EPiC Series in Computing

Volume 105, 2025, Pages 276–283

Proceedings of EUNIS 2024 annual congress in Athens

Examining IT Infrastructures for Learning and Teaching in the European University Alliance Unite!

Martin Ebner[1], Sandra Schön[1] , Jesus Alcober[2], Roberto Bertonasco[3], Katharina Gasplmayr[1], Agnieszka Herczak-Ciara[4], Christian Hoppe[5], Etienne Langevin[6], Romain Laurent[6], Philipp Leitner[1], Juha Martikainen[7], Joakim Petersson[8], Nina Reignier-Tayar[6], Fernando M. da Silva[9], Klaus Steitz[5], Behnam Taraghi[1], and Astrid Würz[5]

[1] Graz University of Technology, Austria,
[2] Universitat Politecnica de Catalunya, Spain
[3] Politecnico Di Torino, Italy
[4] Wrocław University of Science and Technology
[5] Technical University of Darmstadt
[6] Grenoble INP graduate school of engineering and management, University Grenoble Alpes
[7] Aalto University
[8] KTH Royal Institute of Technology
[9] Universidade de Lisboa
martin.ebner@tugraz.at

Abstract

In the digital era, European University Alliances like "Unite!" work to reshape tertiary education by bridging nine prominent universities to champion regional integration, technology transfer, and quality science and engineering education. This paper delineates the methodologies used to harmonize varied IT infrastructures visualizations and descriptions across partner institutions, fostering knowledge sharing and facilitating standardized IT landscape comparisons. The absence of a general universal approach in representing teaching-related IT systems in higher education propelled the development of a unique, synchronized representation methodology. The paper offers a look at TU Graz's digital infrastructure as an illustrative example. Through iterative collaboration, the alliance will develop a comprehensive IT infrastructure report, aiming to serve as a valuable blueprint for other educational entities.

R. Vogl, L. Desnos, J.-F. Desnos, S. Bolis, L. Merakos, G. Ferrell, E. Tsili and M. Roumeliotis (eds.), EUNIS 2024 (EPiC Series in Computing, vol. 105), pp. 276–283

1 Introduction

In our rapidly evolving digital age, the significance of education and collaboration has grown immensely. The concept of "European Universities" — transnational alliances working towards shaping the future of tertiary education — has gained traction. These alliances, while aiming to bolster European values and identity, also aspire to elevate the quality and competitiveness of higher education in Europe, incorporating aspects like the inter-university campus (European Commission, 2023).

The European Alliance "Unite!" (see https://www.unite-university.eu/) exemplifies this drive, merging nine esteemed universities: Technical University of Darmstadt, Aalto University, Graz University of Technology (TU Graz), Grenoble INP graduate school of engineering and management, University Grenoble Alpes, KTH Royal Institute of Technology, Politecnico Di Torino, Universidade de Lisboa, Universitat Politècnica de Catalunya BarcelonaTech, and Wrocław University of Science and Technology. Located in strategic European regions recognized for economic acumen, innovation, and entrepreneurship, they collectively champion regional integration, technology knowledge transfer, and superior education in science and engineering, drawing from their multidisciplinary strengths. Three core platforms were developed during the early Erasmus+ funding phase: the Unite! Website, offering a centralized communication hub; the Unite! uShare, a shared data platform for alliance members; and the "Metacampus" built on Moodle, designed to facilitate the construction of an interoperable and federated learning platform across several universities and support future learning experiences (Alcober Segura et al., 2021; Alcober Segura et al., 2022). The evolution and enhancements of these platforms are well-articulated by Alcober and Mohammadali (2023).

To harmonize the varied IT backgrounds across the partner institutions, an initiative was launched in November 2022 to capture comprehensive infrastructure representations. This effort aimed to promote a systematic description of each partner landscape, facilitating knowledge sharing and the identification of common building blocks and processes of all partner institutions.

In this paper, we outline the methodologies applied to obtain these holistic IT infrastructure representations. Our goal is to provide valuable insights for similar undertakings, ensuring they can leverage our experiences and findings. For the Unite! alliance, crafting concise and insightful IT representations was paramount, ensuring they are understandable to external entities and standardized for comparison. The full results of our methodology, but not the approach itself, are described in Ebner et al. (2024).

2 State of the Art: About the development of systematic descriptions and comparison of learning and teaching IT infrastructures in higher education

The concept of "digital campus" emerged not only to emphasize the inadequacy of learning management systems, but also to underscore the necessity for a "sustainable digital infrastructure for future campuses" (Kerres, 2004, p. 1). Today, the "digital campus" not only pertains to universities but also encapsulates the digital workspaces of companies and organizations (Unity.de, 2023). Within our working group, the focus is squarely on the IT infrastructure supporting teaching and learning in the first run.

Subsequently, we present examples demonstrating potential representations of such infrastructures. The portrayal of IT landscapes, or digital campuses, of educational institutions can be approached from varied viewpoints. For instance, Moșteanu (2021) delineates the distinctions between students' perspectives and administrative viewpoints (refer to Figure 1).

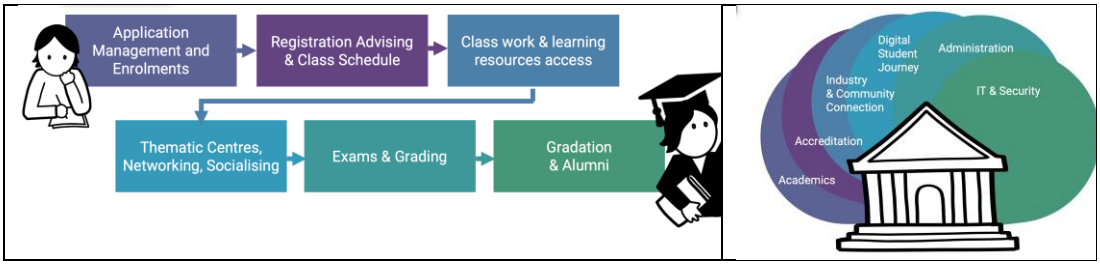

Figure 1: Variations in depicting a digital campus: Student perspective (left) versus administrative perspective (right). Adapted from illustrations by Moșteanu (2021), Fig. 1 (left) and Fig. 2 (right).

The methodologies for describing information systems related to learning and teaching in higher education can vary widely. A scan of higher education information system sketches reveals a plethora of diverse representations. Habraken (2008) proposed a reference architecture for e-learning within a master's thesis, while Stacey (2010) assembled diagrams of learning management systems. Thackaberry (2017) offers an assortment of visual depictions of online learning infrastructures across colleges. However, even a contemporary online search does not suggest any universally accepted representation methodology. This variation likely arises because these illustrations not only stem from different perspectives (as depicted in Fig. 1) but also serve varied objectives, such as showcasing data flows, pinpointing bottlenecks, highlighting dependencies, or demarcating IT organizational responsibilities.

Some efforts aim to produce intricate, layered visualizations. For instance, Nordén's (2018) "Milky Way" concept represents an enterprise technique for charting business capabilities, encompassing value chains, IT systems, customer interactions, and more, all aiming for iterative enhancement. Nauwerck et al. (2022) adapted this concept to university IT infrastructures, highlighting its potential applicability. Yet, the "Milky Way" approach presents multifaceted images from multiple angles, sometimes even incorporating heatmap elements to signal areas necessitating refinement. While promising, it appears overly intricate for our project's objectives.

Our exploration of these diverse representations underscores the absence of a standardized approach to depict teaching-related information systems in higher education. Furthermore, we found no references detailing practices adopted by other institutions within the European University Alliances. This void motivates us to outline our unique methodology.

3 Step-by-step description of the Unite! approach to describe partners' digital educational infrastructure

Our approach was fundamentally driven by several pivotal questions: What are the ideal formats for these descriptions? What common frameworks exist, and how are our partners utilizing them? Which standards for presentation and organization are most logical? How can we achieve consensus, especially considering the variances in infrastructure?

Figure 2 provides a schematic of our methodology, illustrating how we endeavored to obtain synchronized, coherent, and insightful depictions of IT infrastructures related to teaching and its academic management across all partner universities. For temporal context, we have also incorporated pertinent dates.

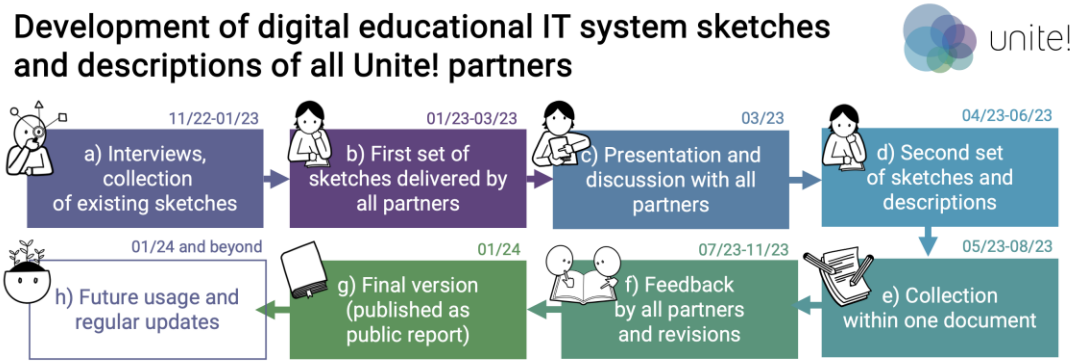

Figure 2: Development of digital educational IT system sketches and descriptions of all Unite! partners at a glance

Our progression was methodical and can be summarized as follows:

(a) Initially, we sought meetings with all partners, inviting individuals well-versed in delineating the digital educational infrastructure of a university. In these meetings, we articulated our goal: to achieve consistent depictions across all partner universities. Several partners already had preliminary system diagrams. We introduced an initial representation of Graz University of Technology's infrastructure as an example. The ensuing discussions around the contrasts and parallels in our systems were productive and well-received. There was a palpable sense of understanding and dedication to the shared objective. Post this preliminary dialogue, we refined the TU Graz sketches, presenting them as a potential blueprint. Nonetheless, the subsequent directive for (b) was laid out with considerable flexibility:

> "Each partner university is asked to contribute with a digital educational system landscape visualization and description as well as with a student journey visualization and description. Please name technology and versions of all digital educational system structures, esp. applications related to educational content within the partner universities. There is not a "final" idea about the illustration and design consideration. But we are sure to develop step-by-step by sharing and comparing the sketches. Please use the existing sketches and links for inspiration. We will use Draw.io to have the same visual possibility." (from our template)

During our first in-person project meeting, we (c) showcased all the sketches, both in enlarged printouts and digitally, with responsible partners narrating each presentation. Ahead of this, we had formulated a "checklist" delineating the elements expected in each representation. This checklist served as a discussion point and was subsequently adopted as a foundation for further refinements. Post-meeting, we evaluated the various representation styles to identify the most effective approach, subsequently crafting a template with detailed guidelines. This refined template was then presented and debated in an online session before being redistributed to all (d). Subsequently, all refined sketches and descriptions were amalgamated into a collective report, upon which feedback was solicited from all partners. We are currently in the stages of further refinement and finalization (g) to establish a robust foundation for upcoming developments (h).

4 Illustrative representations of a partner university

To provide more than just a procedural account, we subsequently exhibit the current depictions of TU Graz's digital educational infrastructure. This depiction not only elucidates TU Graz's systems and

situation, but also serves as a comparative model alongside the other Unite! partners (see Figures 3 and 4).

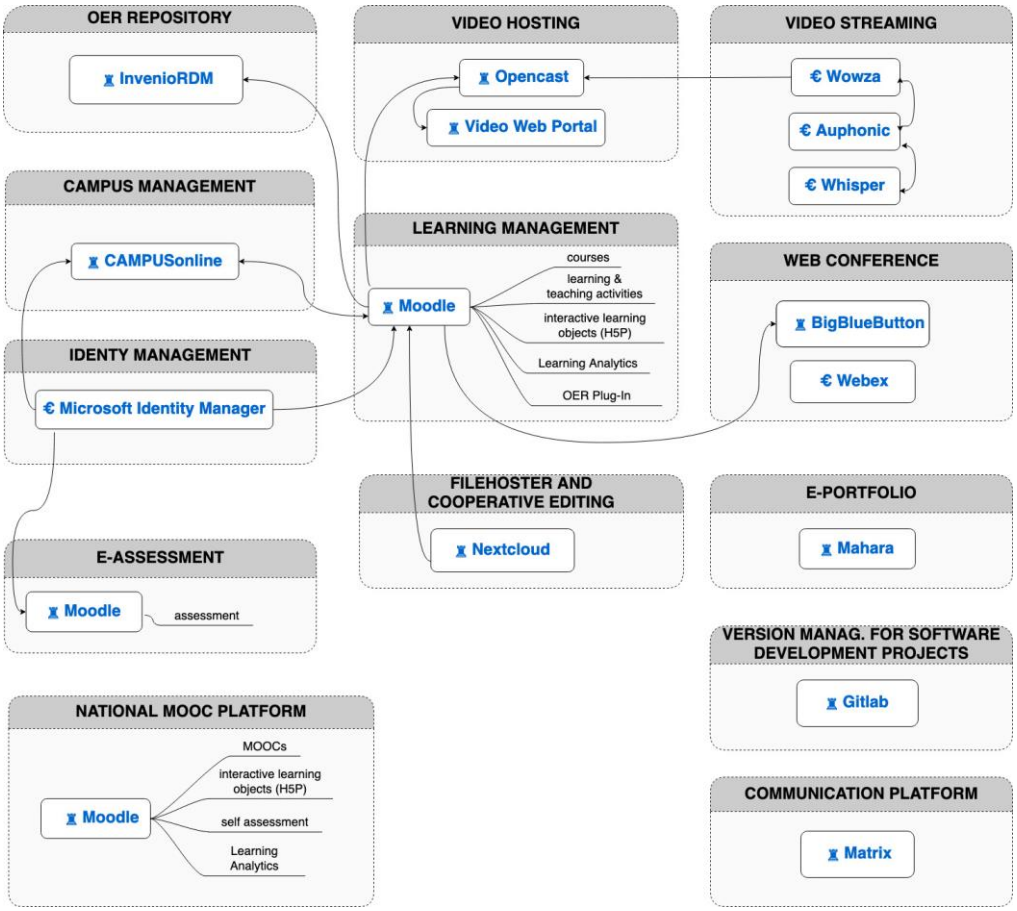

Figure 3: TU Graz's Digital Educational Infrastructure Overview (left).
We decided to use x for on-promise tools and the € sign for not on-promise tools.

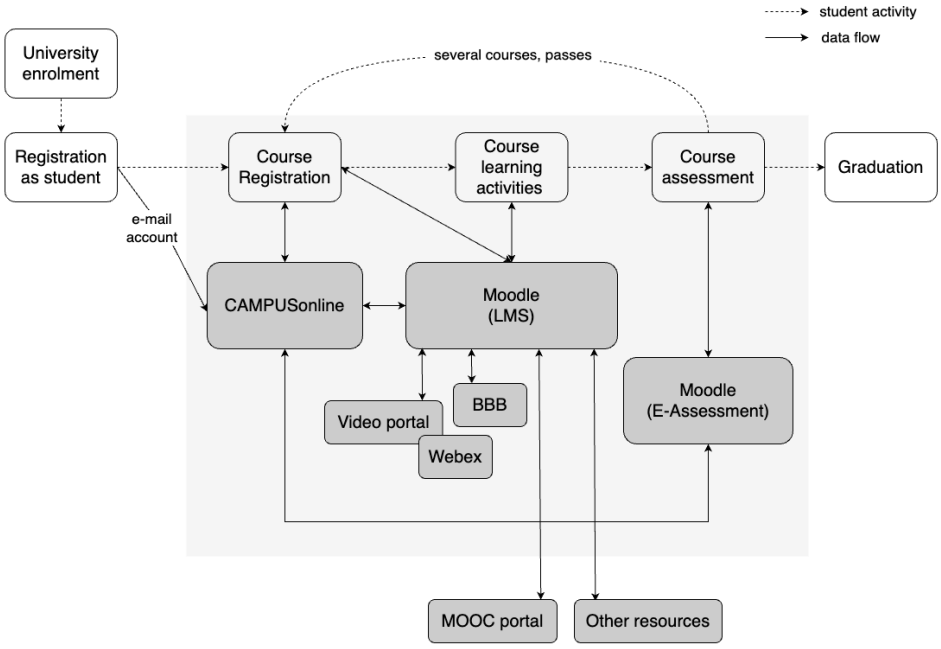

Figure 4: Student's Lifecycle Through Digital Educational Systems (right)

Beyond the visual delineations, we also solicited a text-based description. Displayed here is only the structure; it encompasses concise overviews of all systems and tools (highlighting the product name and primary function), a segment outlining unique attributes (for instance, specifics of the university system or national tools), and, if relevant, a section detailing present and prospective trajectories.

5 Recommendations and future directions

Our approach was met with profound understanding, keen interest, and dedication, showcasing an appreciation for our transparent methodology. The templates we provided were pragmatically utilized. One challenge was aligning the diverse tasks mentioned in the project description with potential uses for these representations. For instance, while one task pertained to the integration of mobility applications, another focused on the integration of services - a task yet to be fully defined in terms of its specific objectives and driven in part by requirements analysis. When there is more clarity and singularity of purpose of such sketches, the process undoubtedly becomes smoother.

Through our interactions and in-depth presentations, the unique circumstances of certain partners were accentuated. For instance, one partner institution is the product of a recent merger and still operates using dual, overlapping infrastructures. Another has a partial federated architecture, and there are slight variations at faculty level and university wide level. There are also partners relying on national systems unfamiliar or unparalleled in other countries. We eagerly anticipate presenting these nuances in our comprehensive report scheduled for spring 2024, which we believe will be an invaluable internal resource. Concurrently, we hope our procedural descriptions and exemplars can guide other universities and alliances in sculpting their respective strategies.

Acknowledgement

The Unite! alliance has received funding from the European Commission. The work presented herein was accomplished collaboratively with invaluable input and feedback from e-learning and IT experts across all partner universities in Unite! Community 2 Digital Campus. We extend our heartfelt gratitude for their exemplary cooperation. We would like to thank you for the excellent cooperation and apologize that we do not might mention every single contributor by name.

References

Alcober, J., & Mohammadali, F. H. (2023). The digital platform for the Unite! Alliance: The Metacampus. 9th International Conference on Higher Education Advances (HEAd'23), Universitat Politècnica de València, València, 2023, DOI: http://dx.doi.org/10.4995/HEAd23.2023.16265

Alcober Segura, J. Á., Llorens García, A., Adam, A., Oller Aubia, M., Prat Farran, J. D. A., & Alier Forment, M. (2021). La Conceptualització del Metacampus d'Unite!. In FIET2021: la investigació i la innovació en tecnologia educativa a l'era digital: 27-29 octubre 2021: llibre d'actes (pp. 7-17). Publicacions URV.

Alcober Segura, J. A., Llorens, A., Adam, A., Oller, M., Prat, J., & Forment, M. A. (2022). La conceptualització del metacampus d'Unite!. In Llibre d'actes FIET2021: La investigació i la innovacióen Tecnologia Educativa a l'era digital (pp. 7-17). Publicacions URV.

Ebner, M., Schön, S., Alcober, J., Bertonasco, R., Bonani, F., Cruz, L., Espadas, C., Filgueira Xavier, V., Franco, M., Gasplmayr, K., Giralt, J., Hoppe, C., Koschutnig-Ebner, M., Langevin, E., Laurent, R., Leitner, P., Martikainen, J., Matias, J., Muchitsch, M., Oller, M., Pereira, A.B., Petersson, J., Santiano, G., Schmidt, A. da Silva, F.M., Steitz, K., Taraghi, B., Torchiano, M., Villas, S., Würz, A. (2024). Aligning IT infrastructures for digital learning amongst the European university alliance Unite! - The Unite! digital campus framework and requirements (1.0). Unite! Community 2 Digital Campus, Graz University of Technology. https://doi.org/10.3217/36yen-0wy21

European Commission (2023). European Universities initiative. URL: https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative

Habraken, J. (2008). Reference Architecture for e-Learning Solutions. A Master Thesis at Open University UK, URL: https://core.ac.uk/download/pdf/55534292.pdf

Kerres, M. (2004). Beyond Learning Platforms: Infrastructures for the Digital Campus. In Proceedings of 6th International Conference on New Educational Environments (ICNEE04). https://www.researchgate.net/profile/Michael_Kerres/publication/268374536_BEYOND_LEARNING_PLATFORMS_INFRASTRUCTURES_FOR_THE_DIGITAL_CAMPUS/links/55103ac40cf2ba84483d3184/BEYOND-LEARNING-PLATFORMS-INFRASTRUCTURES-FOR-THE-DIGITAL-CAMPUS.pdf

Moșteanu, N. R. (2021). Digital Campus–a future former investment in education for a sustainable society. In E3S Web of Conferences (Vol. 234, p. 00029). EDP Sciences.

Nauwerck, M. L. G., Winckler, A., & Cederberg, M. (2022). Visualising the digital transformation of research data management and student administration the Milky Way. EUNIS conferene 2022, URL: https://www.eunis.org/download/2022/EUNIS_2022_paper_42.pdf

Nordén, C. (2018). The Milky Way - Map, Navigate and Accelerate Change. IRM Consult AB.

Stacey, P. (2010). Architecting EdTech. Published in edtechfrontier.com. URL: https://edtechfrontier.com/2010/06/07/architecting-edtech/

Thackaberry, S. (2017). Articulate the technology systems that integrate into a college-wide online learning infrastructure. Published on personal Website, last modified 2017. URL: https://edusasha.com/the-guide-to-everything-elearning/elearning-infrastructure-and-architecture/

Unity.de (2023), Webpage, URL: https://www.unity.de/en/services/digital-campus/ (2023-06-14)