogged-in user)
- Implement actionPath in the Controller class to get the real performing 'controller/action' word
- Configuration and usage guide
- Implement a performance-optimized implementation (using database-stored permission hierarchy and session-time cache with the same API). The cache should be cleared immediately if a database changes.
- Implement scope-dependent permissions (permission connected to a university or course, etc.)
- Note: implementation can be optimized as desired for better performance, but roles should not be cached so that changes to the database are live instantly (i.e., role changes in database via SSH access for example should be reflected instantly for the corresponding user).
- Eventually: move Access Control capability and the basic implementation into the framework

User Roles

Expectations

- Notes:
 - Global scope: for all universities.
 - Regional scope: allow binding to several universities (has local in more than one).
 - Local scope: allow binding to the user's university.
- Super Admin (global scope): a user with this role can do everything the roles below can do, and in particular, assign roles to users of the CC.
- Local Admin (role in regional scope): the same as the Super Admin role, but restricted to selected universities, such as their own university (e.g. they can only manage users at these universities).
- Global PE (the former Admin): a user with this role can create courses and assign a teacher (Lead Teacher) as responsible for filling out the course information and being part of the selection process for applicants. They can also do all what the roles below can do.
- Local PE (university-scope role): the same as the Global PE role, but should ٠ be able only to create, modify or delete courses led by (at least) their university (checked against the Lead University field for the course).

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- Note: "at least" means other universities can be allowed.
- Teacher (global scope): a person with this role can fill the information of the courses they lead, and be part of the selection process of candidates if needed.
 - Note: a user must have the "teacher" role (assigned by any admin) before PE can connect them (as lead teacher) to a course.
- Local Controller (role in university scope): a person with this role can verify the minimum criteria that applicants must meet to become candidates for a course. This is a pre-selection step before selection itself by teachers, for example.
 - o Note: see section on application status for differences between applicant, candidate, etc.
- Student (global automatic scope): a person with this role can apply for the courses offered in the CC.
 - Note 1: "automatic" means the role is granted automatically based on the value ("student") of eduPersonAffiliation SAML attribute.
 - Note 2: Student is not a default role because we might want to set and unset it over time.
- Community Manager (global scope): a person with this role should be able to access relevant information of all the courses in all universities in just one step (dashboard), so that they can promote courses for example. This is different from the admin panel, and the data to be accessed are yet to be defined.
 - N.B.: we can add a filter so that these users only see courses offered at their university (i.e., students at that university can apply for those courses).

Configure the access-control component

- The configuration steps will be described in the implemented access control component above.
- Replace (remove) all ->requireAdmin() and similar calls.

Register all expected roles

Implement the actual role hierarchy, including permission items using the configuration of the access control component (Role/function matrix).

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- Implement the automatic action control based on the access control configuration.
- Insert user->can(permissionName) calls whenever needed.
- Replace the explicit teacher concept from the source code with the corresponding role (Teacher).
 - Migrate entries from existing teacher table to the user table, and set their role to Teacher. An understanding of the data in both tables on production site is necessary to determine how data should be migrated (which fields to delete from the teacher table and how to replicate them in the user table, e.g. Name and E-mail).
 - Update the all pages referencing teachers accordingly (e.g. remove the Teachers section from the administration panel, make sure the course edition form continues to initialize the Lead Teacher field correctly, Etc.).
 - Remove the teacher table from the database and related concepts from source code.
 - Check that all the changed pages are working.

Allow Super Admin to assign roles to other users

- Already possible, but the feature might need some updates following changes to user roles.
- The configured AccessControl component can provide the assignable role list.

Allow Local Admin to do their job according to expectations

• Please refer to the description of the role (i.e., university scope, etc.).

Allow Global PE and Teacher to collaborate on a course.

- Some course fields can be changed by the Global PE and Teacher: which are they?
- Some course fields can be changed only by the Global PE: which are they?
- Must the Lead Teacher in charge of completing the course be at the same university as the Global PE?
 - If so, the user who has control over the course (e.g. the Global PE) must be recorded in the database. Possible solution: we use the internal created_by column (referencing a user) to determine who has control over the course. The created_by user should at least have the Global PE role. This field can only be altered from the database or source code (not from the user interface).

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Allow the Local PE to do their job according to expectations

• Please refer to the description of the role.

Allow the Teacher to take part in the selection process of course candidates if needed

• TODO (when selection process is tackled in this document).

Allow the Local Controller to do their job according to expectations

• Please refer to the description of the role.

Allow the Student to do their job according to expectations

- Detect and assign the Student role to users based on the eduPersonAffiliation SAML attribute.
- Students can apply for courses: already a working feature. But tests can help check that the feature is still working.

Allow the Community Manager to do their job according to expectations

- Create a new course listing interface for community managers to be able to access relevant course information in just one shot (dashboard), so that they can promote courses, for example.
 - This is different from the admin panel, and the data to be accessed are yet to be defined.
 - We can also add a filter for these users to see only courses offered to their university (i.e. students at that university can apply to those courses).

Establish role hierarchy

- Make sure the Super Admin can do what the Global PE can do.
- Make sure the Global PE can do what the other roles can do (Super Admin excluded).
- If possible, make sure that the two rules above are verified automatically. As a result, e.g. after adding a new feature, the Super Admin role will be accepted automatically where the Global PE role is expected, with no need to explicitly check for both in the source code (i.e. checking only Global PE is sufficient).

Application process

Expectations

Application status (for a student) during application process







- Submitted: an applicant applying (submitted application) to a specific course; they will be controlled by a local controller to determine if they meet the local requirements to become a candidate.
- Approved: the applicant is now a candidate, i.e. their application has been approved. Next, a confirmation from a teacher is necessary for the applicant to become a participant (in a course).
- Selected: the candidate is now selected to be a participant in a course.
- Rejected: the application has been rejected by those responsible for controlling/checking it.
- Revoked Before/After Selection: we have two statuses for the case where applicant revokes their application, which may happen before/after they are selected; these statuses also apply when applicant is deleted from the active users, for example.
 - The names suggested here are some of many possibilities. Other alternatives are "Revoked Before Approved" and "Revoked Before Selected", but depending on the names of the existing status these new names would imply adding more "Revoke Before XXX" statues when new ones are added between Submitted and Selected.

Add the "target group" field for a course and check it when applying to a course

- Possible values for the field:
 - o For students only
 - For staff
 - For everyone (logged-in)
- These values are checked based on SAML attributes.
 - N.B.: the value of the eduPersonAffiliation attribute may not be correct for all Universities! This needs to be checked!
- Only users of the target group of a course can apply to the course. This complements the existing rules on course applications.
- Take the field into account when processing the "Only courses I've applied to" filter on the home page of the CC.

Tasks

• TODO

Lifecycle of a course Expectations

Introduction to workflow status

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- Course workflow statuses are a set of identifiers (or codes) that help monitor each course's lifecycle, considering all the operations that can be applied to it.
- The status codes are automatically set by the system. In other words, the user does not select or set them directly in the course form. Instead, they click on a button that changes the status. For example, this would enable us to not have to ask which status are settable or not settable by the user from the user interface, had we presented them with a list to pick the status from.

Valid status codes

- draft: a course proposal created by a PE for which a contribution has never been requested.
- contribution requested: only the Lead Teacher can complete the course.
- Two buttons: Save (keeps the status), Finish (moves to "contribution finished" status); changes go into the course table in both cases (i.e. previous versions of the course are lost).
- contribution finished: the Lead Teacher is ready, the PE can review (and modify) and publish.
- published: the course is visible (for everyone), the PE can still edit it but no more contribution requests for the course can be made.
- cancelled: the course has been published, it can still be cloned but all processes on it end (e.g., apply/unapply/...).

Valid status transitions

- draft: the PE can move to "contribution requested" or "published" (in case contribution from teacher is not necessary).
- contribution requested: the Lead Teacher can move to "contribution finished", and the PE can also do this (in exceptional circumstances, e.g. so that they are not stuck).
- contribution finished: the PE can move to "published" or "contribution requested" (for more contributions).
- published: the PE can move it to "cancelled" or "contribution finished" (to unpublish the course).
- cancelled: the PE can move it to "published".

More statuses to be added to those above?

 Temporary note: the statuses below probably duplicate those that are already defined for application process, in which case they might be removed. However, we could also create a new application status such as "In Review"

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that will perhaps be set after the application is submitted but before it is approved or rejected; this would take into account the first status suggested below, but it is probably unnecessary.

- application review (started by local controllers; do we need a confirmation from a local controller that they have started the process?)
- candidates selected
- selected applicants are to be confirmed by a teacher so they become participants
- participants selected/rejected

Visual representation of the workflow

• The initial version of the workflow can be seen in <u>this diagram</u>. An updated version of the diagram is <u>here</u>. More updates are undoubtedly necessary to take the latest changes to the course workflow into account.

Tasks

• At least: replace current "is public" yes/no field with the corresponding status code to be set on each course.

Email notifications

• Unfinished because there are features from the brainstorming document that are yet to be tackled in this document.

Tasks

• Be able to send a notification from source code between two valid email addresses.

Data lifecycle management

Invalidating or removing users

- It should be possible to remove users after a specific time of inactivity (stipulated in GDPR documents).
 - To be completed: this inactivity period before deletion is to be defined between universities (following discussion).

Discarding application data

- We should define an event (or a condition) after which user data provided only for application to courses (e.g. the motivational text) should be deleted. Such an event could have a duration (six months?) following expiration of the course (applications are no longer accepted for the course).
 - To be completed: discussion between universities to agree on a process.

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New features

Add a new status for archiving courses

- The status name would be "archived".
- An archived course is a course with an application deadline that has passed.
- The new status should complement the list of status codes and transitions defined for managing the lifecycle of a course.
- The system should also label archived courses automatically (based on application deadline): see the specific feature below.

Set course status automatically

- The status of each course should be set to archived/published when its deadline changes or has passed.
- For example, this would mean we do not have to check the same "has deadline passed" condition multiple times when reloading a list of many courses (a thousand?). More specifically, the course status is set once for each course periodically or after the course is changed, so that we do not have to recalculate the status when showing it for each course in a huge list, for example.

Add a link to view the details of a course that had not been published yet

- We could use the course permalink in a new form to do this, as described below.
 - The current permalink would keep working as it already does for published courses.
 - E.g. http://<domain_to_course_catalog>/course/<course_id>
 - The new permalink would allow viewing of the details of a course, provided the user is logged in and has expected roles (to be defined). The course details can thereby be viewed even if the course has not yet been published.
 - E.g.
 - http://<domain_to_course_catalog>/course/<course_id>/private

• Moreover, when we click on the eye icon of a course in the backend, instead of the current summary card we would see the new link to view the course details even if it has not yet been published.

Make it clear that courses shown on the homepage have already passed

• On the current version of the course catalogue, all the published courses are displayed to visitors who are also allowed to filter them according to their preferences. This means the course catalogue need not be empty unless the user has explicitly requested a filtering operation that yields no results, e.g. when only courses that are still open for application have been requested but none have been found.

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• However, this approach does not make it clear to visitors that the courses displayed by default are not necessarily open for application. A new feature can therefore be implemented to solve the problem of lack of clarity.

- Here is a possible solution.
 - By default, we show only courses that are still open for application (even if none are to be found).
 - Then add a new button to view courses offered in the past (timeline). If a user clicks on this button, all the passed courses are shown on a timeline. Moreover, when the details dialogue of a passed course is opened all the current information is shown but in black and white.
 - N.B.: the exact appearance and functional requirements of the timeline could be defined when appropriate.

Implement the permanent course concept:

• A permanent course is a course that does not expire in terms of apply/unapply features (e.g. unless unpublished).

• The latest requirements for this feature can be found at: https://github.com/EDUCAlliance/course-catalogue/issues/122.