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# Teaching and Research in the Digital World

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**Abstract:** Academia has entered a new teaching, learning, and researching era: an era in which more and more services turn to digital and online forms, distances are eliminated, geographical borders disappear, and telepresence becomes common. Though accelerated by the pandemic of the last two years, this transition has been in progress for some time. The importance of creatively nurturing students, academic, and scientific staff in the realms of education, practical knowledge, skills, and competence growth has only increased. Investing in best practices in this digital world, both in teaching and in research, supports a connection between the academic world and society at large, raises societal, environmental awareness, and promotes innovation and excellence at all levels. Each of these considerations plays an important role for the EURECA-PRO European University Alliance, a group of eight partner universities from different European countries working together to establish a modern, diverse European institution. This article focuses on how EURECA-PRO partners collaborate to create a digital campus that supports education, research, and innovation. These efforts rely on the Work Package 4 (WP4) and are led by the Technical University of Crete (TUC).

**Keywords:** Joint Digital Campus, e-Services, Learning Management System, Single-Sign-On

## Lehre und Forschung in der digitalen Welt

**Zusammenfassung:** Im Hochschulsektor hat eine neue Ära für Lehre, Lernen und Forschen begonnen. In diesem neuen Zeitabschnitt werden akademische Dienstleistungen zunehmend digitalisiert, geographische Distanzen und Grenzen verschwinden, und digitale Teilhabe wird zum Standard. Diese Veränderungen waren vorhersehbar, wurden allerdings durch die Corona-Pandemie in den letzten zwei Jahren beschleunigt. Zugleich werden innovative Ansätze in Forschung und Lehre und praktisches Wissen und Kompetenzen immer wichtiger. Außerdem ist der Fokus auf die besten Praktiken in Forschung und Lehre in dieser digitalen Welt wichtig für die Verbindung zur weiteren Gesellschaft, für die Handhabung von sozio-ökologischen Problemen und für das Erreichen eines exzellenten Bildungsniveaus. Alle diese Themen sind ein wichtiger Bestandteil der Arbeit von EURECA-PRO, wo anfänglich sieben und derzeit acht Partneruniversitäten zusammenarbeiten, um eine moderne und vielfältige Europäische Universität zu etablieren. In diesem Artikel liegt der Fokus darauf, wie die Konsortialpartner von EURECA-PRO zusammenarbeiten, um einen digitalen Campus zu etablieren, der Lehre, Forschung, und Innovation unterstützt. Diese Aufgabe ist Teil des Work Package 4, geleitet von der Technischen Universität Kreta (Technical University of Crete, TUC).

**Schlüsselwörter:** Digitaler Campus, e-Services, Learning Management System, Single-Sign-On

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## 1. Introduction

EURECA-PRO [1] has a two-fold societal and ecological mission. First, EURECA-PRO uses novel approaches to holistically contribute to Sustainable Development Goal 12 focused on Sustainable Consumption and Production. Additionally, EURECA-PRO works to transform the European Higher Education Area in support of Sustainable Development Goal 4.

Responsible Consumption and Production (RCP) both significantly influences our global society and causes many of our most complex challenges. Without RCP patterns, we would not be able to sustain a healthy environment, society, or economy. For this reason, the EURECA-PRO alliance members have joined forces to form partnerships capable of acting globally and leading research, teaching, and outreach in the field of RCP.

EURECA-PRO's long-term vision is to be a global hub of education, interdisciplinary research, and innovation capable of developing qualitative environmental and social frameworks focused on the sustainable consumption and production of resources and goods. To this end, EURECA-PRO explores the technological, ecological, policy-focused, economic, and societal aspects of RCP as well as their implications for society and industry. One focal point of EURECA-PRO is the question of how to operate successfully as a joint, digital campus—what forms of administration, communication, education, research, innovation, and outreach are most effective? In order to realize our short and long-term visions, it is important that EURECA-PRO students, faculty, and staff are consistently offered a wide range of support services focused on mutual success.

Academia has recently entered a new, digitised era of teaching, learning, and research. This is a fascinating time in which many routine tasks are accomplished online, services increasingly adopt digital and online formats, distances are essentially eliminated, and people can interact, study, and collaborate in real-time teleconferences. As geographical borders thus disappear and diverse, global cultures and traditions interact and blend, telepresence has become a commodity; almost every educated person on the planet has participated in some kind of digital event, whether a conference, a meeting, a lecture, an interview, or

even an examination. Though the pandemic has no doubt accelerated these developments over the last two years, it does not fully account for this digital transition.

Given the increasing global connectedness, it is more important than ever that modern, higher-education institutions like EURECA-PRO support students, faculty, and scientific staff to develop practical knowledge, skills, and competence within this digital context. Moreover, investing in best practices in teaching [2] and research in this realm connects the academic world with society at large, raises societal environmental awareness, and promotes innovation and excellence at all levels. Simultaneously, ongoing quantitative and qualitative indicators are necessary to measure participation and satisfaction as well as to ensure that stakeholder skill and knowledge continues to advance.

The EURECA-PRO digital infrastructure for teaching and research aims to develop a Digital Campus: a virtual, European, higher-education establishment for the joint administration of study programmes, research, innovation, and user management [1, 3]. The Technical University of Crete (TUC) [4] leads EURECA-PRO's efforts to create a digital campus capable of offering a variety of services to all EURECA-PRO Alliance [5] stakeholders (students, faculty, staff, and affiliate users). Specifically, TUC aims to provide all EURECA-PRO Alliance partner universities with user identity and access management services to support transparency and enable all members to access available platforms and digital services. The development of the necessary infrastructure to establish an operational, digital master platform environment and to create a joint, digital campus with common services has been of great importance; this task affects all EURECA-PRO Alliance partner universities and members.

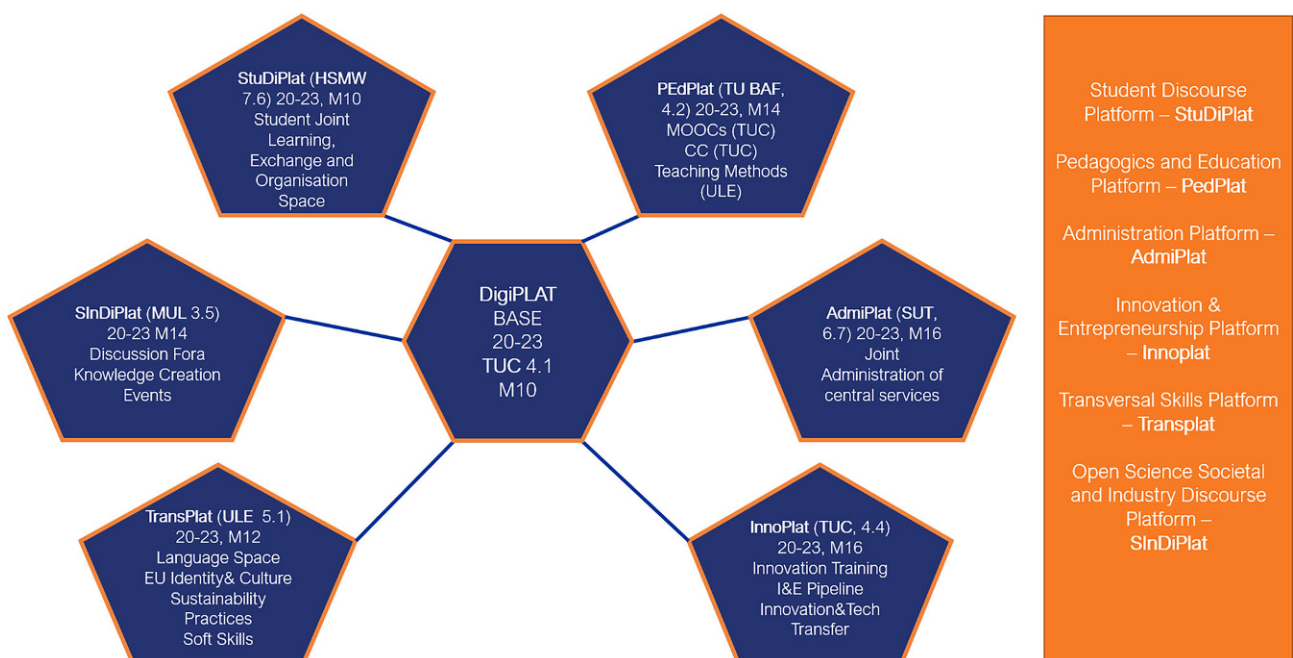


Fig. 1: Overview of the EURECA-PRO Digital Campus infrastructure

TUC leads Work Package 4 (WP4), “Innovation,” within EURECA-PRO and has undertaken the following major tasks toward the creation of a digital campus:

- Develop a Digital Master-Platform Campus to unify administration, education, research, innovation, knowledge transfer, and outreach to industry and society.
- Establish the infrastructure to develop both Credited Courses (CC) and Massive Open Online Courses (MOOC) in digital formats [6] by providing an appropriate learning management system and creating course repositories based on a survey of international best practices.
- Create a digital Innovation and Entrepreneurship platform that includes both digital knowledge transfer mechanisms [7] and administrative space for policy, content, and methodology that supports innovative projects and research.
- Connect existing and developing Innovation and Entrepreneurship Centres to create a joint Innovation training hub (an Innovation Academy). This hub will formulate consolidated value chains, innovation services, and pipelines as tools for creating spin-off companies that facilitate patent licensing and put innovation training course material into practice.

## 2. A Digitised EURECA-PRO

The EURECA-PRO Digital Campus has been designed as a collection of platforms providing different functionalities to serve the needs of the EURECA-PRO community. An overview of this infrastructure is shown in Fig. 1, where platforms are shown as pentagons connected to each other. This design places DigiPlat, as the platform that connects all others, at the centre between AdmiPlat, StudiPlat, PedPlat (now named EduPlat), TransPlat, SIndiPlat, and InnoPlat. The functionality of each platform is briefly described in the table on the right hand side of Fig. 1. Finally, Fig. 1 illustrates that virtually all EURECA-PRO partners are involved in the successful realisation of our digital campus.

Each platform is concisely described in the following paragraphs, along with a quick report on current progress.

The EURECA-PRO Digital Campus has been operational since August 2021, following the establishment of DigiPlat [8]. DigiPlat, the main digital platform, is an Identity and Access Management System that functions within a framework of policies and tools to manage the roles and access privileges of individual network entities (users and platforms/devices) within a variety of cloud and on-premises applications.

Currently, DigiPlat comprises a centralised access management system. Beginning in September 2022, it will transition to a decentralised (i.e., federated) access management system. This will enable users to access all digital platforms and services with one unique, digital Single Sign-On (SSO) identity for user authentication. Efforts continue to be made to meet the need for distributed user provisioning across all EURECA-PRO partners, a circumstance made challenging by the service hosting and management context. Currently, membership in the EURECA-PRO user

directory is strongly tied to membership within a partner university.

A key function of the EURECA-PRO Digital Campus is to support the development and management of digital courses. A Learning Management System (LMS) software for course management, based on Moodle open-source course platform [9], is used as part of the Digital Campus to meet the needs of all educational and training courses. This decision is further analysed and discussed below. This LMS, set up by TUC, covers administration, reporting, documentation, tracking, automation and delivery of educational courses or training, and learning and development programs for a variety of beneficiaries from all partner universities; it has been operational since September 2021.

AdmiPlat [10] is the Administration Platform intended to cover all needs related to the administration of central services. These include student application processes, the uploading of application files, creating candidate profiles, notifying study programs of acceptance, joint student admission and credit recognition processes, e-secretariat services, and a student management information system. These tasks are greatly complicated by the diversity of procedures already established at our partner universities and are occasionally constrained by legal directives. AdmiPlat is currently under development at the Silesian University of Technology (SUT).

StudiPlat [11], a student discourse platform where students can create rooms for communicating with each other, find useful information for certain classes, projects, or activities, and consult fellow students with similar or common interests, offers all students the opportunity for communication and collaboration. The functionality provided allows the formation of different groups or communities based on a variety of criteria and offers varied means of communication (chat, teleconference, etc.). StudiPlat has been operational since August 2021 and is managed by Mittweida University of Applied Sciences (HSMW).

PedPlat (now named EduPlat) [12], an Education and Pedagogics Platform, targets course development and content creation for Credited Courses (CCs), Massive Open Online Courses (MOOCs), training courses (such as lecture series and summer schools), and instructors’ training courses. PedPlat has been hosted and managed directly on the EURECA-PRO LMS [6] since September 2021 and provides a database of all complete courses hosted on the LMS. Diverse course content is gradually contributed by all partners.

TransPlat [13], a Transversal Skills Training Platform, offers users Co-Teaching Training, Digital Skills Training, Soft Skills Coaching, and STEM awareness training. TransPlat has been hosted directly within the EURECA-PRO LMS [6] since January 2022 and is managed by the University of León (ULE).

SIndiPlat [14], an Open Science Societal and Industry Discourse Platform, functions as a dialogue hub, a digital communication platform, a citizen science forum, an open science consultation and training space, a shared workspace for researchers, and a depository of events, media articles, and information on projects and funding

calls. SInDiPlat has been operational since December 2021 and is managed by the Montanuniversität Leoben (MUL).

InnoPlat [7], the digital Innovation and Entrepreneurship platform, creates digital knowledge transfer mechanisms, administration space for policy, and content and methodology in support of innovative projects and knowledge transfer activities (both personalised and codified transfer). Administration space for innovation policy documents is offered through a cloud file sharing service that TUC provides to all partners to facilitate collaboration and interaction. Knowledge transfer mechanisms (such as the Innovation Observatory) are built as a structured collection of innovative projects, products, methods, and knowledge transfer activities such as training courses on innovation and entrepreneurship offered through the LMS. The development and implementation of innovation and entrepreneurship training courses [15] that teach business basics expands participant's ability to turn ideas into business concepts and offers EURECA-PRO Alliance shareholders opportunities for virtual and physical mobility. InnoPlat has been operational since February 2022 as a platform; content has been frequently enhanced ever since. TUC is responsible for InnoPlat.

InnoPlat, along with all the other aforementioned platforms, will eventually connect existing and developing Innovation and Entrepreneurship Centres, Knowledge Transfer Centres, and Technology Transfer Offices to create a master research and innovation hub: the Innovation Academy. The Innovation Academy will formulate consolidated value chain innovation services and pipelines in support of joint spin-off companies, facilitate patent licensing, establish lab-to-market support mechanisms, form new alliances with industry to create opportunities for student internships, expand to include industry, government agencies and services, and the community at large, provide services such as continuing education courses, summer courses, and seminars on RCP, and put innovation training course material into practice.

Having presented the overall structure of the EURECA-PRO digital campus, we will now discuss the challenges facing the development of digital infrastructure:

- All services that we offer (such as student management and admission systems) need to be based on secure and GDPR-compliant solutions.
- Coordinating a big team with diverse expertise can be cumbersome, yet, the involvement of many players (including academic personnel in addition to IT specialised staff) is mandated.
- Differing national environments (both financial and legal frameworks) impose extra constraints on technical developments.
- In the absence of a centralised student information management system (SMIS), and in order to avoid manual administration of student mobility, interoperable solutions among different SMIS may be implemented to exchange student data. This would put extra strain on university IT staff.

### 3. Adopting a Common Learning Management Systems (LMS)

We now turn our attention to a digital campus component that plays a central role in teaching and research in the digital world: the Learning Management System (LMS). In this section, we focus on how EURECA-PRO partners coordinated to analyse requirements and ultimately arrive at a decision to adopt the LMS.

LMSs are course management platforms designed to deliver adult and higher education to adult learners regardless of geographical location. These various eLearning platforms encourage engagement and knowledge sharing between instructors and adult learners asynchronously and synchronously [16]. A LMS helps to deliver online training materials and supports skill development in addition to being used to plan, implement, and assess specific learning processes. LMSs have two types of set-up requirements:

- I. Cloud-based LMSs do not need to be installed locally, but nor do they offer great flexibility in integrating branding or customising dashboards. Nevertheless, they offer low-cost and hassle-free deployment.
- II. Self-hosted LMSs, which need to be downloaded and installed locally, offer creative control customisation. Self-hosted/licensed LMS platforms also include available open-source software platforms.

The main tools that all LMSs provide are:

- Asynchronous and synchronous communication
- Content development and delivery
- Formative and summative assessment [17]

The main features and functions that a LMS comprises are listed below:

1. Create and update training modules

A solid LMS will allow instructors and teachers to create individual courses, chapters, and lessons. Users should be able to easily switch courses, re-order course material, and add new content.

2. Importing lessons and students

A LMS provides the ability to import training videos, audio files, and PDF files to develop the content of a lesson. Additionally, it allows the automatic enrolment of students from another system or massive registration through a file.

3. Manage users and control their access levels

Administrators can enable or disable user access to certain features to ensure sensitive information is protected. A LMS needs to accommodate a variety of users in addition to students (administrators, course admins, revenue partners, and analysts).

TABLE 1  
**Summary of the results of the questionnaire on LMSs used in partner institutions**

Data\Partner	MUL	TU BAF	UP	TUC	SUT	ULE	HSMW
Main LMS	Moodle	OPAL	Academis	Open eClass	Moodle	Moodle	OPAL
Self-hosted or cloud-based	Self	Cloud	Self	Self	Self	Self	Cloud
Open source	Yes	No	No	Yes	Yes	Yes	No
Fee (€/year)	No fee	>20,000	1000–5000	No fee	No fee	No fee	>20,000
Licensed users	250	250	200	200	1800	1192	7600
Students	4000	4000	3700	5000	20,000	11,550	7000
Secondary LMS platform	–	–	–	Moodle, Web-Courses	MS Teams	–	Moodle

#### 4. Quizzes, activities, and assessments

Online quizzes and activities help instructors to assess whether students are learning effectively and to make the course experience more interactive.

#### 5. Report generation: assessment scores, student progress, and engagement

A LMS should generate reports that keep track of student enrolment and engagement.

#### 6. Course calendar and due dates

A calendar allows teachers to list the intended course schedule, set due dates, and send reminders to students when certain modules need to be completed.

#### 7. Certificates

A great addition to a LMS is the ability to generate certificates or to integrate a separate system that will generate certificates and completion badges.

#### 8. Drip content and module delivery

A drip schedule controls student access to course content and allows the instructor to give a specific launch date or to limit the number of lessons that can be viewed in a certain time period. This is useful if a series of training modules must occur in a certain order.

#### 9. Email or SMS notifications

Email or SMS notifications alert instructors and students to course events such as grade postings or assignment submission deadlines.

#### 10. Social learning features

The integration of social media facilitates discussion within a course, enables social learning, and provides an avenue to publicly ask the instructor questions so that the entire group can benefit.

As a first step, information regarding the LMSes used in partner institutions was collected through a questionnaire. The majority of institutions use Moodle as either their main or secondary LMS platform. More specifically, three institutions (MUL, SUT, ULE) used Moodle as their main LMS and two institutions (TUC and HSMW) used it as a secondary system. The rest of the institutions used nationally developed systems as their main LMS: OPAL is used by Technische Universität Bergakademie Freiberg (TU BAF) and HSMW, Academis is used by University of Petrosani (UP), and Open eClass is used by TUC. The majority of the seven (at that time) institutions used self-hosted (5/7), open source (4/7), no fee (4/7) systems. Institutions using Moodle stated that it fully covered their instructional needs and that a supportive online community compensated for the absence of support by a vendor. More detailed information regarding the LMSes used in each partner institution is listed in Table 1.

Completing the market survey and comparative study of the main software systems used in partner institutions and determining the expected number of users as well as their needs were major steps toward the implementation of a digital master platform and its corresponding sub-platforms to serve EURECA-PRO. The specifications of the most important software tools considered were discussed extensively among the consortium members before a decision was made regarding the LMS to be utilised by EURECA-PRO.

Based on a market survey, the comparative study presented above, and subsequent discussion, the EURECA-PRO Digital Joint Campus decided to use Moodle as its LMS [3]. Given that Moodle served as the main or secondary LMS of a majority of partner institutions, most of EURECA-PRO had acquired experience using Moodle. In addition, Moodle is truly open source; this means it is affordable, configurable, highly flexible, and that it has many features (there are hundreds of plugins that allow unique Moodle configuration). In addition, Moodle is interoperable with other software used by partner universities (e.g. web conferencing tools), it is supported by a global community, it is quite well-documented in English, the software is updated regularly (bugs are detected and fixed quickly), and it is trusted worldwide. Furthermore, the on-premises solution allows for scalable setups—for example, the webserver and the database could be installed onto separate servers. In general, Moodle scales easily by increasing hardware. Us-

ing the cloud version of Moodle was not considered since it not only costs money, but is also very restrictive (it does not support a large number of users and the file space is limited; hence it does not meet the high e-learning demands of a university). EURECA-PRO's decision to use Moodle was a major step toward the implementation of our digital campus and its corresponding sub-platforms.

#### 4. Conclusion

In this article, we discussed the challenges of teaching and researching in the ever-changing digital world faced by many European University alliances as well as a number of specific challenges faced by the EURECA-PRO European Universities. This ongoing digital transformation, in addition to posing numerous challenges, also presents several opportunities. It is in the best interests of all higher education institutions to look closely at these challenges and opportunities and to adapt appropriately in order to serve their members in new and innovative ways.

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