

EUNIS 2020 Congress

Wednesday 10 June - Friday 12 June 2020

University of Helsinki, Finland and online

Book of Abstracts



EUNIS at a glance

EUNIS is the European University Information Systems Organization. EUNIS brings together those who are responsible for the management, development and the policy for Information Technology in Higher Education in Europe.

In the beginning of the 90's OECD started a study about the impact of Information Technology on Higher Education Institutions. It must be remembered that it was a time when the Internet did not exist and very few things were known in the different European countries about what was going on in other countries. As usual at OECD the study ended with a seminar where a number of IT managers in European universities participated.

One of the outputs of this seminar was the decision, by some participants, to establish a European organization and the founding members meet in Paris, France, at UPMC (now Sorbonne Université) in May 1993. In the beginning EUNIS was just a series of informal meetings between leaders, in Western Europe, to exchange information. The first congress, held in Düsseldorf in 1995, was such a success that it was decided to enlarge the young organization to all Europe. EUNIS later, was registered as a non-profit organization in Paris in 1997.

The objective of EUNIS is to contribute to the development of high-quality information systems. To achieve this, the aims of EUNIS are:

- *encourage exchange, cooperation and debates between those responsible for information systems in higher education or research institutes/organizations within Europe;*
- *establish relationships with supervisory organizations in charge of information systems in higher education and in research institutes in each country as well as at European level.*

#EUNIS2020 becomes Virtual Helsinki

Our main goal for the EUNIS2020 was again to offer the most significant meeting place for digitalization of higher education in Europe to encourage exchange, cooperation and debates among experts, practitioners and managers responsible for information systems in higher education and research institutes/organizations within Europe.

We sadly had to announce in March that due to the Covid-19 outbreak we are forced to cancel the EUNIS2020 Congress in person in June. Due to the travel restrictions, our planned event at the University of Helsinki in Finland, has become our first ever fully online Congress. The event will be held online in Zoom. A combination of plenary sessions, workshops, panel discussions and short papers followed by group discussion, will offer you opportunities for networking and dialogue with all the attendees from all over Europe.

The main theme for EUNIS2020 was “opening education for the future”, where we covered a wide range of areas within digitization and future campus development for Higher Education as Leadership & Management, ICT, Infrastructure & Security, Learning, Teaching & Student Experience, Software Development / Innovative Concepts, Interoperability and Research.

Thank you all for virtually attending the EUNIS2020 congress online.
Welcome to Virtual Helsinki!

Suvi Valsta

Congress Supervisor

The organizers

About University of Helsinki

The University of Helsinki (UH) is a university located in Helsinki, Finland since 1829, but founded in the city of Turku in 1640. At UH more than 30.000 students are enrolled in the degree programs of the university spread across 11 faculties and 11 research institutes. It has been ranked a top 100 university in the world according to the 2016 ARWU, QS and THE rankings.

The university is bilingual, with teaching by law provided both in Finnish and Swedish. Since Swedish, albeit an official language of Finland, is a minority language, Finnish is by far the dominating language at the university. Remaining true to its traditionally strong Humboldtian ethos, the University of Helsinki places heavy emphasis on high-quality teaching and research of a top international standard.

It was a pleasure to host EUNIS 2020 at the University of Helsinki.

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Cultural Change in Digital Transformation within Higher Education

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Keywords

Digital transformation, Higher Education IT, Cultural Change.

1. SUMMARY

The role of information technology within higher education is changing radically with the progress of digital transformation. This implies significant changes in several areas. The focus has typically been in the business change, in the processes, and in the new technology. However, cultural aspects have recently been identified as the most important road blocker for organisations to take digital transformation forward. Recently, we have seen how significant external events, such as the Covid-19 pandemic, can accelerate and redirect change at the cultural level.

This paper investigates selected aspects of cultural change required by digital transformation and examines them in the context of the Higher Education sector. We will present a simple framework that allows institutions to find the best approach for addressing cultural change when implementing digital transformation.

2. THE NEED FOR A CULTURAL CHANGE

Digital technology is affecting all aspects of the organisation. The most obvious changes take place within technology and in the processes using them. Typically, automation and self-service are being applied to areas where manual processes have traditionally been in use. This work has usually focused on the back end of the business, leaving the forefront unchanged. When the use of technology extends to the customer-facing part of the business, this typically results in disruptions and radical changes in the business itself.

It has been observed that the above changes can only reach their full potential if also the culture of the organisation changes to support the new role of technology. In a study by McKinsey, cultural and behavioural challenges have been identified as the most significant challenge to meeting digital priorities (Goran et al, 2017). This evolution of digital transformation is illustrated in Figure 1.

Layer		Primary goal
Culture	↑	Maximising benefits
Business	↑	Front-end improvements
Processes	↑	Back-end improvements
Technology		Cost efficiency

Figure 1. Evolution of Digital Transformation through layers of impact.

3. KEY ELEMENTS FOR CULTURAL CHANGE IN HIGHER EDUCATION

In higher education, we have identified the following seven cultural items to be at the core of the required change:

- *Focus on the customer.* In the past, organisations have been optimising their operations from the delivery perspective and this has often left the customer bridging the gap between different parts of the service process. In higher education, this manifests itself through the

number of separate student support functions that are not working together in an optimal way. With digital tools, the processes can be changed to provide a smooth end-to-end process and a seamless student experience.

- **Digital first.** The traditional model for service design has been to first build manual processes and then upgrade them into the digital world. This often introduces unnecessary steps in the process and limitations in flexibility. Turning this the other way around and designing the digital version first will allow organisations to create future-proof processes while still maintaining the possibility to introduce manual interventions wherever needed.
- **Calculated risk taking.** The higher education sector has traditionally been risk-averse in its decision making, and this has introduced several controls, such as yearly planning rounds, budgetary controls, and complex governance models. To be able to survive in a rapidly changing business environment new approaches, such as “failing fast” will be essential and this will in turn change the current practices.
- **Agility.** To be able to survive and thrive in a fast-changing digital environment, organisations need to be flexible and agile in their development activities. This way, they can adopt to changing requirements and use learnings obtained during the development work. As a result, the outcome will be better aligned with business requirements and user needs.
- **Open innovation.** Accessing and exploiting outside knowledge while allowing internal experts to interact with the external world will be critical for keeping up with the rest of the world. Higher education has been strong in this area amongst the sector itself but there has been a lack of exchange between the HE community and other business sectors.
- **Breaking silos.** To be able to exploit the full benefits of digital technology, cross-organisational processes are critical for the success of the organisation. This in turn requires working across silos and using cross-functional teams to create and support truly customer-centric services.
- **Data at the core.** To support fact-based decision making at all levels of the organisation, there is a need to have a consistent and holistic view of the organisation’s information resources. In higher education, the focus of data management has been on statutory reporting and operational activities. Consequently, there is typically a need to change the full flow of data from the source all the way to the decision-making process.

4. CONCEPTUAL FRAMEWORK OF CULTURAL CHANGE ELEMENTS

Based on the observations in the previous section, we can identify interdependencies between the different core cultural items to address digital transformation. To provide a full image, it is useful to indicate business challenges that are linked to the above cultural items. In our analysis, we are using the following typical challenges: (1) Student/staff dissatisfaction, (2) Slow pace of change, (3) Inefficient organisation, (4) Inefficient decision-making, and (5) addressing significant external events, such as the Covid-19 outbreak. The result is illustrated in Figure 2.

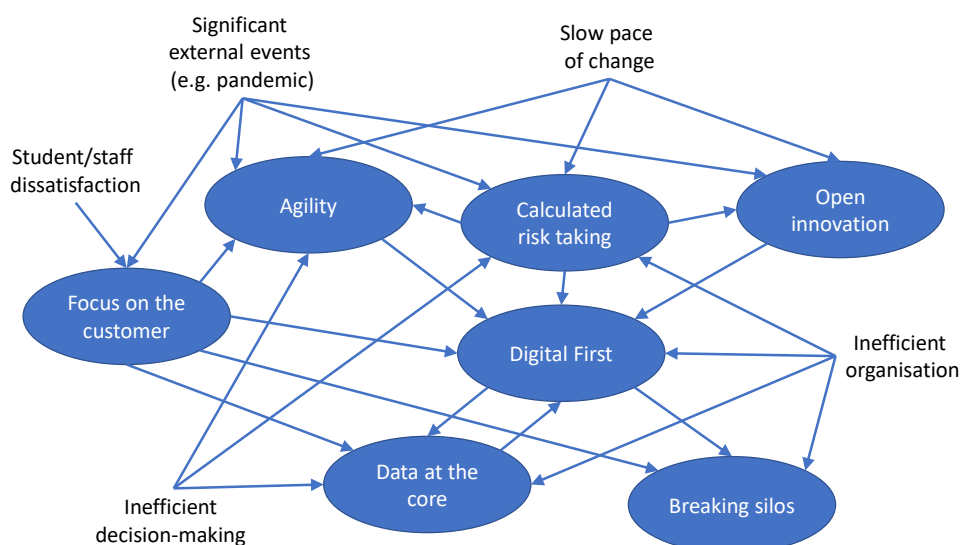


Figure 2. Framework of cultural change elements and related business challenges.

The full paper will analyse the dependencies of the above diagram and will provide a simple framework for institutions to address their own challenges in their journey to the digital future.

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Maximising benefits from ICT in Federated/Hybrid organisation models and balancing the roles of CIO & CPO function in Higher Education

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Keywords

ICT Organisation models, Centralised vs Federated vs Hybrid IT, ICT Operating models, Balancing CIO and CPO role, maximising commercial value through ICT.

1. Summary

The objective of the paper is to share a simple governance framework to discuss the skills, competencies and structures required to meet the demands of federated and hybrid ICT models. There are multiple ways in which ICT organisations can seek to provide value to the business. The paper shows four different types of ICT organisation models driven by the complexity of business and ICT's role. For each model, efficiencies and business value is typically sought after with different approaches, such as driving standardisation, managing business complexity or enhancing the agility of IT. The paper also illustrates example structures for ICT for demonstrating the differences between the common models - Centralised, Federated, Hybrid. The second part of the paper dives deeper into how commercial benefits are driven for different ICT organisation models. Higher education will be used as an example to illustrate the models.

2. DIMENSIONS AFFECTING THE IT ORGANISATION

The purpose of the ICT organisation is to add value to the business with technology. The structure and operating principles of the ICT function depend on several factors, but the following two dimensions often influence design choices:

1. **What is the role of ICT for the organisation?** If the role of ICT is to be an invisible enabler, the ICT organisation has often only a loose connection to the rest of the business and is seeking efficiencies through standardisation. However, if the role is to support digital transformation in the business, ICT activities have tighter links to the business and the focus is on agility and business alignment.
2. **How complex or diverse is the business to be supported?** If the business has a clear focus on a single core, the ICT infrastructure and the supporting organisation are typically centralised and there is a focus on standardisation. However, if the business is diverse and requires heterogeneous ICT solutions, efficiencies can only be achieved if the heterogeneity and the complexity is managed properly.

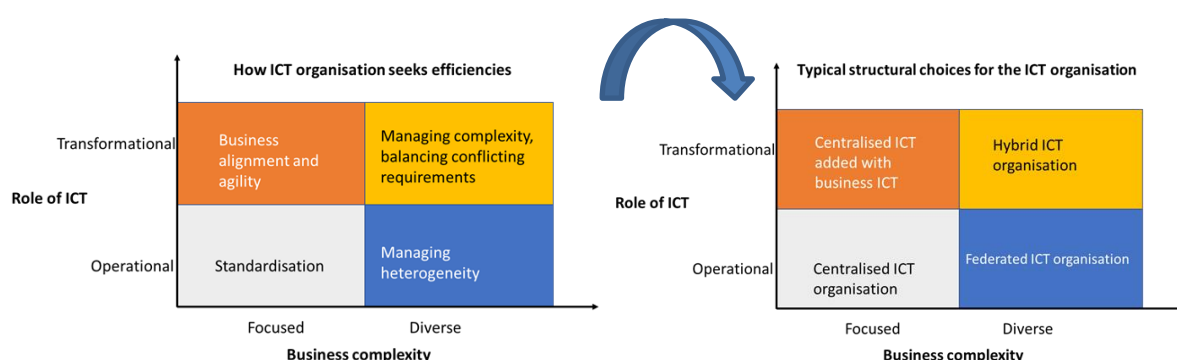
3. SOURCE OF EFFICIENCIES AND THE ORGANISATION STRUCTURE

Based on the above two dimensions, the source of efficiencies and the focus of the ICT organisation depends on the role of ICT and on the complexity of the business.

- **A centralised ICT organisation** drives efficiencies through standardisation of technologies and processes. This propels economies of scale, better cost control, reduced operational risks and simplicity of operations. These are typically enabled by frameworks such as CMMI, Six Sigma, Code factory, and ITIL.

- In a **centralised ICT organisation** with added business ICT capability, there is an amalgamation of business and ICT activities to support the use of digital technologies to enhance existing business and to generate new business. This is often implemented with cross-functional teams using agile methodologies to ensure alignment with the business. The activities remain centralised to maintain the benefits of standardisation.
- A **federated ICT organisation** adopts to the diversity of the business through separate ICT units in business areas. There is often an overseeing CIO role in the organisation, but solid line reporting from the separate ICT functions stays within the business area in order to have full local control.
- A **hybrid ICT organisation** combines the characteristics of centralised and federated ICT organisations. Typically, there are central elements for dealing with common services and devolved elements for coping with local needs. This introduces additional tasks for coordinating the different aspects.

Comparing the above viewpoints i.e. the role of ICT and business complexity vs. structural choices, we can see that there is a clear correspondence:



4. OPTIMISING THE VALUE IN HYBRID ICT

Hybrid ICT is the most common structure used to maximise business benefits and achieve optimal ICT Standards, especially in complex and diverse business such as Higher Education. Commercial success hinges on careful balancing of CIO & CPO roles and responsibilities. The governance model needs to balance importance of business requirements and the standard IT & Procurement Standards. The key elements of a successful model are

- **Central supplier management** of common products and services employed across the organisation. However, acknowledge that different organisations may have specialist requirements which will be addressed locally.
- **Robust processes and tools** embedded into the standard operating procedures. This ensures the benefits of Procurement deals are used across the organisation without compromising critical IT requirements e.g. data protections.
- **Strong business partnering** and clarity of responsibilities between CIO and CPO organisation.

5. SUMMARY

Structural choices, skills and tools can be used to ensure that ICT delivers great value to business. ICT's structure is driven by how ICT is tasked to manage organisational complexity and whether the role is primarily operational or transformational. Mature ICT organisations play a crucial role in managing business complexity and balancing conflicting requirements. Strong ICT provides the certainty of smooth-running secured back office services with the agility to support business changes. Procurement is playing an increasingly important role in ensuring good commercial value is delivered by ICT. Careful balancing of CIO & CPO organisations and clear roles and responsibilities is critical.

The full paper will provide a detailed structure of the various organisational models and more details on how the CIO, CPO and business units can operate successfully together. Higher Education will be used to illustrate the concepts.

6. AUTHORS' BIOGRAPHIES



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Survey on the Status of Digitization at German HEI

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Keywords

Digitization, Universities, Germany

1. Summary

The results of a survey on the digitization of universities in Germany prove that digitization is of great importance for the three dimensions of research, teaching and learning and administration in general, but that the actual implementation status of digitization at German universities is much more restrained. Particularly in the area of administration, the actual level of digitization accomplished at German universities is still regarded as comparatively low. If the IT infrastructures and the systems implemented are analyzed, the status quo is characterized by a large amount of different systems, most of which do not yet allow continuous workflows and are hardly integrated. Many universities show completely different levels of maturity for different systems.

2. Results

2.1. Introduction

Digitization has initiated a comprehensive process of differentiation at higher education institutions (HEI), transforming established forms of scientific and administrative work. Despite a number of studies on partial aspects, comprehensive surveys on HEI digitization have not yet been available, neither in Germany nor internationally. This is the background to the survey "Digitization of Higher Education" (Gilch et al. 2019a), conducted by the HIS Institute for Higher Education Development (HIS-HE) on behalf of the German Expert Commission for Research and Innovation (EFI 2019). The objective of the study was to analyze the process of HEI digitization, considering the dimensions of research, teaching and learning, administration and infrastructure. Methodically, the study focused on a partially standardized full survey among German university leaders, conducted in spring 2018. 119 universities (response rate: 30.1%) completed the questionnaire. The quantitative data were evaluated by means of descriptive analysis methods and multivariate analysis methods (cf. Gilch et al. 2019b).

The study focuses in particular on the importance, strategies and objectives of digitization, the embedding of digitization in IT governance, the status and framework conditions of digitization, digital infrastructure, digital research, learning and governance, and recommendations for action to policy-makers. The most important survey results with a focus on status of digitization, digital strategies and system implementation in German universities are presented and discussed in this paper.

2.2. Status of Digitization

With regard to the significance and status of digitization, a central result of the quantitative survey is that the significance of digitization at universities in Germany is generally rated as high. With regard to the whole institution, 82.6% of the university leaders rate the importance of digitization on a five-point scale as high or very high. In terms of individual dimensions, university leaders attribute the

greatest importance to the digitization of teaching and learning (75.7%) and the digitization of administration (71.9%). The status of digitization of one's own university is assessed much more cautiously than its respective significance. Mostly, university leaders attest a high or very high level of digitization to the areas of research (34.3%) and teaching and learning (29.3%) at their own university.

2.3. Digitization strategies

It was then analyzed to what extent digitization is reflected in university strategies and which objectives the universities pursue with digitization. A written strategy or concept for digitizing the university as a whole is available or being developed at 54.5% of the universities. Dimension-specific (digitization) strategies are primarily available for teaching and learning (69.6%) and administration (61.8%) or are currently being developed. The objectives most frequently associated with these strategies are to improve the teaching quality (91.7%), to increase the administrative services' quality (90.0%) and the administration's efficiency (90.0%) and the teaching of digital skills (86.7%), to increase the ability of... (73.3%), profiling (66.7%), intensify research (50.0%), attracting new target groups (48.3%), internationalization (45.0%), increasing research quality (45.0%), intensification of transfer activities (45.0%), increase research performance (43.3%), increasing the diversity of the... (38.3%), and Other, namely (6.7%).

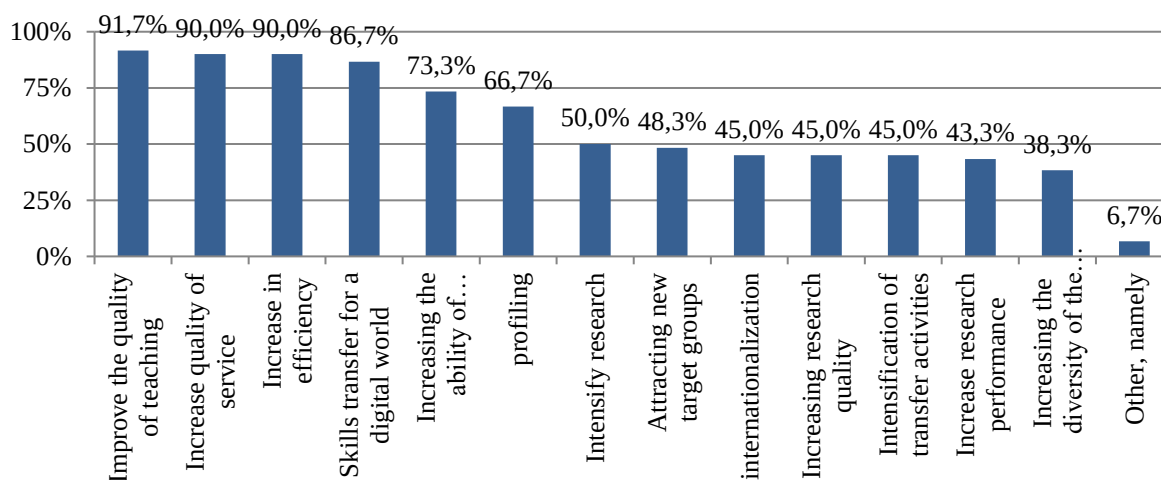


Figure 1: Objectives of digitization strategies

""What objectives should the university's digitization strategy achieve?"
(N = 60, multiple answers possible) (Gilch et al. 2019a: p. 69)

2.4. Status of IT infrastructure and selected IT systems

With regard to the implementation status of digital infrastructures and the implementation level of selected IT systems, fully digital workflows have so far only been offered to users at 9.2% of universities. In most cases (72.3%), a large number of IT systems and applications are in use, but these are only partially but not fully integrated. Considering the implementation level of selected IT systems, Learning Management and Student Information Systems are already in use almost everywhere, while other administrative systems are in an introduction phase for the most part (e. g. ERP, CAFM, BI). The use of cross-university infrastructures for research (e. g. Research Information System) is either not planned, the implementation is currently under review or has already been decided but not yet realized.

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A transitional plan for digital and technology change

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Keywords

Governance, Transition, Art and Design, Being Digital, Teaching Digitally, Strategic Oversight

1. Summary

This paper explores the establishment of a University governance structure for digital and technology change in an art and design based institution consisting of six world class colleges on 18 sites across an international city and a constituency of users that total over seventy thousand.

2. THE EXTENDED ABSTRACT

This is a challenging time for the University of Arts London (UAL) as it seeks to fully harness the potential of being digital and teaching digitally and to advance how we manage our UAL wide digital services and how we think about the potential to leverage the digital landscape to advance UAL's mission and values.

So much of what UAL needs to achieve to maintain its leading global position is reliant on a clear and structured approach to the digital. This approach has to include both Learning and Teaching and operational rationalisation. In order to best position UAL for the next three years of growth and success it is essential that this Digital and IT strategy is fully endorsed and fully supported.

Over the last twelve months a UAL IT transitional plan has been developed to enable a transition towards a fully developed IT & Digital strategy. The development of a transitional plan is a good way to have a stepping stone approach to major strategic change rather than a sudden change. The transitional plan is laying the foundation for a future IT & Digital Strategy

The transitional plan sets out how to prepare UAL for the next mid-term UAL strategy period through greater business efficiency in the technology function, ensuring IT plays an enabling role in learning and teaching, research and knowledge exchange. UAL is seeking to develop the management of IT services to sector standards and to leverage the digital landscape to advance UAL's mission and values. Much of what UAL needs to achieve to maintain our global position is reliant on a clear and structured approach to technology.

The main expression of this transitional plan is a three-year portfolio of activities, based on service design principles and providing a common, technology-agnostic view of the value to be delivered. This portfolio prepares the ground for the themes of the emerging digital transformation strategy:

- Transformative Education - improve the student's learning and teaching experience
- Connected Campus - a seamless experience between and within the digital and physical estate
- Data Matters - harness the power of data, ensuring compliance and ethical management
- Business efficiency & innovation - improve and put in place the right infrastructure for operational efficiency and innovation.
- Enterprise & sustainable funding - enable and achieve the ambitious entrepreneurship strategy and maximising UAL income.

The transitional plan centres on the experiences and needs of students, staff, and the wider UAL community. A user-centred approach will enable the development of more effective ways to deliver and embed key existing services and develop and embed new services. It will be delivered by many partners across UAL, who have different levels of IT/digital knowledge and expertise. The aim is to

put in place the right infrastructure for operational efficiency and innovation through a unified, evolutionary and collaborative approach across the University and Colleges. This will include infrastructure, services, cybersecurity, process, culture and agility.

The transitional plan has five objectives:

- introduce strategic oversight across University and College IT
- improve availability, resilience, client support and service levels for front-facing systems
- increase operational efficiency and reduce complexity across all software and hardware
- control expenditure and put in place a value for money framework to reduce cost of ownership and of study
- realign our project portfolio towards learning and teaching and the student experience.

This transitional plan, subject to further discussions anticipates that our focus during the period of this transitional plan to be in line with the following

THE CONNECTED CAMPUS - creating a seamless experience between and within the digital and physical estate for both student and staff.

DATA MATTERS - harnessing the power of data, ensure it is ethically managed and we remain compliant.

TRANSFORMATIVE EDUCATION - to improve the student's teaching and learning experience.

BUSINESS EFFICIENCY & INNOVATION - to improve and put in place the right infrastructure for operational efficiency and innovation.

ENTERPRISE & SUSTAINABLE FUNDING - to enable and achieve the ambitious entrepreneurship strategy and maximising UAL income.

3. AUTHOR BIOGRAPHY



Jim Nottingham is the Chief Information Officer at the University of the Arts London (UAL). UAL consists of 6 world class Colleges of Art & Design, the Colleges include; Camberwell College of Arts, Central St Martins, Chelsea College of Arts, London College of Communications, London College of Fashion and Wimbledon College of Arts. The Colleges & UAL currently occupy 18 sites across central London. UAL has over twenty-two thousand full-time students and over sixty thousand part-time students.

Jim holds a BA(Hons) Fine Arts Printmaking degree from Loughborough University and an MFA Terminal Degree -equivalent to an EdD in Studio Art from Louisiana State University. Jim is a Chartered IT Professional validated by the British Computer Society and an active Master Printer. Jim has over 35 years of experience of working in Higher Education in a number different roles from teaching life drawing to leading institutional change.

Intelligent Campus: Risks, Benefits and Ethics

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...

Keywords

Intelligent Campus, Smart City, Data Protection, Ethics.

SUMMARY

The Intelligent Campus is a microcosm of the Smart City. Smart cities, according to Finch and Tene (2016), may be 'more livable, more efficient, more sustainable and more democratic' or 'turn into electronic panopticons in which everybody is constantly watched'. Intelligent Campuses amplify both of these possibilities since - unlike cities where space and data are owned by many different organisations - a university may well control and monitor the whole physical and digital infrastructure of its students' lives, from bed to workplace to social spaces. Students and staff might well consider such monitoring 'creepy', or worse. But that single control, and the strong shared interest between campus managers and occupants, may make the goal of smart citizenship easier to achieve on campus than in cities, where political and commercial interests have largely limited the relationship to a paternalistic one, at best. This talk will present practical tools to help educational institutions deliver this goal.

EXTENDED ABSTRACT

Our responses to monitoring depend not only on fact, but on sentiment. Attitudes to electronic monitoring, in particular, are often set by the behaviour of social networks and other commercial service providers. Campus occupants used to hearing that they are 'the new oil' (Kuneva, 2009) or 'digital silkworms' (Brown & Marsden, 2013) need to be reassured about the purposes, intentions and incentives of those who monitor, as well as how monitoring is currently performed. Campus managers therefore need to ensure their plans and actions are acceptable to both their organisation and the campus occupants. If not, occupants may well respond by changing behaviour - for example swapping identities or providing deliberately incorrect data - in ways that undermine both the intelligent campus and, more importantly, the institution's primary purposes of research and education.

As well as smart city literature, tools borrowed from other fields can guide us towards intelligent campuses that are welcomed by their occupants. Many issues are shared with Radio Frequency Identification (RFID) technologies, for which a toolkit was endorsed by European Data Protection Regulators in 2011. When selecting appropriate purposes for intelligent campus technologies, ethics codes on using digital data for research and policy formation are also relevant.

Intelligent campuses can be viewed as having three 'senses': sight, sound and location. Sight includes Passive Infra-Red (PIR) sensors that indicate whether or not a desk is occupied, and face recognition analysis of live video images; sound can record conversations, or detect whether a room is empty; location and movement of devices and individuals can be gathered from wireless access points, door access or payment cards. As these examples indicate, all three senses cover a similar, wide, range of intrusiveness. Rather than ranking the senses, it is better to generalise and extend the four-level scale of impact from RFID guidance: presence, counting, identifying, recording and analysing. This gives an immediate indication of the likely level of intrusiveness, and the depth of analysis and mitigation likely to be required.

The context from which information is gathered can significantly affect both intrusiveness and perception. A standalone PIR desk-occupancy monitor is much less intrusive in a hotdesk area than in a personal, locked office, or if its data are linked to login or other information that can identify individuals. Some spaces, such as bedrooms, offices and toilets, are obviously more sensitive, but universities may also have spaces such as counselling services and some laboratories where monitoring,

and its results, require particular protection. Sight sensors naturally respect opaque boundaries, such as walls, but sound and location may leak through them.

While an extended version of the RFID toolkit provides guidance on controls - such as organisation and policy, system architecture, sensor choice, and other risk reduction measures familiar when protecting personal data - these may be insufficient to ensure acceptability. For this we need to consider not just legal questions ('what **can** we do?') but also ethical ones ('what **should** we do?'). Kitchin (2016) identifies six ethical concerns for smart cities: datafication, dataveillance and geosurveillance; inferencing and predictive privacy harms; anonymisation and re-identification; obfuscation and reduced control; notice & consent empty or absent; data use, sharing and repurposing. The Menlo Principles (Homeland Security, 2012) for digital research ethics and the UK Government's Data Science Ethical Framework (Cabinet Office, 2016) for policy formation reinforce the need for organisational controls, but add choice of purpose; robust models (in both theoretical and data science senses); and awareness of - possibly changing - public perception.

One of the greatest challenges in both smart cities and intelligent campuses is to ensure that occupants are informed about data collection and use. Much data collection takes place through passive observance, unconnected to any specific action by the individual (entry and payment cards are a rare exception); many 'internet of things' sensors are designed to be unobtrusive. Individual occupants may well be, or become, unaware of data collection, reducing the effectiveness of traditional protections such as notice, consent and objection. In any case, it is often unreasonable to rely on individual actions to control risk: individuals cannot realistically avoid using campus infrastructures, and should not be burdened with daily, or even more disruptive, consent decisions.

The concept of 'smart citizenship' may well help with this transparency challenge, as well as identifying acceptable uses of intelligent campus technologies and holding institutions accountable for their activities. Rather than viewing citizens as 'consumers or testers', authors such as Cardullo and Kitchin (2018) propose involving them from the start in the selection, design and monitoring of smart city (or intelligent campus) projects. Policies or proposals that feel unfair, creepy, or worse, to citizens will then be discovered - and improved or rejected - at an early stage, before money or infrastructure has been deployed. Such an approach also reflects the ethical need to be aware of public sentiment, and the legal requirement for Data Protection Impact Assessments to consider consultation with individuals. Smart citizens guide the development of their city, rather than merely occupying it. The complexity of cities has, so far, prevented the achievement of this concept. The simpler organisational structure of an intelligent campus might be an opportunity to show how it can be done.

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He enjoys hill-walking, birdwatching and cooking.

Presenting the HE-BIA Maturity Model v2.0: a lean assessment model of business intelligence and analytics initiatives in Higher Education

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Keywords

Business Intelligence, Analytics, Maturity models, Higher Education.

1. Introduction

Business intelligence and analytics (BIA) have been instrumental for many years in delivering value to organizations, bridging the gap between raw data and actionable insights that can be used by business users to make more data-driven informed decisions. Typically, the development path of this type of applications is iterative and needs to take into account several critical success factors. There are several aspects that can endanger the success of BIA projects (Yeoh and Popovic 2015). The implementation of BIA systems involves a combination of technological and organizational issues that need to be secured in order to be successful. The design of maturity models tries to map this iterative and progressive path, in which an organization starts with a basic or initial stage of maturity and progresses towards a more mature state. Maturity is therefore related to this notion of evolution or progression towards full development. Maturity models are defined using a set of dimensions a sequence of levels (or stages). Maturity models can be used as a self-assessment tool to identify the strengths and weaknesses of certain areas in an organization.

Several BI maturity models have already been created, including both generic and domain-specific models (Cardoso and Su 2019). A generic model can be used across different industries, enabling benchmarking. However, this approach tends to be complex, with a large amount of assessment questions and a terminology set that is not particularly overlapping with the vocabulary and definitions of a particular domain. A previous study (Cardoso et al. 2013) reported that the use of a generic BI maturity model resulted in difficulties in assessing correctly the BI maturity level of initiatives in different Higher Education Institutions (HEI). The reasons being the lack of understanding of key BI concepts and complications in locating the right set of experts in each institution that could correctly and informedly answer the many diverse questions of the maturity model. This result led to the decision in 2019 to develop a new maturity model specific to the assessment of HE business intelligence and analytics systems. This paper presents the HE-BIA maturity model version 2.0, that enables HEI to perform a lean self-assessment of their business intelligence and analytics solutions. Specifically, the HE-BIA maturity model enables HEI to: (1) Identify their current maturity level; (2) Set a desired maturity level for the BIA initiative according to university strategic goals; (3) Identify the dimensions of potential improvement, and use them to internally devise an adequate path for improvement (roadmap) to reach the desired maturity level; and (4) Use the model as a strategic tool to raise awareness among university management of the need to invest in BIA.

2. The HE-BIA maturity model v2.0

The HE-BIA maturity model is the outcome of a research project, conducted by two BIA professors in collaboration with the BI Special Interest Group of EUNIS - the European University Information Systems organization (www.eunis.org).

The initial set of requirements that led to the development of a new BI maturity model, as opposed to use an existing one are the following: (1) The model should enable each HEI to conduct a self-

assessment exercise; (2) It should be easy to understand and use relevant terminology for HE (i.e., it should be domain-specific); (3) The model should use a lean approach (i.e., enabling a high-level assessment that can be achieved with few resources (people and time) as opposed to providing an extensive list of questions); (4) The model should capture new analytical aspects, such as the use of artificial intelligence and big data, Internet of Things and 5G, that will be increasingly more relevant in the campus of the future; and (5) It should be designed following a research methodology.

The resulting HE-BIA maturity model is divided into two parts (Technological and Organizational), seven categories, and 18 maturity dimensions, as displayed in Figure 1. It uses five maturity levels to specify the progression in each dimension: 1- pre-adoption, 2- Initial, 3- Managed, 4- Systematic, and 5- Optimized.

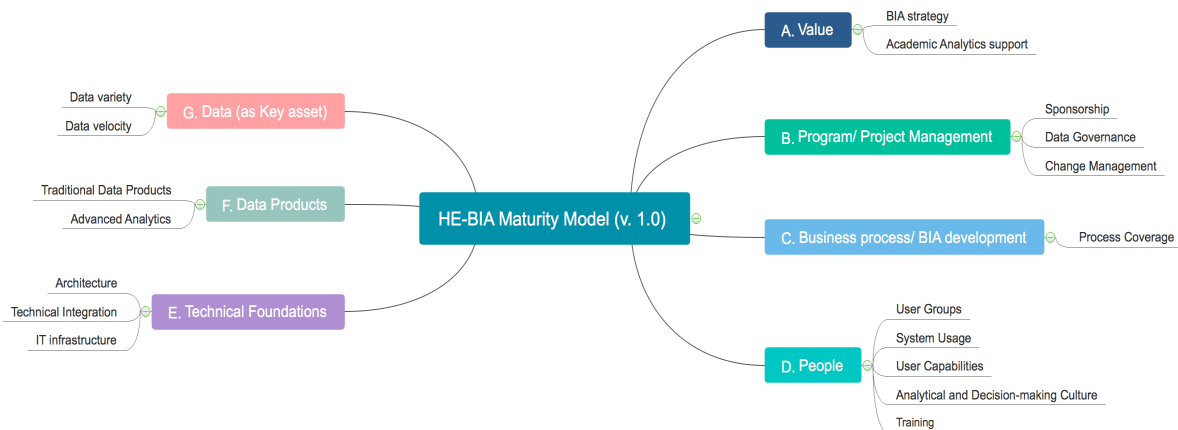


Figure 1: The HE-BIA maturity model: categories and maturity dimensions

The proposed model was developed according to the research setting displayed in Figure 2. Following a first phase of knowledge acquisition (Cardoso and Su 2019), phase 2 encompassed the first implementation design originating version 0.1 of the model. This version was discussed and validated at the BI SIG pre-congress workshop @EUNIS2019, in Norway. In phase 3, the model was tested in three case studies (with three HEI) and one joint BI SIG workshop, that took place in February 2020 in Belgium. This paper details the final version of the maturity model (v2.0) that takes into account the feedback received during phase 3. Finally, phase 4 refers to the expected outcomes that the model can bring to the activities of the EUNIS BI SIG, in particular to serve as a basis of understanding for the HE-BI community of the critical success factors of BIA deployment, with an inspirational mindset looking at the future campus.

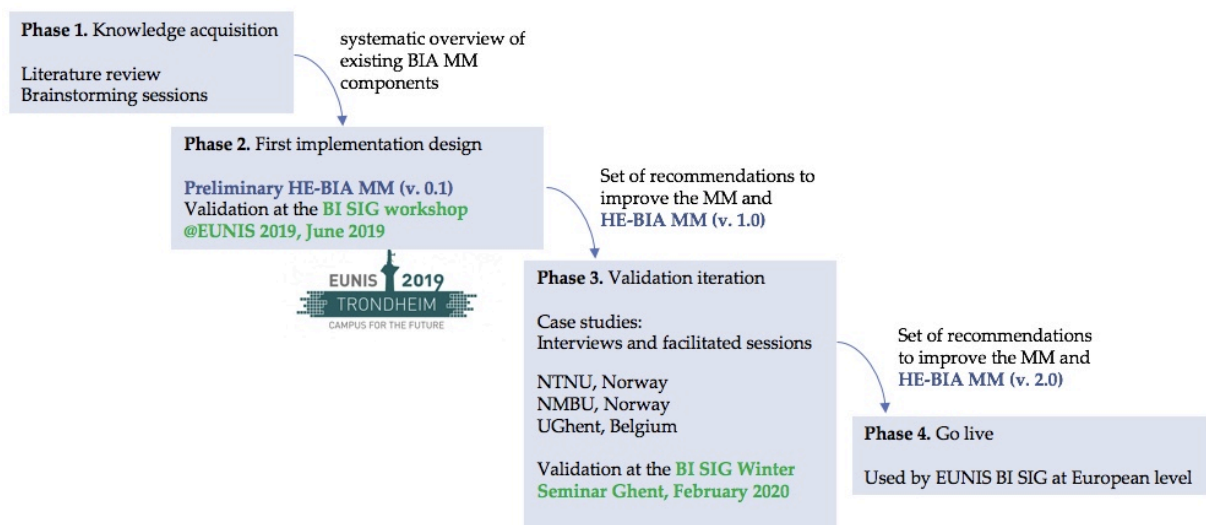


Figure 2: The HE-BIA maturity model research setting

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HEI Ecosystem for Business Intelligence in Finland - Building on Common National Information Infrastructure, Data Flows and Information Services

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Keywords

HEI, HEI cooperation, business intelligence, data, data warehouse, information system, leading with knowledge, national information infrastructure

Summary

Leading with knowledge and making the most out of data is an ambition for HEIs globally. To collect, link and analyze data into actionable information is often complex and demands resources. One example of making data usable and interoperable for HEIs is a solution based on shared national educational and research information infrastructure.

We present a model of HEI business intelligence ecosystem in Finland that visualizes HEI data sources and relations between different data flows and systems. We validated the model together with HEIs in order to better support them and the Ministry of Education and Culture (MoEC) in data and knowledge management.

The ecosystem model is very timely, as Finnish HEIs have committed to a shared digitalization vision for 2030 with shared data as a joint platform for success. This goal highlights needs for better understanding of the current state of the ecosystem, needs for its improvement and utilization possibilities for learners', HEIs', and ultimately, society's benefit. [We will include some cases or examples of benefits to the HEI sector and describe how collected data is or can be used in leading with knowledge.](#)

At CSC, national HEI data from multiple sources gathers into an extensive data warehouse 'Vipunen'. We offer Vipunen as an example of shared services within the ecosystem. Vipunen includes i.a. data from education achievements and publications, financial and organizational data collected by the MoEC, data from applicants and selected candidates, student feedback data and other national statistics. Currently, Vipunen provides educational information from early childhood education to higher education.

Vipunen transforms data into reports and analysis for HEIs needs using Excel Services, Power BI and REST API. Sub-portal 'Extra-Vipunen' accessible only for HEIs makes available also dynamic live data. Extra-Vipunen offers HEIs opportunity to manage data quality, benchmark performance, and use more customized reports and variables. [We will include some examples of queries \(pivot report modifications\) that can be made within Vipunen reports and by using the API.](#)

Shared data and BI platforms such as Vipunen support extensive user groups in decision making and information management from HEIs to governmental officials, students and media.

Abstract

The national information infrastructure and open data are cornerstones for the ecosystem.

Vipunen

Information portal and data warehouse for education administration

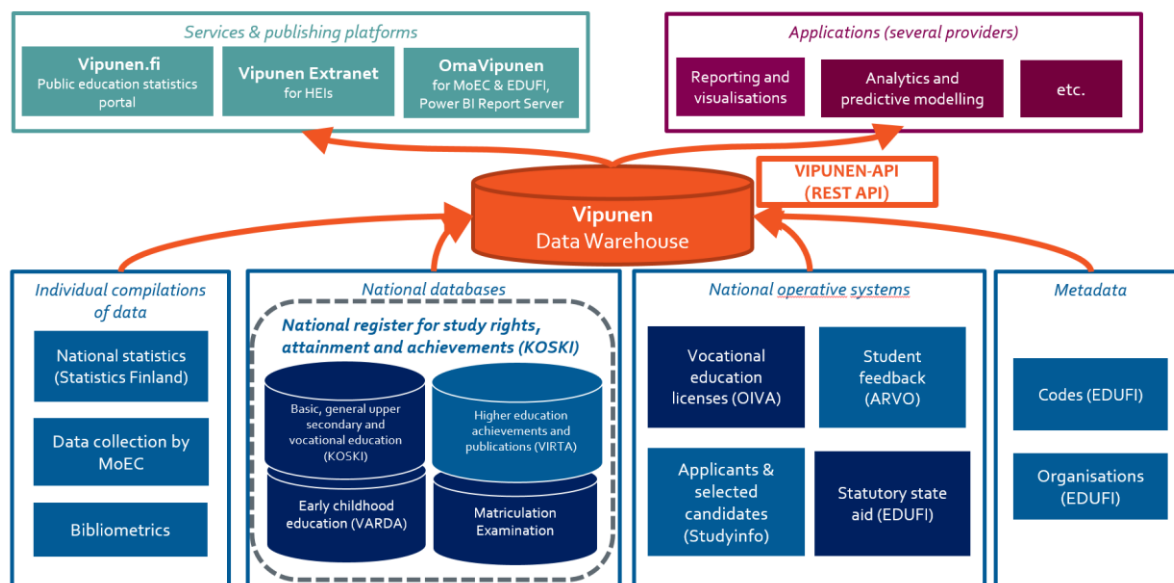


Figure 1. Vipunen information portal and data warehouse for education administration

Vipunen public portal in English: <https://vipunen.fi/en-gb/w>

Improving the quality assurance of higher education and science through the databases interoperability - Croatian case

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Keywords

Higher education, Science, Quality assurance, Data collection, Database interoperability

1. SUMMARY

Within a quality assurance procedures that Croatian Agency for Science and Higher Education (ASHE) conducts, higher education institutions are required to submit a considerable amount of data into the ASHE's information system MOZVAG. Experience from the first reaccreditation cycle, conducted from 2010 to 2016, has shown that data collection and data analysis are the most challenging parts of the process, both for HEIs and ASHE. In order to optimize the re-accreditation process and to facilitate the delivery of HEI's data, the existing ASHE information system (MOZVAG) had to be upgraded. Two systems recognised as a quality source of information were *Croatian Scientific Bibliography - CROSBI* and *Database of Project Activities in science and higher education of the Republic of Croatia*. Optimization of data collection through upgrade and enhancing interoperability of three information systems was done through several phases from 2017 to 2019. Upgrade of the MOZVAG showed that investing in better IT tools and integration of already existing sources of information has multiple benefits. It will ensure better credibility of the data and provide greater opportunities in data analysis, with envisaged use in decision making, particularly those of strategic importance for the operation of the HEI but also the higher education system as a whole.

2. QUALITY ASSURANCE IN CROATIA - BACKGROUND

Although quality is not (all) about data, part of every external evaluation procedure is submission of considerable amount of data on core activities of the institution being evaluated. Agency for Science and Higher Education (ASHE) in Croatia is in charge of quality assurance (QA) and promotion of quality culture in higher education and science. In 2011, by becoming a full member of European Association for Quality Assurance in Higher Education (ENQA) and European Quality Assurance Register for Higher Education (EQAR), ASHE proved its reliability as a quality assurance agency working in the European Higher Education Area in line with the *Standards and Guidelines for Quality Assurance in the European Higher Education Area*, also known as the ESG (ENQA et al., 2005, revised 2015).

Following its accreditation, ASHE was given the task of evaluating all public and private HEIs in Croatia within a five-year period, in line with the ESG and the national regulations for institutional re-accreditation. Criteria for the assessment of quality of higher education institution in Croatia were developed and adopted in 2010, in compliance with national regulations and ESG, which as a result led to the considerable amount of data required from HEIs within re-accreditation procedure.

3. DATA DELIVERY AND ANALYSIS IN QUALITY ASSURANCE PROCEDURES

Due to the large amount of data required from HEIs, ASHE was facilitating improvements of the collection and processing of data provided by HEIs, inter alia to create the confidence of institutions in the quality assurance system. Within the 1st cycle of re-accreditation of Croatian HEIs, conducted from 2011 to 2016, ASHE's information system MOZVAG was used in re-accreditation procedure for submitting data by HEIs, but only to check the compliance of HEIs with the minimum legal

requirements¹. Aware of the fact that part of the data required in the re-accreditation already existed in other information systems used by HEIs, such is Information System of Higher Education Institutions (ISVU), and that both - ISVU and MOZVAG are developed and maintained by SRCE - University Computing Centre, interoperability between MOZVAG and ISVU was established. Additional data, not existing in ISVU, were submitted within a self-evaluation document provided by each HEI within re-accreditation procedure according the guidelines given by the ASHE (ASHE (2010, revised 2013)). This led to a challenge for ASHE when analysis of the five-year cycle had to be produced and most of data were submitted within a pdf document. A special database had to be created in order to transfer the data from the documents in order to do the analysis. Scope of the analysis was wider than any analysis done before because information on HEIs and their activities have not been collected in such a systematic way and in such a wide range ever before (ASHE, 2017). Yet, challenges encountered in analysing the data indicated the need to find a better way of collecting data within evaluation procedures, which led to the upgrade of the MOZVAG system.

4. UPGRADE OF THE MOZVAG SYSTEM THROUGH DATABASES INTEROPERABILITY

In addition to the existing interoperability with the ISVU system, two already existing (and used by HEIs) information systems were recognized as a potential quality source of information about HEIs activities. One is *Croatian Scientific Bibliography - CROSBI* and the other is *Database of Project Activities in Science and higher education of the Republic of Croatia* (Projects database). Both of these systems were developed and maintained by the Centre for Scientific Information at Ruđer Bošković Institute (CSI-IRB). In cooperation between ASHE, SRCE and CSI-RBI upgrade and interoperability of MOZVAG, CROSBI and Projects database was developed, which, as an added value, contributed to wider use among HEIs of the two latter systems.

5. CONCLUSIONS

The investments made in the development of the interoperability of information systems improved the quality of data used in quality assurance procedures, which is a prerequisite for ensuring well-informed decisions, not only in quality assurance, but also for the strategic planning of the institutions and policy decision making.

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¹ Minimum legal requirement are prescribed by the *Ordinance on the Content of Licence and Conditions for Issuing Licence for Performing Higher Education Activity, carrying out a Study Programme and Re-accreditation of Higher Education Institutions* and *Ordinance on Conditions for Issuing Licence for Scientific Activity, Conditions for Re-accreditation of Scientific Organisations and Content of Licence*

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Digitalizing Teaching Processes - How to Create Usable Data with Minimal Effort

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Keywords

Digitalization, information management, teaching processes, thesis

1. Summary

Digitalization and digital transformation are changing the processes and practices in all kinds of business areas, and education is not an exception. Although different kind of e-learning platforms and other tools supporting learning have already been in use several years, not much attention has not been paid on digitalizing the teaching processes, and even less on information management in digitalization of the teaching processes.

Since teachers, especially in higher education, are experts with a high level of autonomy, digitalizing teaching processes is not as straightforward as in other kinds of industries. This even restricts the tools of the management: pure top-down approach can be really challenging and may cause result in failure. Some recommendations exist on how the digitalization project should be carried out (see e.g. Kauppinen, Lagstedt, & Lindstedt, 2019), but not much is discussed about the information management's role in projects where teaching is being digitalized.

During 2016 – 2018, we conducted a thesis management system development project, where we used expert-oriented digitalization model (EXOD) (Kauppinen et al., 2019) in the digital transformation. One aspect heavily stressed in the project was the quality of the data produced with the new system. Especially we wanted a system producing reliable data of high quality without requiring extra work from the users. The aim was to have as user-friendly system as possible while collecting the necessary data automatically from the users' daily actions.

The developed system, Wihi, was taken into production from the beginning of 2019. Based on the feedback we collected at the end of the spring semester, we found out that the system was considered easy to use, and the data it collected it was seen useful. We see that the development model (EXOD) worked very well in this case, but more importantly, we claim that the basic ideas and foundations of information management in Wihi can be utilized also in other teaching process digitalization projects.

2. EXTENDED ABSTRACT

Digitalization and digital transformation are changing the processes and practices in all kinds of business areas (Borg, Olsson, Franke, & Assar, 2018), and education is not an exception. However, in education sector the main emphasis is put on digitalizing learning processes, while the digitalization of the teaching processes is rarely discussed. In addition to the teaching processes digitalization being largely neglected, also the quality of data collection from the teaching processes has not received sufficient attention, which makes measuring, steering and improving the processes difficult. Teaching, especially in higher education, is expert work where cookbook type of processes will not work (Davenport, 2010). Teachers have to have considerable autonomy and control over how they organize their work. Thus, new kinds of models on how to develop usable systems creating adequate data of high quality under these circumstances, as well as good examples, are needed.

The thesis process in Haaga-Helia University of Applied Sciences was digitalized using expert oriented digitalization model (EXOD) (Kauppinen et al., 2019). The development of an information system (IS) supporting the new process was started in 2016, and the process development and the IS development

were partly overlapping. The new system was piloted in autumn 2018 and taken into production from the beginning of 2019.

To evaluate the results of the project, we did a case study during the spring of 2019 where we followed the recommendations of Yin (Yin, 2009). We extensively used the four data collection sources Yin (Yin, 2009) recommends, namely documentation, archival records, participant-observation, and interviews. In the analysis, the main emphasis was on the interviews while the other sources were considered complementary.

The developed system, Wihi, was considered to be easy to use, and the data collected by it was seen useful. We see that the development model (EXOD) was a very good fit for this case, but more importantly we claim that the basic fundamentals of information management in Wihi can be utilized in other teaching process digitalization projects. Concerning a data creation, we consider the following fundamentals the most important ones: 1) in expert work the results are more important than the actions, 2) students are the owners of their data, so we should not ask questions from teachers when data is derivable from students actions, 3) it is much easier to get students to do something than the teachers, 4) a small amount of data is better than no data, but too much data (collection) is worse than no data: only the essential data should be collected, 5) for all the user groups, the main emphasis should be facilitating the workflow while inputting the data should be a secondary thing, and 6) teaching is autonomous, so the teachers must have the control instead of an IS.

Overall, we realized that instead of asking questions we should provide a tool for facilitating all the user groups and just follow the progress of the students. Even if we do not get as much data as possible in this way, the quality of data is better enabling the further development such as advanced analytics, AI based alarm and prediction tool and even in some extent a robotic process automation (RPA).

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The Transfer Dashboard: Integrating the Third Mission into the University Infrastructure

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Keywords

Third mission, transfer, dashboard, analytics

1. Summary

The goal of this paper is to introduce aspects of transfer (the third mission) into the digital infrastructure of a higher education institution (HEI). While there is little visibility of transfer characteristics in discussions on digital infrastructure, the political importance of this topic is growing. Therefore, our approach is to extend the infrastructure of HEIs with features from modern data analytics. We identified sources relevant for transfer and visualize them in a dashboard. In the first step, we designed descriptive or diagnostic components for the different fields of the third mission. Finally, next steps towards predictive components are discussed.

2. Motivation

HEIs are mainly focused on three missions: education, research, as well as transfer of knowledge and technology. In the late 20th century, knowledge and technology transfer (the third mission) was set up as transfer offices at German universities. By integrating the third mission into the institution, the idea of transfer changed from a one-way output to a multidirectional exchange (Krücken, 2014).

In contrast to the political efforts in funding third mission projects, the discussion about the digital infrastructure at HEI leaves out digital needs of the third mission and is mostly about advancing components for education, research, and administration, for example considering current recommendations for information processing (Deutsche Forschungsgemeinschaft, 2016).

The German Science Council identified the third mission as a dimension that contributes to the opening of science to society and industry (Wissenschaftsrat, 2016). Here, the third mission is subdivided into three fields of action: communication, consulting, and deployment. *Communication* creates a channel to arouse awareness in science or to help educate interested parties. *Consulting* maps the field of advisory councils for scientific debate in economy, politics, or society. Finally, *deployment* describes the traditional approach of knowledge and technology transfer by patenting or founding scientific results. Our approach is to detect potentials for digital support in all of these fields.

The large amount of data available in the scientific and administrative environment of HEIs opens up several opportunities to discover innovation potential or to make synergies with local or external stakeholders visible. Hence, it is necessary to have this data available in a non-proprietary and machine-readable format. Despite the overall objective to gain insights, every organization has to climb the ladder of analytical maturity. As outlined in the Analytic Ascendancy Model (Laney et al., 2012) it is essential first to create descriptive and diagnostic analytics and then move on to predictive and prescriptive analytics. Consequently, we started to design descriptive components for third mission analytics.

3. The Transfer Dashboard

In this project, we utilize a dashboard as a carrier for analytics components. Thus, these components are developed as micro-services and the dashboard provides a generic framework to integrate their

results. The layout of the dashboard can be customized depending on the environment and the individual needs. We have focused on analytics components that do not require any preparatory work from users.

The overall question for designing these components was: How can we improve the visibility of the third mission? In our concept we covered all three fields mentioned above:

- **Communication:** One way to visualize the impact of HEI's research in the local non-scientific society is to measure how often scientists appear in media. For this purpose, we use press reviews, which are a daily summary of a keyword-based search in regional and national newspapers, social media etc.. For each article in this review, metadata indicates the circulation and range of the medium. These can be tracked and visualized over time to see which topics are relevant for science and society.
- **Consulting:** It is challenging to find reliable data for the consulting activities of scientists. One possibility is to browse publicly provided CVs on websites in which many scientists declare their memberships in committees, councils etc.. This data can be extracted, validated by the researchers, and used to visualize their scientific networks. By the way, another benefit for scientists is to get reminders for keeping their CVs up to date.
- **Deployment:** This field is the core of the third mission. That is why employees of transfer offices already use to assemble descriptive data for reports on the recent patenting and start-up activities. The challenge here is not to collect the data but to centrally maintain the collected data. Once stored in a re-usable way, it can be used in dashboards both for statistical analysis and for selected qualitative descriptions.

Especially in the deployment field, using well-established reporting practices analytics could be improved by raising the descriptive level to a diagnostic one. For example, the University of Potsdam has a web-based platform for collaborative learning and working. Here, users can create content in blog posts, wiki articles, or discussions in forums. These activities are tracked and visualized as a network. This can be used to detect key persons in terms of activity and networking. This analysis, combined with the patenting and start-up activities, is a valuable basis of a predictive component that helps to scout early innovations.

4. Conclusion

Mostly, analytics in HEIs is used to support processes of education (learning analytics) or research (scientometrics/altmetrics). The third mission is often perceived as an independent task, which can only be achieved at extra cost. In this paper, we present an integrated approach for a dashboard with analytical components that are based on existing data. We propose several analytics components in the fields of communication, consulting, and deployment. Further research will evaluate whether and to which extent the dashboard may increase the visibility of the third mission in HEIs.

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EUNIS 2020: Privacy: Investigation of Student's Trust to Universities Using an Implicit Association Test

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Keywords

Privacy, Informational Privacy, Trust, Implicit Preferences, IAT.

1. Introduction & Motivation

Many students use social media platforms such as Facebook or other services such as Dropbox for learning. Thereby, they (consciously or unconsciously) disclose personal information and metadata which are frequently used as part of business models. Commonly universities provide similar services or also innovative digital learning spaces to their students which can be particularly helpful for students, e. g. by supporting for learning processes through the visualisation of the progress (cf. Learning Analytics). Such systems rely on access to user data of varying sensitivity (such as study success, online time, health or demographic data, etc.) but still respect the European General Data Protection Regulation (GDPR) and, therefore, are designed with a high level of privacy. However, the services provided by universities are often not that intensively used compared to commercially provided services. Also, students are only agreeing to disclose university-relevant data to university but not personal information or metadata about their online activities (Schumacher & Ifenthaler, 2017). Hence, there seems to be a diverging willingness to provide personal data to commercial rather than university services for personalization and adaptation.

Generally, there appears to be a general problem with privacy and data protection questionnaires (often called “informational privacy paradox”): When explicitly asked about privacy most students underline its importance, however, often do not act accordingly (cf. Kokolakis, 2017).

In order to investigate this gap a preliminary study was conducted. The goal was to examine the inner attitude of students towards the disclosure of personal data to commercial and non-commercial (university) services by means of a so-called Implicit Association Test (IAT). This test measures implicit preferences without requiring the respondents to be aware of their attitudes or are willing to report on them. In this test, participants have to assign objects to categories as quickly as possible. The objects and categories are swapped during the test multiple times. The time for the assignments is measured and taken as indicator how closely linked an object to a category is and a normalized so-called D-score value is calculated. The IAT was chosen because explicit surveys tend to collect expectations rather than actual attitudes. This way the participants can hardly influence the outcome of the IAT actively. Two hypotheses were investigated:

- Hypothesis 1: Between the two categories of commercial services and the university there is a difference in implicit attitude in the sense of the IAT.
- Hypothesis 2: The calculated implicit attitude of students with a high technology affinity score differs from the results of students with a low technology affinity score.

2. Design of the Study

Generally, there are multiple dimensions which need to be considered why external services seem to be preferred (cf. Technology Acceptance Model 2): knowledge of services, usability, quality, habits, and trust to the institution. For this preliminary study trust was identified as a major driver for disclosing personal information.

In order to investigate the said hypotheses, a specific IAT had to be implemented. Firstly, the IAT had to be adapted for this purpose. There are two main components of an IAT which need to be properly

selected: the attribute and target concept. For the target concept on the one hand logos of well known internet companies and on the other hand photos of the local university campus were used as items. Systematically derived synonyms of trust and mistrust were used for the attribute items. In order to prevent biases, the (appearance) order of the attribute items and target concept items was randomly determined.

The procedure of the study was as follows: The study was implemented as a website which the participants had to open on their laptops or desktop computers. On the website they had to enter their age and subject. Then, the IAT was conducted and, finally, the participants were asked to fill out the technology affinity questionnaire (Karrer et al., 2009).

3. First Results & Outlook

There were 34 participants taking part in the prestudy (sex: 10 f., 22 m., 2 u.; average age: 25, $s=8.1$). The average D-score is 0.39 (standard deviation of 0.42, median=0.47) and corresponds to a moderate implicit positive attitude towards the university. Hypothesis 1 is therefore accepted. Regarding hypothesis 2 (cf. Figure 1) there only seems to be a light tendency for a difference between the groups of technology affine and not affine students (not statistically significant, $p=0.39$). However, an exploratory data analysis showed a significant difference in the D-scores regarding the enthusiasm for technology ($p=0.04$).

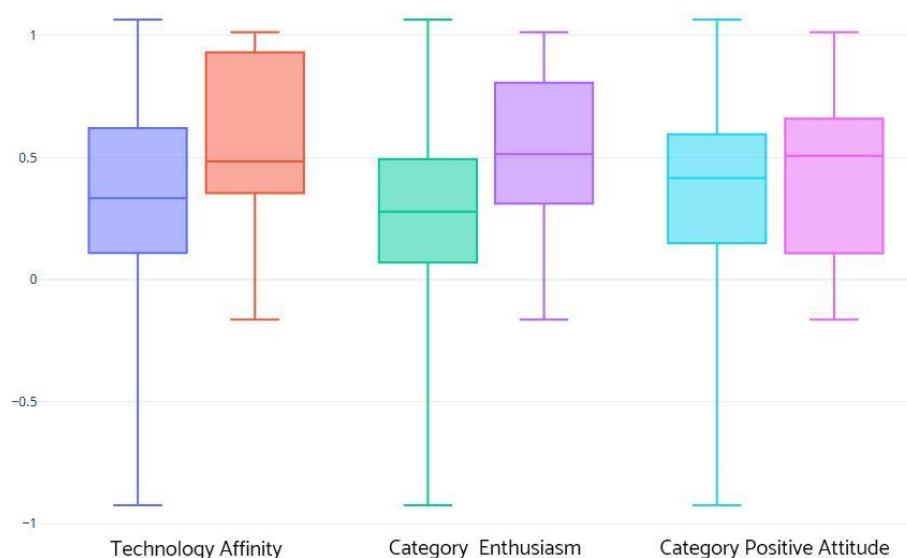


Figure 1: Boxplot diagram of the D-scores regarding different technology affinity scores

Still, there is a need for further research - particularly to investigate the difference of explicit and implicit privacy attitudes. Based on these preliminary results our goal is to conduct a more comprehensive study. Particularly, it would also be interesting to extend this study to other universities across Europe.

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The Weakest link of Office 365 Security - 2020 Edition

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Keywords

Office 365, Azure AD, security, mitigation, risk

1. SUMMARY

Office 365 service is widely adopted in the Higher Education sector all around the world. It is a cloud service provided by Microsoft, including Office suite desktop applications, and services like Exchange Online, SharePoint Online, and Teams.

One of the top current security risks of web applications is Security Misconfiguration. This paper introduces some techniques a rogue administrator may use in order to exploit users' confidential information. Symptoms, detection techniques, forensics, and mitigation techniques of these are also introduced. As a conclusion, it can be argued that the weakest point of Office 365 security is the organisation's on-premise misconfiguration. This paper helps organisations' security officers and IT administrators to audit and strengthen their on-premise environment security.

The previous version of this paper was presented at the EUNIS 2015 conference in Dundee, Scotland. By March 2020, the full paper has been read more than 1000 times. This revised and updated version introduces new attack vectors and techniques found by the author after 2015, including three backdoors utilising design flaws in pass-through authentication, seamless single-sign-on, and identity federation.

2. EXTENDED ABSTRACT

The previous version of this paper was presented in the EUNIS 2015 conference (Syynimaa, 2019). It introduced four techniques to access users' confidential information by (i) changing permissions, (ii) changing the user's password, and (iii) by altering system configuration to impersonate users. In this paper, three new backdoors found in Office 365 and Azure AD after 2015 are introduced. All the techniques mentioned in this paper are included in an open-source tool called AAD Internals (Syynimaa, 2020).

Pass-through authentication (PTA) is an authentication technology allowing Office 365 users to authenticate using their on-premises credentials (Microsoft, 2018a). It is more light-weight than older technology, Active Directory Federation Services (AD FS), that has been available since Windows Server version 2003 R2. Microsoft currently prefers PTA over AD FS (Microsoft, 2019b). When PTA is installed and configured, a service is installed on the server. This service is called "Azure AD Authentication Agent" (PTA Agent). As the PTA Agent is a service, a local administrator can inject a malicious DLL to (i) gather users credentials, and to (ii) accept any given password. If the rogue admin has Global Admin role in Office 365, he or she can also emulate PTA Agent from any computer having an internet access.

Seamless Single-sign-on (SSSO) is a technology that automatically logs users into Office 365 if they are logged on to the organisation's domain-joined computer (Microsoft, 2019a). This can be used in conjunction with PTA. SSSO is using Kerberos authentication, which requires that the secret (i.e. password) of the service provider (i.e. Office 365) is known by both the service provider and the identity provider (i.e. AD). When SSSO is installed, a computer account called AZUREADSSOACC is created on the organisation's Active Directory (AD) and is given a long random password. The name and password of the computer account are sent to Azure AD so that Kerberos authentication can be performed. If the rogue administrator has Global Admin role in Office 365, he or she can reset the computer account password in Office 365 to any password. If the administrator has also rights to reset

computer account password in AD, he or she can set it to same than in the cloud. After that, the users can log in normally but the password is now known by the admin. With the password, the administrator can create fake but valid Kerberos tokens and impersonate any user in Office 365.

Identity federation is a technology that allows users to authenticate to Office 365 using their on-premises credentials (Microsoft, 2018b). It also provides single-sign-on when logged on to the organisation's domain-joined computer. Federation is typically implemented using AD FS, which is a built-in feature of Windows Server operating system. Federation uses SAML or WS-FED technologies and the trust between AD FS and Office 365 is formed using digital certificates. The certificate is needed to sign SAML tokens by AD FS so that Office 365 trusts them. The certificate is stored in an encrypted form in a configuration database. As explained in previous papers (Syynimaa, 2015, 2018), local administrators of the server running AD FS may alter configuration so that they can impersonate users without access to the certificate. However, a local admin can export the certificate allowing the creation of fake but valid SAML tokens to impersonate users from any computer having internet access. If the rogue admin has a Global Admin role in Office 365, he or she can utilise a vulnerability in Office 365 identity federation. The vulnerability allows registering any domain name to Office 365 and defining the digital certificate used to sign SAML tokens. As such, the registered domain can be used as a backdoor to impersonate any user of the Office 365 environment.

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From Decentralization to Collaboration - Providing Groupware as a Service for Multiple Universities

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Keywords

Collaboration, IT Service, Groupware, Identities, Web Service, Community Cloud

1. SUMMARY

For the past decades, HEI in Germany have been acting each on their own, particularly concerning building up and maintaining IT infrastructure. During the last years, not only the standards in IT and therefore the demands on the infrastructure have changed, but also the available IT staff on the labor market. Therefore, it gets harder for HEI to recruit qualified IT staff and keep them in long term. One strategy to cope with this situation is to increase collaboration between HEI and offer services across universities.

Email- and groupware services are essential for the collaboration of students, researchers and staff alike. This makes them one of the most important services of a modern HEI. Currently, a number of solutions and vendors exist and HEIs mostly maintain their own email- and groupware-infrastructure. This means a significant overhead with regard to administration, storage and server capacities.

Based on the observation that the services provided and the overall infrastructure behind them does not greatly differ from one university to another, it is imaginable to plan a central instance instead of independent ones. This faces a number of challenges, from account provisioning to contracting and support. We describe the pilot phase of a collaboration project that is conducted by four universities aiming to provide email and groupware functionality for a number of HEIs in Germany using Microsoft Exchange.

2. PROBLEM STATEMENT

Due to the decentralization in the IT infrastructure and IT strategy, the status of groupware services in HEI in Germany differs, although all of them do provide groupware services. There are different policies concerning which group of people has access to the groupware service: every member of the university, only students, only staff or sometimes even just parts of the staff. Additionally, it is regulated differently, if their use is mandatory or voluntary, and which and how groupware systems are hosted. Thus, the creation and use of accounts for these services is closely linked to identity management (IdM) since this usually provides the data, rights and roles for these processes.

Creating a collaborative groupware service has to regard all the points mentioned above. Furthermore, the system has to be capable for multiple customers, to allow data separation between the HEIs to a certain kind of extend.

At RWTH Aachen University the groupware system used is Microsoft Exchange. The service is available for all members of the university. Before the start of the project two different forms of collaboration already existed between the RWTH and two of the current partner HEIs:

- maintaining an Exchange system which is physically hosted at another university
- maintaining an Exchange system which is nearly identical to the RWTH system and physically hosted there as well

Though the systems are similar to nearly identical, both collaboration concepts do not scale in large, since there is no reduction in the total amount of the administrative effort, as well as server and storage capacities.

Due to legal insecurities and objections concerning the GDPR in German HEIs, cloud solutions by commercial vendors are not applicable at present. Furthermore the issues of correctly licensing a large number of students and / or staff and the form, number and content of data exchange between HEIs remain to be solved.

3. SOLUTION

A feasible concept to collaborate in this context is providing a community cloud. A community cloud is maintained by one or more members of a community or interest group for the members of this group alone. In our case the groupware system is on-premises for the RWTH Aachen University, while it is a cloud service for the other HEIs. If a cloud service is provided by another HEI, the problem of reservations towards commercial vendors is settled.

A consortium of four universities received a two-year sponsorship for conducting a feasibility study to test this solution by DH.NRW, a cooperative association of 42 universities from North Rhine-Westphalia and the Ministry of Culture and Science in Germany.

The goal of this project is to figure out solutions to the main points in building up such a community cloud groupware service:

- Which contracts have to be fixed between the university, e.g. concerning exchanging data and services?
- Which technical processes have to be defined? This applies e.g. to the email routing, migration process, account provisioning and data separation between members.
- Which organisational processes have to be defined, e.g. support processes, service development and information security concept?
- What points need to be clarified within each HEI individually in order to participate in such a service e.g. involvement of data protection officers and staff councils?

Since the IT infrastructure in Aachen is partly built up in a decentralised way, meaning that each institute has its own subdomain (e.g. institute.rwth-aachen.de), the groupware system has to be multi-client capable as well. Because of this we created an additional administrative layer on top of our groupware system, which provides the possibility of maintaining email accounts for each subdomain. This layer can now be used for the administrators of other universities as well.

4. CURRENT SITUATION

Six months into the project, most of the technical processes are defined, but not all of them have been tested sufficiently yet.

During the first phase the main focus was on account provisioning which is managed through a web service. This allows the creation of accounts for other HEIs without giving them direct access to the groupware system. Furthermore it is independent of existing infrastructure and identity management processes in other universities, as it only provides main features like create, read, update and delete. By relying on one web service for all, transferability is maintained.

The next phase of the project consists of the definition and test of a migration process to move existing mail accounts of students or staff from a possibly different mail system to our mail infrastructure.

5. CONCLUSIONS AND OUTLOOK

The project showed that there is a significant interest to participate a groupware service, provided by another HEI. After successfully completing the feasibility study, sustainable solutions for a long term operation of the community cloud groupware service need to be found. This includes for example financial compensation for the service provider to fund the increasing amount of storage and servers, as well as finding a way to assure legal certainty with regard to licensing.

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Why data services should be invisible. A coordinated approach across universities.

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Keywords

data services, digitalization, reliability, collaboration

1. SUMMARY

“Digitalisation” is a ubiquitous theme at every university. Since by now literally all aspects of university work and life depend on IT and, in particular, on data, the availability and persistence of data and data services is essential. As trivial as this appears, scientific users need to rely on the availability of their data and data stores, either for using previously stored data or to run experiments that generate new data. This includes all aspects, from the availability and persistency.

Since in many cases access to the data happens in a tiered IT setup, there is no way of “direct” access to the data but a suitable - often server-based - software stack has to be up and running as well. Plus, it’s not “a” software stack but a vast multitude. Therefore, the mentioned requirements go beyond bitstream preservation but include the infrastructure to access the information.

In addition, the justified expectation of all users is an (almost) 24x7-availability of services, and, in particular, an assured persistency of once-stored data. So, data services have to be invisible in the sense that they are expected to be ubiquitously and continuously available. Any “visibility” can be regarded as a disturbance of this expectation.

To cope with this combination of amounts of data, level of expectation, and technical multitude - and steady growth in all of these dimensions, a consortium of universities in North-Rhine Westphalia currently runs a project to develop structures for joint, university-spanning services for safe data storage and high storage and server availability.

2. PROBLEM STATEMENT

Along the ongoing course of digitalization of either in teaching and learning, in research and in administration, almost all processes rely on a stable IT infrastructure.

From the user’s perspective, “data store” also includes the software layer he or she is interacting with, like a database, a versioning system like gitlab and many others. It also refers to everyday actions like email communication or storing data in a shared directory. Therefore, the mentioned requirements go beyond bitstream preservation but include the infrastructure to access the information.

In all these cases, if the proposed - or implemented - service level is (or is felt to be) below the scientist’s expectations, local circumventions are built either by the scientists themselves or, in a better case, by the IT staff. These solutions appear to solve a particular problem including a concrete infrastructure or software layer, but effectively hinder structured approaches. Thus, they are in total, from the organization’s perspective more expensive than central services. Furthermore, specialized local solutions make the exchange of data and hence the collaboration between scientists more difficult as they can create the need to convert data to another format and store it in another system.

3. SOLUTION

A structured approach to this problem has to be developed as a central service, e.i. by the central IT of a HEI. However, due to the increasing varieties in data protection use cases this imposes a huge effort on the IT's side. This is particularly challenging for HEIs with a non-technical focus where often the IT is hardly scaled to accommodate the flood of digitalization. Since the demand and the challenges are quite the same for many universities we started a project across the universities of the state of North Rhine-Westphalia in Germany with the goal to develop technical as well as process models for joint data services. This collaborative approach leaves the necessity to focus on technical aspects of data services for only some of us while all of us can concentrate either on process aspects or how to translate data services into higher level services for scientists and artists. By this approach the efforts imposed by the service improvements are shared among those centers that provide the service in its various facets. Furthermore, small and/or highly specialized HEIs like universities dedicated to music and the arts with only very limited IT capabilities are enabled to advance digitalization by relying on this nascent service structure.

Furthermore, the joint data service paves the way to

- support other collaborative services that rely on data persistency
- true geo dispersed redundancy and thus a high resilience against disasters

4. CURRENT SITUATION AND OUTLOOK

In the recent discussions it became obvious that not terms and metrics are used consistently across the participating universities. Furthermore, at some sites we discovered data silos without any data protection measures at all. And, last but not least, the processes of how the scientific departments interact with the respective IT department, are quite heterogeneous.

Therefore, we developed a survey to comprehend the situation in the universities involved:

- what is there
 - types of systems, amounts of storage
 - service level agreements
 - expectations by role
 - processes
- what should be, by role perspective, from a functional and process perspective.

From discussions in various combinations it became very clear that different roles have differing views that have partly been cultivated for a long time. We therefor distinguish between managers and staff in the central IT and between managers, IT- and non-IT-staff in the departments.

Furthermore, it became clear already that there will be the need to develop up to date ways for the users to interact with storage, define university-spanning processes for running and supporting these services.

In our contribution we will show design and details of the survey and the draft processes for deploying storage services on the depicted scale.

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JupyterHub on WWU Cloud: A Paradigm Shift for Data Science Analysis and Teaching

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Keywords

Cloud, IaaS, OpenStack, Ceph, Kubernetes, JupyterHub

1. Summary

At the University of Münster (Westfälische Wilhelms-Universität - WWU), we provide IaaS Cloud services to researchers and faculty members. These services are primarily designed to store large amounts of data for collaborative analysis and to provide all kind services for research and education. Using this private cloud, we provide a JupyterHub to researchers for web based interactive data analysis and visualization.

2. WWU Cloud

Many researchers are used to work collaboratively with differently sized datasets. These datasets are acquired using various methods, for example data from experiments using sensors, imaging data from microscopes or MRT devices, videos, simulated data from HPC users or simply manually entered data. To facilitate working with these datasets, we built a private cloud (WWU Cloud), where researchers can store and process this data (Vogl, 2019). We provide cloud services free of charge to researchers and faculty members. Funding for this project is provided by the German federal state of North Rhine-Westphalia.

The cloud architecture is based on three main open source software packages: Ceph, OpenStack and Kubernetes (see Figure 1). Kubernetes is used to orchestrate all Ceph and OpenStack services and is invisible to the end user. OpenStack is an Infrastructure-as-a-Service (IaaS) self-service platform to create virtual machines, which can be used to provide services, or to create network shares for data storage. Network shares are accessible from virtual machines, desktop workstations, the HPC cluster and a JupyterHub.

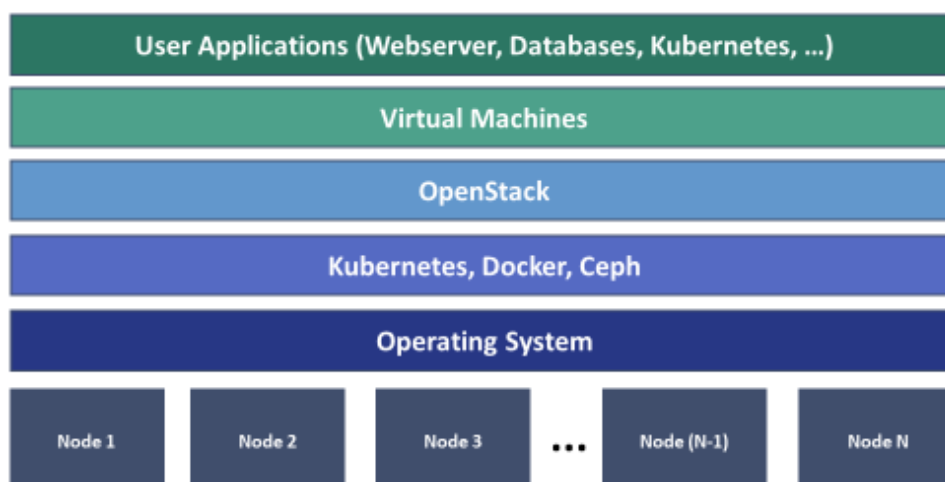


Figure 1: WWU Cloud Architecture

At universities and research institutes, there is already much interest in providing OpenStack clouds as an alternative to expensive commercial cloud services. Some examples are the large-scale cloud deployments at CERN (Bell, 2015) or JetStream (Steward, 2015). However, we are currently unaware of any Kubernetes based cloud deployment in research and education.

Apart from JupyterHub, which will be covered in the next session, there are already many large projects using WWU Cloud for providing services and data storage. In the first four months of 2020, we have already received 13 new project applications. Being one of the most mission critical infrastructures in this digital semester, we host our OpenCast platform in WWU Cloud, which provides videos of recorded lectures to students. WWU Cloud is used for data storage, video processing and content delivery. Furthermore, WWU IT provides a Jitsi cluster for video conferences as an open source alternative to commercial proprietary software, and we are currently considering BigBlueButton as a video conferencing solution especially focused on digital teaching. In terms of pure network filesharing, there are currently 13 active projects storing a total of 162 TiB of research data, which can be accessed and analyzed from workstations, HPC and JupyterHub. In total, we currently host 225 VMs and 539 TiB data.

3. JupyterHub

For data analysis, researchers often use a limited set of applications, mainly consisting of scripting languages, development environments, visualization software and also specific tools for proprietary data formats. The standard framework of choice for data analysis currently is interactive web based Jupyter notebooks (Jupyter standing for Julia/Python/R as the most widely used programming languages for data analysis). Since the data resides on the servers, it is favorable to also run the Jupyter notebooks not on client workstations, but in the cloud.

Using virtual machines in the WWU Cloud would result in very big memory overheads, as data analysis typically needs much memory. However, this memory is used very infrequently, as analyses are performed only between measurements and researchers also have to interpret their analyses.

To counter this potentially massive memory overhead, and to provide a standard set of software tools for interactive data analysis and visualization we provide a JupyterHub, which runs in a Kubernetes cluster within the WWU Cloud and provides a framework to host the execution of Jupyter notebooks on the cloud backend resources. Accessing this JupyterHub from the web browser, the researcher has direct access to network shares on WWU Cloud and access to IDEs like VS Code or R Studio, as well as traditional Julia, Python or R Notebooks. Additionally, we provide access to X11 applications in the browser using noVNC. Optionally, the researchers may request server-side hardware acceleration to speed up data visualization using X11 applications. An integration with the WWU HPC system PALMA through the Python “dask” allows to invoke substantial compute resources for demanding analysis or machine learning applications from within JupyterHub applications.

JupyterHub was very quickly adoption by user groups. WWU IT uses JupyterHub as the core platform for the pyMOR (python based Model Order Reduction) project, where a special numerical mathematics library is developed (using state of the art WWU cloud hosted gitlab based CI/CD toolchains) at Münster Mathematics Institute and is made available for the research community as a JupyterHub based executable environment. Because of the excellent GPU accelerated remote 3D data visualization possibilities, JupyterHub also represents a central building block of CRC1450 (Multiscale imaging of organ-specific inflammation). Within this project, research workflows will be accelerated and simplified by introducing more user-friendly and transparent HPC resource usage within JupyterHub. Other than in research projects, JupyterHub also finds enthusiastic reception for teaching: several courses are already using JupyterHub for students exercises, resulting in up to 60 concurrent sessions. Furthermore, a 50 person AI/ML course and a 150 person python course for physicists are planned to be held in the summer term relying on JupyterHub.

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From solving wicked challenges to innovations to AI - world-class HPC giving rise to international cooperation in research and education

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Keywords

High-performance computing, HPC, EuroHPC, LUMI, supercomputer, research, AI

1. Summary

This presentation will showcase a world's leading computing and data management ecosystem, LUMI, being built in Finland, and explore the ways in which European research and higher education institutions can benefit from the unique investment into HPC. The new opportunities in emerging areas are highlighted in terms of international collaboration. LUMI will be one of the world's best-known scientific instruments for the lifespan of 2020-2026.

2. EUROPEAN GRAND INVESTMENT INTO HIGH-PERFORMANCE COMPUTING FOR RESEARCH AND EDUCATION

The EU and national governments are jointly investing in high-performance computing (HPC) to help to advance research, innovation and industrial growth and to keep Europe globally competitive. The EuroHPC Joint Undertaking will pool EU and national resources in high-performance computing acquiring and providing a world-class supercomputing and data infrastructure for Europe's scientific, industrial and public users supporting an ambitious research and innovation agenda. EuroHPC joint undertaking has 32 European member countries. The budget includes public investments from the EU and participating states as well as investments from the private sector. The EU call for proposals process resulted in a decision to place three pre-exascale supercomputers in Finland, Italy and Spain. The new supercomputer to be located in CSC's data center in Kajaani, Finland is called LUMI.

LUMI is a unique joint endeavor in high-performance computing. LUMI research infrastructure provides a high-quality, cost-efficient and environmentally sustainable HPC ecosystem based on true European collaboration. The nine LUMI consortium members are Finland, Belgium, Czech Republic, Denmark, Estonia, Norway, Poland, Sweden and Switzerland. Possibly some other European countries may join the consortium in the future. Consortium continues a solid tradition of collaboration in HPC training and education, user support and data management services.

LUMI supercomputer is the first ever co-investment of this scale in scientific computing. The total budget of the LUMI system in CSC's data center in Kajaani is more than 200 million euros. Half of this funding comes from the EU and the other half from the consortium countries. LUMI supercomputer will start operating in Q1/2021 and will operate until 2026.

LUMI data center network connections are a direct part of the Nordic backbone, Funet network, the infrastructure that connects the institutions nationally and internationally through NORDUnet. The next-generation NORDUnet connects the Kajaani LUMI site to GÉANT, ensuring European-wide availability of any HPC resources installed in Kajaani

Environmental sustainability and reducing the global carbon footprint are at the heart of CSC's data center in Kajaani. All the energy used will be CO2 neutral and renewable. LUMI supercomputer will be cooled by water and the waste heat generated by the equipment will be utilized in the district heating network of Kajaani.



Figure 1. LUMI Consortium Countries February 2020.

3. OPENING FUTURE AVENUES FOR COOPERATION

Through LUMI European researchers can access world-class computing resources, which aids European research in nearly all scientific disciplines. It will help to attract top experts to universities and research institutes. Supporting the wide, many disciplined use of our new international state of the art tools as part of the research process brings forth a challenge as well as an opportunity - for the HEIs, research institutions and national HPC centers to work together. Supercomputers alone will not ensure Europe a leading place in innovation and science without the necessary HPC training and skills development. The tools together with a focus on competence building open new opportunities for cooperation and matchmaking between Universities, Universities of Applied Sciences, Research Institution and industry, giving a boost for European economy and competitiveness.

Services for data in various forms have grown. AI has become one of the focus areas and a high priority in Finland as well as in the European community, and there is a need to support the AI development. Also data analytics increases fast and new areas such as digital education and learning, and services for culture and public administration require resources and focus. Opportunities to benefit from digitalization are wider and more actual than ever before. The new data management and HPC infrastructure will lay grounds for innovation and new data-based business opportunities in areas such as platform economy and the development of artificial intelligence.

Once we have this platform for the future, we should start thinking what we should do next - what grand challenges do we solve? How do we promote European collaboration further? Not only in research and education but also with technology development, startups, eGovernment, industry, ... possibilities are abundant.

This presentation will discuss the emerging new possibilities for closer international collaboration brought forward by a world's leading computing and data management ecosystem. The aim of the session is to explore the ways in which European research and higher education institutions can benefit from the investment into HPC and work together.

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EuroHPC
Joint Undertaking



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**Leverage from
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2014–2020



Kainuun liitto

How to Manage IT Resources in Research Projects? Towards a Collaborative Scientific Integration Environment

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Keywords

distributed systems, eScience, research data management, service-oriented architecture

1. SUMMARY

With *CoScInE*, the *Collaborative Scientific Integration Environment*, we present a software platform to allocate and manage IT resources in research projects. While the platform itself does not store any research data, it enables integration of multiple storage resources and allows metadata management across these resources. This supports researchers in curating their research data and complying with principles to safeguard good scientific practice such as findability, accessibility and reusability. Additionally, operators of central IT infrastructures can benefit from resource allocation management and usage monitoring while complying with established scientific and economic standards.

2. INTRODUCTION

Researchers typically employ a broad spectrum of IT service infrastructures for their projects that range from local to centralized, federated and also external IT service providers. Local setups typically aim towards rich support of workflows specific to individual research groups like the management platforms for medical study data (Kirsten, Kiel, Wagner, Rühle, & Löffler, 2017) or chemical samples (Politze, Schwarz, Kirchmeyer, Claus, & Müller, 2019). Central applications like *MetadataManager* (Politze, Bensberg, & Müller, 2019), *Radar* (Kraft, et al., 2016) or *MASi* (Grunzke, et al., 2019) are less specific and address a wider community with more generic research data management (RDM) workflows. External “clouds” like *Zenodo*, *Figshare* or *Open Science Framework (OSF)* support basic RDM workflows like citation or persistent identification. By far most prominent are generic “clouds” like the *Owncloud*-based *Sciebo* (Vogl, et al., 2015), *Dropbox*, *Google Drive* or *GitLab* to store and manage data, however these options usually lack in support of RDM workflows.

This spectrum is also reflected by researchers’ use of services within their projects. With multiple services being employed by a research project, distributed research data and cross-institutional projects the complexity of already challenging RDM tasks become a burden especially to senior researchers who are in charge of keeping track of the all resources used within their projects. Another perspective to these issues comes from IT service providers, like the IT Center of RWTH Aachen University, that allocate central resources like storage and compute infrastructures or services like *GitLab*. These providers have to meet researchers’ requirements, provide needed services and have to assure that resources are allocated according to scientific and economic standards to meet the requirements of funding agencies.

To mitigate these challenges, we introduce *CoScInE*, the *Collaborative Scientific Integration Environment*. The platform allows researchers to manage and combine different IT resources they already use in their research projects while consequently ensuring a minimal standard for RDM. *CoScInE* mainly draws from two guidelines, the *FAIR Guiding principles* (Wilkinson, et al., 2016) and the Code of Conduct of the German Research Foundation (Deutsche Forschungsgemeinschaft (DFG), 2019).

3. INTEGRATED PROCESSES

CoScInE acts as an information hub for researchers. It allows for interlinking existing infrastructures at universities (local and centralized) (Schmitz & Politze, 2018) as well as cloud services. *CoScInE* gathers infrastructure components from different environments, abstracts core features in generic adapters and provides an RDM platform for researchers based on these components. Figure 1 shows different dimensions of processes and infrastructure components that are integrated.

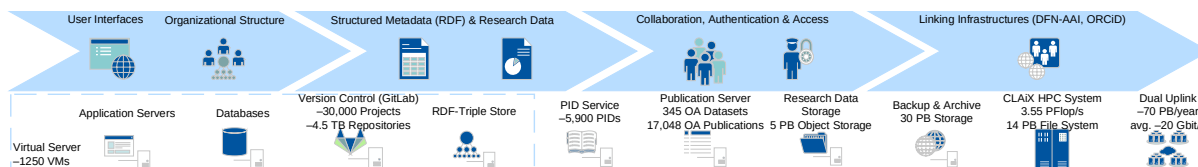


Figure 1: Central IT services at RWTH Aachen University supporting various research processes.

CoScInE makes use of several existing high-level components for authentication, data storage and metadata. Identities are collected and managed in a way that allows collaboration and identification across organizations, highlighting the increasing importance of authentication and authorization infrastructures as operated by *eduGAIN* and researcher identifiers like *ORCID* (Haak, Fenner, Paglione, Pentz, & Ratner, 2012). *CoScInE* makes use of the results of the *AARC* project (Liampotis, 2019) to allow combining academic and “cloud” identity providers.

Resource Adapters abstract specific interfaces of storage (and potentially other) services and define an interface with common operations. Currently, *CoScInE* uses the *Waterbutler API* (Center for Open Science, 2020) from the *OSF* project to connect 15 cloud storage providers. *CoScInE* assigns a persistent identifier that allows global identification to each resource. Sub-identifiers make each data set uniquely identifiable. Discipline-specific metadata across the resources makes research data discoverable in the system. *CoScInE* utilizes the W3C standards *RDF* (Cyganiak, Wood, & Lanthaler, 2014) and *SHACL* (Knublauch & Kontokostas, 2014) as the internal metadata model and for validation. This allows researchers to enrich their data independently of its actual storage location. See Figure 2 for a representation of the composition and interaction of high-level components.

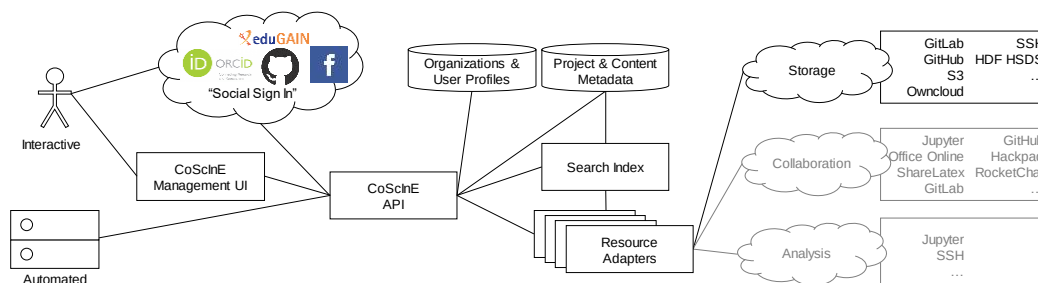


Figure 2: Overview of the system architecture for resource management of *CoScInE*.

Note that while resource allocation and -access are managed by *CoScInE*, it functions only as an information broker since time-critical and data-intensive workflows still use the interfaces provided directly by the resources. Hence, *CoScInE* aims neither to replace nor to obscure the integrated systems but to integrate them. This becomes vital for workflows that cross system boundaries, (e.g. moving data sets for data publication or archival) which now can be represented as consistent and cohesive functions in the user interface that also are in accordance with RDM best practices.

4. OUTLOOK

CoScInE just started in a pilot phase for users at RWTH Aachen University. The development team will continuously improve and extend the existing functionalities based on implicit and explicit user feedback. The focus will be on the support of more sophisticated RDM workflows like data publication, archival and automatic extraction of metadata from contents of managed resources.

All software components are developed as open-source (RWTH Aachen University, 2020). The microservice architecture allows reusing of individual components in other systems. Consequently, it is possible for other universities or research groups to adopt the standardized interfaces to their local environments.

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Processes behind the research data management

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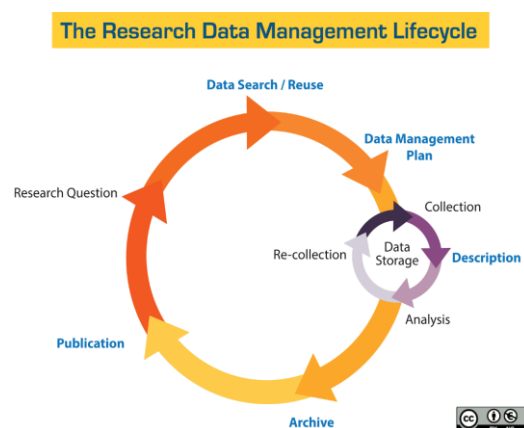
Keywords

Research data, research data management, rdm, processes, life cycles, data services

1. Summary

Without understanding the need for interoperability between research data management systems and processes, it is not possible to understand and develop efficient and user-friendly data services for researchers. In this paper we describe the research data processes behind RDM lifecycles and provide an insight into the actual implementations of these services all around the world in different research systems.

2. Research data management lifecycles



Research data management (RDM) is a combination of processes, systems, and their integration. RDM lifecycles are used to present these processes as a cycle, which starts from the planning phase and ends with reusability, long term preservation or publication. Lifecycles are one way to visualize the bigger picture. When real-world research data processes and architectures are presented, however, we can see that they rarely fit the idealized vision. Lifecycles hide several data use cases of researchers, and more informative and specific models are needed.

Figure 1. Example of the RDM lifecycle

3. Process mapping

Process maps help illustrate several very different paths to move and handle data within the data lifecycle. In the figure 2 we present more specific model of the research data processes including their interoperability.

The multiplicity of possibilities for arranging research data paths through the service jungle also presents a challenge to the governance of the RDM infrastructure. The many paths make the lives of service providers hard and blur the situation for decision makers, all at the same time the as the demand for services and capacity are increasing with the data deluge. Process mapping and its integrations based on practical research data services used by researchers.

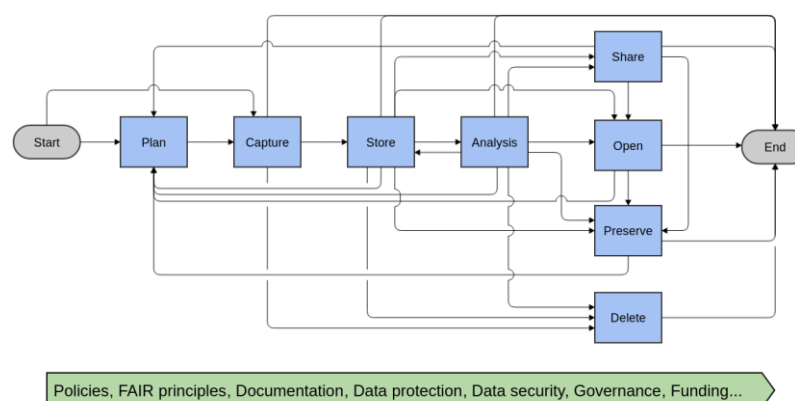


Figure 2. Research data processes and their relationships

4. Insights into the survey results

The Research Data Architectures in Research Institutions (RDARI) Interest Group of the Research Data Alliance (RDA) Survey of Institutional Research Data Services was conducted between July and November 2019. The aim of the survey was to build a picture of the current state of research data management at universities and other research-conducting institutions across the world, both to assist with benchmarking and also to help put people in touch with each other so they could exchange notes about their implementations (assuming they were happy to share their details).

The survey covered institutional RDM governance and infrastructure as well as a number of individual services offered by institutions, such as data storage services, long-term repositories, data management planning services, database hosting, services for sensitive data, and several others. For each service, the survey questions the technologies used, costing and pricing models, and uptake. The survey reports on current priorities for new service development and the growth of research data provision, in the context of lifecycles and process maps.

Less than 15% of responding institutions claimed that they supported a tightly-integrated suite of research data services at present, but what does this mean to different institutions, and how are they going about such integrations in practice? Meanwhile more than 60% of respondents report that their institution is currently in the process of developing new services, but what are they prioritizing, and why?

Conclusions

Usual research data management models give a general picture of the landscape of research data operations but it is not enough for the service development purposes. More specific tools for designing user driven data services are needed. Process mapping described in this article and detailed integration description are potential option. RDARI survey gives real world data to describe services and their integrations in the research institutions.

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Migrating from Team Foundation Server to GitLab - A Progress Report

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Keywords

Continuous integration, git, software development, task management, version control

1. SUMMARY

In our initial situation, we used a locally operated Team Foundation Server 2015 (TFS) as version control system (VCS) and for tasks and sprint planning for our project teams. Our current effort is to move our development from this locally operated infrastructure to a shared GitLab instance provided for all users of our university. The goal is to reduce our local maintenance efforts and foster standardization of setups throughout the software development and operation departments of the university. From our reference case, we learned to overcome some obstacles that helped us during the migration of several successive projects. In our presentation, we want to share our lessons learned when migrating between VCS and planning tools.

2. MIGRATION SZENARIO

In our department, we use git for our software development projects since about 2014. Previously TFS came with Team Foundation Version Control (TFVC), which some development teams continue to use today while other projects were already migrated to git version control on TFS. Some of the projects are more than 15 years old. Over the years, some projects were migrated from Visual Source Safe and continuously used more features from version control via continuous integration (CI)/continuous delivery (CD) and automated tests to task and sprint planning.

We use the “Quality Management System Teaching” developed by a five-person scrum team at our department as a reference case. The software enables involved parties to maintain this continuous improvement process by setting quality goals and evaluating key performance indicators (KPIs) based on aggregated data from various existing source systems, as well as defining and tracing action measures and generating evaluation reports for external audits and follow up evaluations in the cycle. The team uses C#, SharePoint and MSSQL for the backend and implements the frontend using SQL Server Reports and Vue.js powered HTML5 pages. However, the discussed workflows are, in principle, transferrable to any kind of software project. Several other projects within our department could already successfully reuse them and thus drastically reduce efforts needed.

In our reference case, we already used git as VCS, CI/CD and features for sprint planning provided by TFS. During the migration, we also revised the CI/CD infrastructure. In the initial situation, CI as well as CD were running on the live infrastructure. After migration, our goal is to additionally separate running CI in build environments and running CD in staging and live environments only.

Our roadmap for the migration to GitLab hence was broken down to separate migrations of...

- Source code version control
- Tasks and sprint planning
- CI/CD

The migration of source code turns out to be as easy as expected as it is well supported by the git VCS. Using the mirror functionality of git allowed to keep copies of the source code synchronized on both systems while moving to the new GitLab platform. This process is obviously more complicated for legacy projects, but certainly not impossible. The git extension git-tfs allows easy conversion from

TFVC to a git repository including the full history and mapping of users to corresponding authors of git commits. This procedure is equally possible for migrations from SVN VCS using git-svn.

The migration of the task boards in TFS to issues in GitLab required a lot more effort. It was clear that no history (e.g. closed tasks) were migrated to the new environment. The existing structure made use of the hierarchical task model in TFS that was replaced by Milestones, Labels and Checkboxes in GitLab. This change required an intensive coordination with the scrum team to meet their needs during the different phases of the sprint. Hence, open tasks and the backlog were first revised and cleaned up and then copied and converted manually into the new structure.

Last but not least was the migration of the existing CI/CD processes. TFS allowed a UI based configuration that had several predefined tasks e.g. for building, copying files or running commands on remote Windows machines. The existing build pipeline had to be translated to the appropriate console commands in the text based YAML file used by GitLab. Especially running remote commands on windows required detailed evaluation of PowerShell methods running in the CI/CD services. As already mentioned, the occasion was used in order to separate CI and CD tasks currently defined in a bundle. For the rolling release application, the team now uses a four-stage model based on GitFlow:

- Development: local development system, deployment by developer on feature-branches
- Integration: shared by developers, automated deployment from integration-branch
- Staging: demo system for stakeholders, automated deployment from development-branch
- Production: live system deployment is automated but triggered manually

3. LESSONS LEARNED

Migration was done mostly during normal operation. The scrum team was instructed to move before the beginning of a next sprint. A small sub-group carried out the migration itself. However, a longer span (4 instead of 2 weeks) between successive releases was planned to compensate for migration overhead. The migration went without any major disruptions of the development process. It should be noted that the migration is a severe change for the developers and additional time should be allowed for the development team to adopt the new user interfaces and practices.

However certain things need to be considered when migrating VCS and / or task planning systems:

Due to very different structures in management of tasks and sprint planning capabilities, issues likely need to be migrated manually. This essentially means the history of issues is not migrated, old issues may be left in the old system and may need to remain there for reference. In our case, we retain the old issues on TFS and after six months check if they are still needed.

TFS and GitLab additionally have entirely different models of Groups, Projects and Repositories. While TFS allowed almost arbitrary (m:n:k) relations, GitLab is designed for multiple projects per group with a single repository (1:n:1). Hence, tasks that were previously managed across multiple repositories had to be migrated to issues that are located on repository level. This required the creation of a single project for managing the product backlog for the scrum team, independent of the repositories for the actual source code. Unfortunately, this workaround, hinders from creating merge requests and feature branches directly from the issues and they have to be created manually using the git client.

Together with separation of CI/CD, migration of CI tasks was more time consuming than expected; especially rebuilding tasks for file copy or remote execution but this actually allowed version controlling the task definitions with the source code. GitLab, however, supports the new multi stage CI/CD process very well and thus provides quite an improvement in the development process.

By far the easiest task was the migration of the actual VCS. As a decentralized VCS git supports successive migration and mirroring of the source code during the migration phase. This allowed moving one feature at a time with very limited overhead.

Taking the time to think about the development process furthermore allowed including some of the more advanced features like merge request approvals to speed up regular code reviews. Overall, we see that the goal for harmonization of processes was reached. Not only with the other departments: Due to successive migrations of other projects, it also helped to clean up and standardize some setups especially in the historically grown projects to a common ground.

4. AUTHORS' BIOGRAPHIES



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The Key to Reusability and Cost Reduction - Standardization

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Keywords

Standardization, Collaboration, System integration, IT-cost

1. Summary

The digital transformation drives the need for information exchange and system integrations between IT-system. However, system integrations is often a cost driver and is one of the main reasons why many projects exceeds the planned budget. Because of this, higher education institutions in Sweden has decided to collaborate around system integrations in order to cut IT-cost. The key part of the collaboration was the use of a common standard in the student information domain. When a large number of Swedish institutions procured LMS (Learning Management Platform) through Sunet it was decided to create a common asynchronous integration between the national student information system Ladok and the LMS platform. The choice of standard was LIS (Learning Information Services) from IMS Global, which fulfilled the overall requirements. Today several institutions use the integration in production between Ladok and LMS and others is about to enter the solution. Use of the LIS integration with other target systems in other domains has also been evolving. The initiative has so far been beneficial for the higher education sector and as a next step, a collaboration has been formed to develop the new generation of the standard.

2. Extended Abstract

During 2017, the Swedish University Network - SUNET handled a national procurement regarding a new LMS for a large number of institutions. All participating institutions were interested in having an automatic system integration with the LMS and the Swedish student information system called Ladok. Ladok is a modern application based on a Domain Driven Design with an event driven behavior. Around 40 Swedish institutions rely on Master Data from Ladok to manage their everyday processes. The model of the chosen LMS vendor was to sell individual integration solutions for each institution, which would have been a very expensive solution. A point to-point integration with the LMS would not be possible to re-use and several other systems had similar information requirements.

It was decided that the best way to go forward was to initiate a collaboration between institutions in order to solve the integration and drastically reduce cost for the institutions. The collaboration was initiated by ITCF, which is an independent group of CIOs and IT managers from Swedish universities. Sunet was commissioned to start a project in order to implement a common integration solution between the LMS and Ladok. The first task in the project was to solve the architecture challenge creating a common reusable integration. The use of an international standard was an important part of the solution. After some analysis and comparisons between different standards, the choice was Learning Information Services from IMS Global. It was not a perfect match but by using the ability with extensions, the gaps could be filled in a satisfactory way.

The solution is based on the following principles.

- *Standardize information models on the LIS Format* - Increase interoperability in the student information system and LMS domain. Increase interface stability and prevent re-inventing the wheel.

- *Service Orientation* - Express all integrations from Ladok as reusable Services. Loose Coupling between Service Provider and Consumer. Idempotent Services i.e. the same effect is achieved every time. The provider do not need to have knowledge about the Consumer State.
- *Event driven integration* - Act on each event in the business and use publish/subscribe pattern (Pub/Sub).
- *Standardize Transport* - Asynchronous Transactional Messaging through AMQP 1.0, which allows transactional support - the message, is delivered at least once to each Consumer. Limits need to re-send information. Enables The Consumer and Provider to operate independently. The Provider can send a Message even when the Consumer is not available. The Consumer can read information at will. Messages will wait on queue if the consumer has been unavailable for some reason.

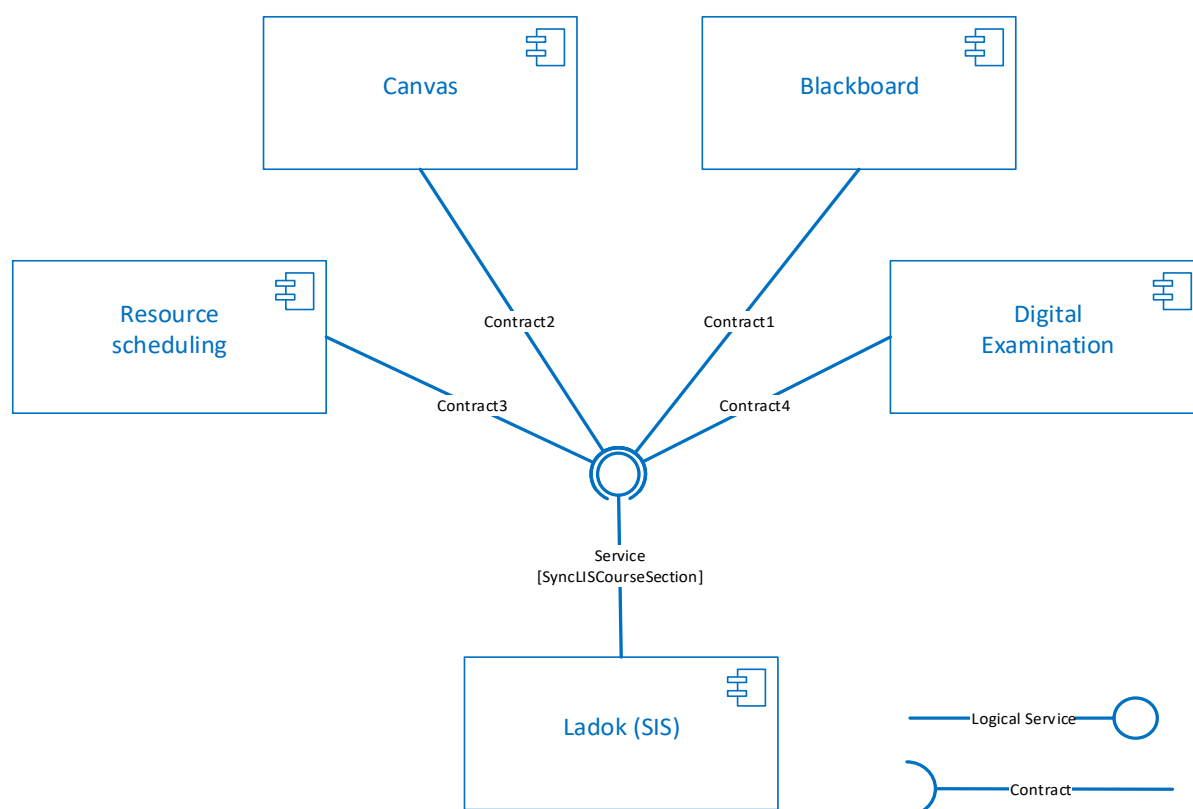


Figure 1 The use of pub/sub pattern for the integration

The LMS integration has now several institutions in production and more to come. The solutions have been reused for other domains such as Digital Examination. A new procurement concerning several institutions regarding system for Digital Examination will soon start. The next domain to handle is student exchange administration systems.

The common effort towards standardization using an international standard in higher education will make it possible for institutions to have common requirement on system vendors. Vendors learn if they want to enter the market, they must provide a system that can handle the specific international standard. In the long term, this will increase collaboration between institutions and they will be able to share integrations towards the national student information system Ladok. Overall, this approach will cut cost for institutions in higher education, which already has been proven in the LMS case.

To ensure that the development of the selected standard allies with the future needs representatives from the higher education in Sweden is working within the IMS Global task force to develop the new standard within the student information domain, EduAPI.

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Sharing of student data in the “European Universities” alliances with EMREX

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Keywords

Universities alliance, EMREX, learning mobility, digital results exchange, data sharing

1. Summary

The European Commission has launched an initiative called “European Universities” alliances with the goal to enhance the quality and attractiveness of European higher education and boost cooperation between institutions, their students and staff. There are currently 17 funded alliances with 114 participating institutions. The initiative is designed to explicitly strengthen mobility of students and staff. Therefore there is a need for a mechanism for sharing student data. EMREX is here to help! It is an easy-to-implement way to transfer student records between institutions. The transfer itself is very straightforward and the receiving party decides how the data should be made useful, be it just transcript of records or diplomas of double/joint degree programs.

2. EUROPEAN UNIVERSITIES ALLIANCES

According to the EC official website¹, the European Commission announced on June 26 2019 the higher education institutions from all over Europe that will be part of the first “European Universities” alliances. They will enhance the quality and attractiveness of European higher education and boost cooperation between institutions, their students and staff. 17 European Universities involving 114 higher education institutions from 24 Member States were selected (see link in references²). European Universities are transnational alliances of higher education institutions from across the EU that share a long-term strategy and promote European values and identity. The initiative is designed to significantly strengthen mobility of students and staff, and foster the quality, inclusiveness and competitiveness of European higher education.

European Universities will become inter-university campuses around which students, doctoral candidates, staff and researchers can move seamlessly. They will pool their expertise, platforms and resources to deliver joint curricula or modules covering various disciplines. European Universities will also contribute to the sustainable economic development of the regions where they are located. A second call was opened in late 2019 with possibilities to up to 24 new alliances and a budget of 120 million €.

One of the key issues with the alliances is to share student achievement data between the partners. To be able to build a common curriculum there must be easy ways to combine the parts taken at different institutions. The easiest solution to the problem of sharing student data in a reliable and secure way is EMREX and this system is already in use at several institutions in Europe.

3. THE EMREX SOLUTION

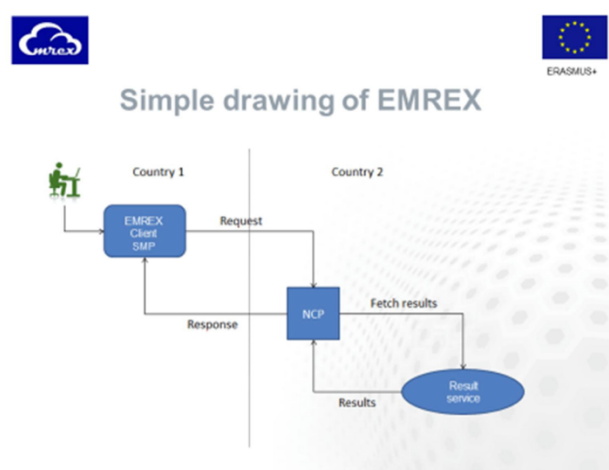
EMREX is a solution for transferring student data internationally in a machine-readable way. It consists of two parts: the technical solution and the international network of partners (EMREX User Group - EUG). It originated as an EU-funded project 2015-2017, aiming to simplify and increase the quality of the credit transfer process after a student exchange. The EMREX service network went into production already before the successful project ended and has been in production ever since, being one of the rather few EU projects maintaining itself and being able to grow after the project officially ended. EMREX is not limited to the EU i.e. it can be used worldwide.

At present, EMREX is operational in a number of countries in Europe. It is a technical solution used to securely exchange educational data between students and third parties, for example higher education institutions (HEIs) or potential employers. In this way, EMREX can facilitate student mobility and decrease the administrative burden of student exchanges for the institutions. EMREX uses an open source technical solution, through which different kinds of educational data can be transferred, be it transcript of records or entire diplomas.

The technical solution is extremely flexible, the only requirement is that participating clients (student mobility plugin – SMP) and National Contact Points (NCP) follow the ELMO standard. ELMO is the data standard used in the EMREX network to describe student achievements and supporting data. It is used also by other projects and organizations (such as Erasmus Without Paper,

www.erasmuswithoutpaper.eu). Any actor can be behind an NCP, for instance a single HEI, an organization or a national level data provider. The requirements for participation for data providers and consumers are low – anyone can build an EMREX client and any local system can be

connected to an NCP that delivers data upon request. Security is maintained in an adaptive manner, from initially a basic solution to coming technologies like eIDAS and Blockchains. More information on this can be found at www.emrex.eu³. All specifications and software are open source and can be found in Github⁴. It is an easy and cost efficient solution for implementing transfer of student records between institutions.



4. EMREX SOLVES THE PROBLEM

The EMREX NCP and the EMREX client are so flexible that any institution can build them and since substantial parts can be reused it would not be difficult to let EMREX exchange encompass the whole alliance. Many of the institutions involved in the alliances are already part of the EMREX-network so the transition to electronic transfer of student data should be feasible. At least ten of the selected alliances have one or more EMREX-universities as partners. The presentation will go through statistics, development plans and the easy steps to take to be a part of the EMREX network.

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⁴ Github, repository for specifications and software Retrieved February 20, 2020, from <https://github.com/emrex-eu/>

6. AUTHORS' BIOGRAPHIES



Tor Fridell, M. Sc. in Computer Science and Engineering. Currently Head of Student Information System at Linköping University and also coordinator for international affairs for the national Swedish Ladok Consortium. Previous jobs include Operations manager for the Ladok Consortium, Area Manager for Statistics and Follow-up for the Ladok Consortium, IS manager for Linköping Institute of Technology, and programmer. Tor has been employed by the university since 1996. Tor has long been involved in international cooperation regarding exchange of student data and is also active in standards work and development of student information systems. Tor has been President of the European Campus Card Association and Chairman of the National Swedish Standards Committee SIS TK450, the national body for CEN TC 353, working with Learning Technologies. Tor has been involved in the EMREX project since start and is also active in standards work and development of student information systems.



Geir Vangen has more than 20 years' experience in developing nationwide systems within higher education. He is head of development at Unit - The Norwegian Directorate for ICT and Joint Services in Higher Education and Research. He participates in national and international standardisation work. He has been member of national committees appointed by the Ministry of Education and Research, and has led projects on behalf of the Ministry. Geir Vangen graduated from University of Oslo, Institute of Informatics in 1989. <https://www.linkedin.com/in/geir-vangen-7a7aa44/>.



Janina Mincer-Daszkiewicz graduated in computer science in the University of Warsaw, Poland, and obtained a Ph.D. degree in math from the same university. She is an associate professor in Computer Science at the Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw. Since 1999, she leads a project for the development of a student management information system [USOS](#), which is used in almost 70 Polish Higher Education Institutions, gathered in the [MUCI consortium](#). Janina takes an active part in many nation-wide projects in Poland. She has been involved in Egracons, EMREX and Erasmus Without Paper European projects. <http://www.mimuw.edu.pl/~jmd>.



Jan Joost Norder works at the Dienst Uitvoering Onderwijs, part of the Dutch Ministry of Education, Culture and Science. In his role as Product Owner he is responsible for the Dutch Diplomaregister and also Chair of the Executive Committee of EMREX. He has many years of experience in improving the digital enrolment process and exchange of student data in higher education. Since 2016 he has been involved in the international projects.



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How can I get my mobile student ID card?

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Keywords

Mobile student ID card, Mobile USOS, USOS, USOS API, MUCI, mLegitymacja, mObywatel, Ministry of Digitalization, Trusted Profile, login.gov.pl

1. SUMMARY

Let us assume that I study in the University of Warsaw or some other university from the MUCI consortium (which gathers 70 higher education institutions in Poland, which use the same student information system, called USOS [4]). I have a mobile app, called Mobile USOS, which gives me access to my student records in the student information system of my university. Polish government has just issued a mobile student ID card (mLegitymacja, mStudentCard [2]). I want to install it on my smartphone. I want it now, when I am at home or on vacation, far away from the student's office of my university. I am eligible, my Mobile USOS can confirm that I am an active student, have a valid plastic student id card (but who uses plastic nowadays), have not been expelled from the university.

A mobile student ID card is not issued by my university, but by the Ministry of Digitalization. It is an official document, can only be given to students who fulfill the necessary conditions [3]. My university should deliver the data needed to issue the mobile student ID card to the Ministry, and then the Ministry would create the mobile student ID card and post it for me on the ministerial server. Through my university I would get the QR code and PIN needed to download it to my smartphone and activate. The card is issued only upon request. This data flow has been designed by the Ministry and is supported by the ministry's information system.

So how can I get my mobile student ID card?

If the only option given to the institution is to upload data of all active students, who apply for the mobile student ID card, to the portal of the Ministry of Digitalization, via the web interface, separately for each student, every semester, and to upgrade the information every time the status of the student changes, the institution should really consider all pros and cons, since the manual data transfer between systems means significantly higher burden on the university administration.

If the student wants a mobile student ID card, the student should be given the possibility to get it by himself, without the assistance of the university administration, anytime, anywhere.

The student should be able to trigger the necessary flow of data from the system when the information is stored to the one which needs it. This can be obtained via integration. The systems can be integrated also when one is run by the higher education institution and the other is run by the Ministry of Digitalization. The needed tool is the API (Application Programming Interface).

The aim of this paper is to show that digitalization is not the goal in itself; the goal is to **facilitate** the implementation of **business processes** for prospective stakeholders.

The ultimate goal of the paper is to share the good practice implemented by the University of Warsaw, for itself and other HEIs in the MUCI consortium, which is an example of how to properly digitalize business processes.

2. Mobile student ID card

The mobile student ID card (**mLegitymacja**) is one of the electronic documents available as part of **mObywatel** (mCitizen) – official mobile application, published by the Polish government and delivered by the Ministry of Digitization. Installing mObywatel on the phone is not complicated and does not require leaving the house. One has to set up **Trusted Profile**, but that can be done online via electronic banking. Trusted Profile is an element of the infrastructure of the Polish eID node, available at login.gov.pl.

According to law on higher education mLegitymacja can only be issued to an active student who possesses the plastic student ID card, valid for the current period of study. In practice it means that the student's photo, personal data, citizen number (PESEL), available in the student information system of the university, should be delivered to the Ministry of Digitalization, upon request made by the student. The Ministry implemented the web interface for uploading students' data and created accounts for schools, which signed an agreement. In the period of March-November 2019 app. 3000 Polish primary and secondary schools used this interface to request mLegitymacja for their pupils. Nobody complained, probably because the largest school in Poland has no more than 1500 pupils. Also for schools which do not offer mobile apps to their students and do not have IT support for their student information systems the other options were not possible or at least difficult to implement. However the largest higher education institution in Poland, the University of Warsaw, has more than 44 thousand students. Entering such amount of data from the keyboard to the web interface, separately for each student, by an administrative staff logged into the dedicated account, is neither possible, nor reasonable. The first reaction of the authorities of the University of Warsaw was negative. They asked for the solution which would not put an extra burden on the administrative staff.

The Ministry of Digitalization accepted the arguments and implemented the API for transferring student requests for the mobile student ID card, with all relevant student data, to servers of the Ministry, and transferring the credentials for downloading and activating the student cards to servers of the university. It is up to the university to organize the process of gathering requests from students and passing them credentials. The architecture – compliant with the original solution – was chosen by the Ministry and was not negotiable.

The University of Warsaw made an important decision. University administration should not be involved in the data flow. A student himself should be fully in charge of the whole process. Students have access to Mobile USOS, the official university app, which can be fully trusted. In Mobile USOS a student is authorized by the central authorization service (CAS) of the university, and gets access to his grades, schedules, courses, and other data stored in the USOS database.

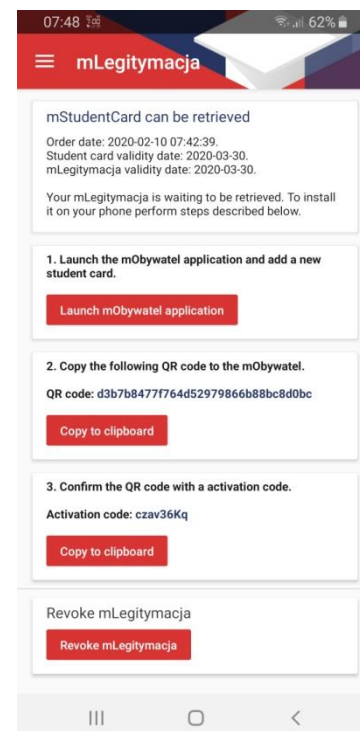
From Mobile USOS the eligible student can request the mobile student ID card. The request is passed from USOS to the Ministry. It is done by a system daemon, periodically. The same daemon gets information from the Ministry about issued cards and sends notifications to the students.

The student gets the needed credentials (QR code and PIN) to Mobile USOS, and then uses them to download his personal mLegitymacja from the Ministry to mObywatel, installed on the smartphone, and activate it. This is done by copying two strings from Mobile USOS and pasting them to mObywatel – these two separate mobile apps are installed on the same smartphone and the data between them can easily be transferred by copy-paste. The other option – scanning the QR code – would be less convenient. Entering the data stored in the QR code and PIN to mObywatel cannot be omitted. The student is in charge and the whole process can take no more than a couple of minutes.

The university system keeps track of all active mobile student ID cards and sends the deactivate requests when the student's status changes, e.g. the student leaves the university or decides to deactivate the mobile student ID card.

On a technical level the integration is based on Mobile USOS, which communicates with USOS via USOS API, the notifier installed in USOS API, which handles notifications to pass new information when it is ready, USOS system daemons, which wake up periodically to transfer data to/from the mObywatel backend system, located at the Ministry of Digitalization, using mObywatel API. VPN installed between the two systems ensures secure communication.

The statistics and status of student requests can be traced on the special web page of USOS available for the administrative staff.



3. CONCLUSIONS

Any eligible student can apply for the mobile student ID card, anytime, anywhere. The student logs in to the Mobile USOS, and if the conditions are met, sends the request. University administrative staff is not involved in the process. Student is the master of his own data – this approach is compliant with the GDPR regulation. First mLegitymacja for students of the University of Warsaw have been issued in February 2020. The integration is described in more detail in [1].

4. ACKNOWLEDGEMENTS

Mobile USOS has been implemented by Piotr Zalas and Dominik Murzynowski. They also integrated Mobile USOS with mObywatel, run by the Ministry of Digitalization.

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6. AUTHOR BIOGRAPHY



Janina Mincer-Daszkiewicz graduated in computer science in the University of Warsaw, Poland, and obtained a Ph.D. degree in math from the same university. She is an associate professor in Computer Science at the Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw specializing in operating systems, distributed systems, performance evaluation and software engineering. Since 1999, she leads a project for the development of a student management information system USOS, which is used in 70 Polish Higher Education Institutions, gathered in the MUCI consortium. Janina takes an active part in many nation-wide projects in Poland. She has been involved in Egracons, EMREX and Erasmus Without Paper European projects.

EUNIS 2020

MyAcademicID: Building bridges with a European Student eID Scheme for Higher Education

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Keywords

eID, student mobility, higher education, e-services, identity providers, service providers, digital infrastructure, authentication, digitisation.

1. Summary

With a new, simpler and more digitised Erasmus Programme around the corner, various initiatives to support education in Europe have been launched by the European Commission. Most notably, the European Student Card Initiative aims to enable students to identify and register themselves electronically at higher education institutions within Europe when moving abroad for studies, eliminating the need to complete onsite registration procedures or paperwork (European Commission, 2019).

As a key supporter of this initiative, the MyAcademicID project is close to releasing an important building block in the form of a unique Student eID Scheme for Higher Education. This key piece of digital infrastructure will be the result of the integration of eduGAIN and a newly developed European Student Identifier. Furthermore, digital bridges with the eIDAS interoperability framework are being rolled out to further expand the opportunities for online student authentication.

Developed by a consortium of 13 partners with the support of the Connecting Europe Facility, MyAcademicID presents a single-sign-on OpenID Connect provider for authentication of students, a specification and implementation of a European Student Identifier, a bridge with the eIDAS interoperability framework, and corresponding technical blueprints and specifications for all services. Moreover, the project seeks to have four e-services integrate this scheme: the Online Learning Agreement, the Erasmus Dashboard, the Erasmus+ Mobile App and the PhD Hub Platform, showcasing how this scheme can benefit student mobility under the Erasmus programme.

The scalability of the project and the potential for integration of the European Student eID with a myriad of other student services (both online and offline), not only pave the way for seamless student mobility and a stronger, reinforced European student status throughout Europe, but make MyAcademicID a key component of the European Student Card Initiative spearheaded by the European Commission.

2. Extended abstract

In 2017 alone, more than 300,000 higher education students went abroad on exchange under the Erasmus+ Programme (European Commission, 2018, p. 24). Since its inception three decades ago, the programme has undergone a monumental expansion: from 11 participating countries and a mere over 3,000 students going abroad in 1987, to 33 participating countries and more than 9 million people having benefited from mobility under Erasmus+ by 2017) (European Commission, 2017). The future programme (2021-2027) is set to have its budget tripled and send an additional 12 million Europeans abroad in addition to various new initiatives to increase the amount of students studying abroad.

Despite this resounding success, the basic procedures that allow European higher education institutions (HEIs) to exchange data related to student mobility have changed very little and remain largely paper-based, making students dependent on using a number of accounts and documents to identify themselves, authenticate their student status, apply for mobility and access e-services at their host institution. As more students go abroad, these procedures become more cumbersome for both administrative staff at HEIs and students, slowing down mobility flows. This is at odds with a growingly interconnected world where most transactions are already digital. It also represents an important obstacle to the ambitions of a fully functioning Digital Single Market and the European leaders' vision of a European Education Area by 2025 where there are no borders to student mobility.

MyAcademicID (MyAID), a transnational project running from January 2019 until June 2020, may provide an answer to this problem. Co-funded by the Connecting Europe Facility of the European Commission, MyAID is building a European student eID scheme for higher education that will allow students to consistently and reliably authenticate themselves across institutions and borders to access online services when going abroad on exchange.

Rather than building digital infrastructure from scratch, the project partners have worked on a federated approach that relies on the integration of eduGAIN, the European Student Card Project (ESC) and the eIDAS interoperability framework. The goal is to enable federated access to tools that HEIs and students will use as of 2021 to manage the mobility cycle under the new Erasmus programme: the Online Learning Agreement, the Erasmus Dashboard and the Erasmus+ Mobile App. This allows students to access them all from their institutional accounts via a single sign-on; in the future, the connection between eduGAIN and eIDAS will allow students to authenticate and register at their HEI using their national eIDs. Related to this aspect, the project is working on rolling out an inter-operable European Student Identifier (ESI) that will be integrated by the digital Erasmus tools mentioned above to univocally identify users across different services and institutions.

A key challenge in providing persistent, cross-service student authentication using eduGAIN is the current lack of a globally unique European Student Identifier. Some properties within eduGAIN could be leveraged for this purpose, but a more permanent solution and roll out in all federations would take a couple more years. Given the timeline and the importance of these tools, the MyAcademicID project is close to releasing a single-sign-on multi-protocol service provider proxy which will allow the services to use the OpenID Connect protocol in order to authenticate users in eduGAIN. This proxy will allow to add a persistent and globally unique student identifier on top of the federated authentication mechanism provided by eduGAIN, until the European Student Identifier is widely rolled out by Higher Education Institutions.

Since MyAID was initially presented at EUNIS in Trondheim last year, the project partners have implemented a proof-of-concept bridge with the eIDAS interoperability framework using the Swedish node. This second proxy will allow students to authenticate and enroll at their universities using their national eID, linking it to their institutional accounts, leveraging the national eID scheme proposed by the European Union, and opening doors to smoother integration with the academic world.

A third important outcome of the MyAcademicID project is the specification and implementation of a European Student Identifier. In order to properly authenticate students across different platforms and services, the consultation and technical work carried out throughout the project determined that said identifier must be not only globally unique and persistent, but also protocol-neutral (work with both SAML and OAuth2), non-targeted, and data-transport-neutral to allow a wider usage in back-office applications such as transcripts of records. An initial version of the proposed identifier will be issued by the OpenID Connect Proxy, but is later foreseen to be issued by Higher Education Institutions directly.

Piloting the European Student eID scheme for Higher Education within the Erasmus+ mobility scheme provides the ideal testing environment that can later be enlarged to include other scenarios non-specific student mobility; a range of services, both online and offline, public or private; and geographical boundaries beyond the European Union and the Erasmus+ Programme.

The scalability of the project and the potential for integration of the European Student eID scheme with a myriad of other student services, not only pave the way for seamless student mobility and a stronger, reinforced European student status throughout Europe, but make MyAcademicID a key component of the European Student Card Initiative spearheaded by the European Commission.

Project partners

European University Foundation (EUF); Géant Association (GÉANT); Swedish Research Council (SUNET); Centre national des œuvres universitaires et scolaires (CNOUS); Humboldt-Universität zu Berlin (UBER); University of Malaga (UMA); Réseau national de communications électroniques pour la technologie, l'enseignement et la recherche (RENATER); Direção-Geral do Ensino Superior (DGES); Fondazione ENDISU; Aristotle University of Thessaloniki (AUTH); Deutsches Studentenwerk (DSW); Ente per il Diritto allo studio Universitario dell'Università Cattolica (EDUCATT); Direction Interministérielle du Numérique et des Systèmes d'Information et de Communication de l'état (DINSIC).

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3. Authors' biographies



Jeroen van Lent completed a double degree Master's degree in Computer Science at KTH Royal Institute of Technology in Stockholm and the Technical University in Berlin. He has worked for various industry leading companies and NGOs on different projects involving digital transformation and became a supporter of International Student Mobility as a member of the Board of the Erasmus Student Network. At the EUF, Jeroen aims to streamline all the digital initiatives around Erasmus and work on digital transformation of the Higher Education sector, through projects such as the Online Learning Agreement, the Erasmus+ App, the Erasmus Dashboard and MyAcademicID.

[LinkedIn reference.](#)



Victor Aguilar holds a BA in Psychology from the National Autonomous University of Mexico (UNAM) and a Master's in Public Policy and Administration from the Centre for Research and Teaching in Economics (CIDE). He has worked as a consultant and applied researcher in both the public and the private sector in Mexico. After his Blue Book traineeship at the Executive Agency for Small and Medium-sized Enterprises (EASME), Victor worked as a Policy Officer in the field of Higher Education at the Directorate-General for Education, Youth, Sport and Culture (DG EAC) of the European Commission. He joined the European University Foundation (EUF) in 2018, where he now coordinates MyAcademicID.

[LinkedIn reference.](#)



Joachim Wyssling completed his Master's degree in EU studies at the University de Franche-Comté. During his studies, he actively volunteered in student NGOs welcoming and integrating international students in local communities. After serving as Vice-President of ESN International, he joined the EUF in 2011. His current mission as Project Manager involves the incubation of innovative project proposals for member universities and the identification of development opportunities within the European Higher Education Area, notably in the field of digitisation of HE with the Online Learning Agreement, Erasmus+ mobile App and Erasmus Without Paper; more recently in the field of doctoral education with the European PhD Hub; and in the field of social inclusion and recognition of informal learning experiences with SocialErasmus+.

[LinkedIn reference.](#)

Designing an academic electronic identity (academic eID) management system, essentially linked with eIDAS eID, by using Self-Sovereign Identity technologies and Mobile Authentication practices

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Keywords

Academic networks, academic eID, eIDAS eID, Identity Management, Self-Sovereign Identities, Mobile Identity, Multi-Factor Authentication

1. Summary

European Universities are currently entering a phase of inter-university alliances to face the challenge of mobility across Europe in the context of a digital university organizational model and core service platform. The main component of this emerging model and platform is the flexible and seamless provision of cross-university and cross-border electronic services to students and academic personnel moving to another institution, inside or outside of their country, for studying, teaching or research purposes. The concept of a well-defined and flexibly managed academic identity becomes a critical priority for the successful deployment of an inter-Higher Education Institutions European digital infrastructure and the delivery of a consistent “digital customer experience” to the user.

Academic Identity systems have evolved from specific solutions provided by the eduGAIN network and the European Student card initiative, to more generic eID solutions provided in the context of eIDAS regulation linked with specific academic information under the users’ consent in a secure and privacy-protecting manner.

This paper investigates different approaches and academic eID frameworks using eIDAS generic eID services and sectorial academic attributes. The proposed framework utilizes Self - Sovereign identities, linked with other decentralized trusted identities using blockchain. The new proposed forms of identity are under the complete control of the user, who is capable to hold and manage links between different identities, hosted by different IdPs. In this context, Verifiable Credentials stored in a secure wallet that can be accessed by the user with biometrics and multi-factor authentication practices play a vital role. The multi factor authentications imposes the use of secure personal devices that follow the trends of BYOD architectures. Last but not least the paper presents the design of instant digital signature for academic documents that are typically required in the context of students’ mobility and can be reused in e-government services.

2. Extended Abstract

European Universities are currently entering a phase of active networking and inter-university alliances to face the challenge of mobility across Europe in the context of a digital university organizational

model. European policies and initiatives such as Erasmus Without PaperNetwork¹, Erasmus+ Mobile App², Online Learning Agreement³, boost the PII data exchange among the Universities. Several programmes such as the Connecting Europe Facility Telecom programme provides funding opportunities for the realization of these policies⁴ through the implementation of core service platforms. The main component of this emerging model and core service platform is the flexible and seamless provision of cross-university and cross-border electronic services to students and academic personnel moving to another institution, inside or outside of their country, for studying, teaching or research purposes. Obviously, while designing the digital framework for digital cooperation between Higher Education Institutions (HEI) and cross-frontier service provision, the concept of a well-defined and flexibly managed academic identity becomes a critical priority and a fundamental necessity for the successful deployment of an inter-HEI European digital infrastructure and the delivery to the user of a consistent “digital customer experience”.

Nowadays, academic identity systems are fragmented and integrated only through eduGAIN[1], i.e. a federated identity management system [2] mostly tailored to the needs of online authentication. Other initiatives such as the European Student Card [3] and different forms of inter-campus cards also claim a (more specific) position in the academic digital identity value net. Furthermore, the policy push to create an effective link between the academic identity and eIDAS eID [5] is likely to increasingly affect the choices of the academic institutions and the inter-university cooperation networks they plan to participate with. However, how is it possible to upgrade, reform and adapt the existing academic IT infrastructures to these challenges? Which new technologies should be adopted in order to accelerate the digitization path in academic identity management to effectively support the provision of a new generation of cross-organization and cross-border e-services?

The proposed paper aims at addressing these questions by following a concrete investive path.

First, we attempt to provide a coherent overview of the different academic identity management frameworks and the opportunities, and difficulties, to converge and further integrate with the eIDAS Network and its service offerings.

Second, we adopt the perspective of Self-Sovereign Identities [6] [9][15][16] to design a decentralized academic identity management framework capable of Linking Academic and PII data [10] under the users' consent in a secure and privacy-protecting manner [11], leveraging eIDAS eID. Such a framework may: a) transform digital (federated) identity into trusted linked identities with blockchain, b) implement new forms of identity management, under the complete control of the user, capable to hold and manage links between a user's different identities, hosted by different IdPs and delivered through different networks (for example eIDAS, GEANT) without compromising the privacy of the user. In this context, the user (i.e) Data Subject “holds” a wallet of Verifiable Credentials (VC); each Credential is composed of a number of identity claims (a VC is a piece of information that is cryptographically trustworthy).

- VCs are shared as proof of a set of identity attributes (obtained by authoritative resources, eIDAS eID, eduGAIN etc.), and are anchored using Decentralized PKI (DPKI) to a Distributed Ledger, by a public Decentralized ID (DID) written by the Issuer of the Credential.
- The authenticity of a VC will be verified by a public key associated with the Issuer's DID through a Service Interface provided to academic Service Providers (HEIs) and beyond
- Ownership of a VC may be verified cryptographically, in a similar manner
- VCs are transferred encrypted and signed to the user's Wallet (a secure application, usually stored on the user's mobile device)

¹ <https://www.erasmuswithoutpaper.eu/ewp-network>

² <https://erasmusapp.eu/>

³ <https://www.learning-agreement.eu/start/>

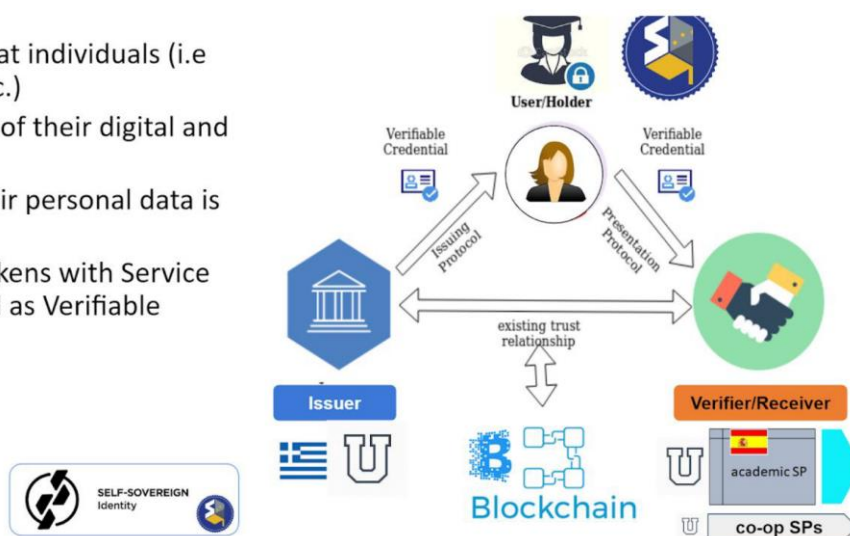
⁴ https://ec.europa.eu/inea/sites/inea/files/eu_student_ecard_call_for_a_core_service_platform_final-v1.0.pdf

The main objectives are that individuals (i.e. students, academic etc. etc.)

- Have sole ownership of their digital and analog identities
- Control over how their personal data is shared and used
- Exchange identity tokens with Service Providers (configured as Verifiable Credentials)

Main **Actors** in SSI:

- Issuers
- User/Holders/Subjects
- Verifiers/Receivers



Third, we improve the proposed design above towards *next gen academic identification schemas* by incorporating the ongoing trends in mobile computing and BYOD architectures that currently shape the core of the enterprise and government IT. Specifically, the proposed paper will explore the potential of using biometrics and multi-factor authentication practices to increase the security of a user-managed identity and efficiently manage the process of user consent provision [7, 12, 14]. We will essentially prove that a mobile multi-factor authentication can successfully complete and improve over “federated” Single-Sign-On (SSO) [13, 17] practices since it allows for the creation of an eIDAS-verified academic electronic identity, mobile-enabled, that can serve both the needs for, a) secure and credible user identification across institutions and countries and, b) instant digital signature of the academic documents that are typically required in the context of mobility projects. Designed under these “complexity constraints”, a next academic eID can be also effectively used as an authorization bearer token towards multiple academic (and academia affiliated) and e-government Service Providers, to reduce the environmental impact from energy consumption and the resources invested by academic and e-gov IT to support numerous, long-lasting and frequently repeated SSO sessions for cross-service user authentication.

3. ACKNOWLEDGEMENTS

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IMA-NET: Innovative e-Management of Academic Network for enhancing joint programs and students' mobility

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Keywords

E-Management, Academic network, Joint programs, Students' mobility, CEEPUS.

Summary

Joint programs and students' mobility, as features of internationalization of higher education and research, are priority goals in EU and worldwide. The offer of Joint programs face challenges based on different regulations in countries and HEIs and motivation for students's mobility needs special efforts. Generally in the networks, the mobility quota offered to students is fulfilled in lower percentage than the quota for teachers' mobilities. Academic networks are the most appropriate environment for developing and boosting both joint programs and students' mobility. Based on the positive experience with the coordination of CEEPUS Network - CIII-BG-1103-04-1920 Modelling, Simulation and Computer-aided Design in Engineering and Management, a platform for Innovative e-Management of Academic Network IMA-NET is developed and described in the paper. Modules developed in IMA-NET are: Knowledge base collecting and storing the know-how of teachers in the network (courses, tools, modules); Reviewer's tool; Survey tool to evaluate students interest to different courses offered; Tool to generate context-oriented Flexible courses with 3 ECTS, composed by 3 modules from the Knowledge-base; Certificate generator and assessment tool; Tool to assist Joint Doctoral program "Thèse en co-tutelle"; Tool for Events with Feedback option; Tool for dissemination of joint achievements and new knowledge created in the network; Option for audio-video meetings in the network; Tool assisting multi-language communication in the network. The IMA-NET platform is developed to be implemented in CEEPUS Network: CIII-BG-1103-04-1920 and the first event to be managed by IMA-NET is the Summer Academia in UBT, Pristina in July 2020.

1. CEEPUS ACADEMIC NETWORK MANAGEMENT

University networks are a trend in higher education development nowadays. CEEPUS program is a good example of long term academic network implementation. Schuch K. (2019), based on Central CEEPUS office information, shows that 80 CEEPUS academic networks are granted for the academic year 2019/2020. The CEEPUS Network CIII-BG-1103-04-1920 Modelling, Simulation and Computer-aided Design in Engineering and Management is in its 4th year, it involves 32 partner HEIs from 15 countries from CEEPUS region (Site of CEEPUS program (2020)) and it is considered as a large scale network. The number of teachers' and students' mobilities awarded to the network for the academic year 2019/2020 is 94 months. The network is event-oriented and in average 10 events per year are planned and organized (Site of the CEEPUS project CIII-BG-1103-03-1920 (2020)). We are talking about events, when more than 2 teachers and or students are on mobility at the same host institution, in the same time. Long term students' mobilities in the network are reserved mainly to the students (currently 5) enrolled in the Joint doctoral program in the network. The rest of the mobilities in the network are organized and realized individually. Management of mobilities individual and event-oriented in a CEEPUS network is a challenge. The goal is to organize successful CEEPUS events, short and long term students and teachers mobilities, using the grants awarded to the network, in an optimal way. To achieve this goal CEEPUS events and individual study and teaching programs have to be organized early enough to permit students and teachers from partner institutions to apply for CEEPUS grants in the deadlines defined by CEEPUS program and by the National CEEPUS offices in CEEPUS partner countries. To face the challenges in a growing academic network an Innovative e-management platform IMA-NET is designed and developed.

2. IMA-NET: INNOVATIVE E-MANAGEMENT PLATFORM FOR ACADEMIC NETWORK

2.1. Design of IMA-NET Platform

The design of the IMA-NET platform is presented on Figure 1. The platform is hosted on the web address: ima-net.ubt-uni.net.

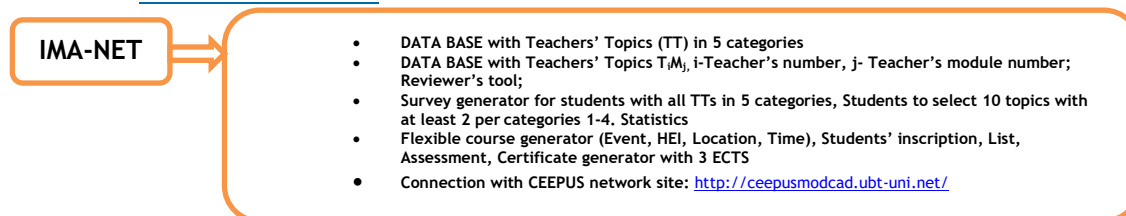


Figure 1. Design of the IMA-NET platform

2.2. IMPACT OF IMA-NET PLATFORM ON JOINT PROGRAMS AND STUDENTS' MOBILITY

IMA-NET platform permits to organize the know-how in the academic network, to automate and optimize the Flexible course content and Certificate generation (Marinova G. (2019)) for concrete CEEPUS events and Joint doctoral program courses, to inform students and teachers on time about the events and Joint program courses and to permit them to apply for CEEPUS grants in the deadlines fixed by CEEPUS program. The platform IMA-NET performs statistics to analyze the students' and teachers' interest and feedback. The dashboard of IMA-NET is presented on Figure 2. Thus it is an excellent instrument to assist the coordination of the network.

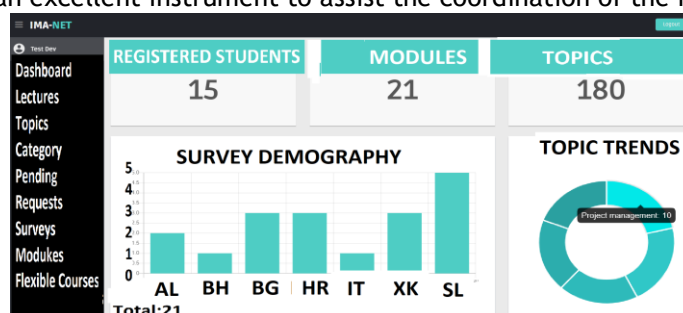


Figure 2. Dashboard of IMA-NET

2.3. CASE STUDY OF THE IMA-NET BASED E-MANAGEMENT OF THE SUMMER ACADEMIS IN UBT, PRISTINA, KOSOVO

IMA-NET platform will be probated to organize Flexible course within CEEPUS, at the Summer Academia, planned for July 2020 in UBT, Pristina, Kosovo. The viability of the platform will be tested and the feedback from teachers and students involved will be analyzed.

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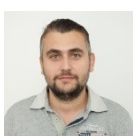
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e-diplomas: An online diplomas platform for the Greek Higher Education Institutes

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Keywords

e-diplomas, authorization, authentication, privacy enhanced technologies

1. Summary

The eDiplomas platform (<https://edipomas.gr>), developed by the Greek Universities Network (GUNet), and its integration into the EMREX network are described. The ongoing national initiative for upgrading the SIS in Greek HEIs will pave the way towards the compliance of the Greek SIS specifications with the EMREX APIs for courses, grades and credits. The platform envisaged by GUNet will combine existing technologies in order to provide maximal protection, while keeping the student records usable in a flexible but controlled manner, and enhance interoperability and collaboration between HEIs at national and European level.

2. The need

One of the most important challenges that Higher Education Institutes (HEI) have to cope with is the transfer of diplomas transcripts in a privacy preserving way and the validation of diplomas authenticity. The printed-paper certificate system has repeatedly been a cause of concern for security and reliability, because it allows fraudsters to forge certificates. Also, there is no definite mechanism to easily verify and check the authenticity of a certificate. Current approaches designed to overcome the disadvantages of paper-based academic certificates has not addressed issues like the validation of claimed certificates yet. In addition, it is based on centralized solutions that can be targeted by malicious users. Likewise, currently there is no standardised, automated method to certify university diplomas in Greece. The degree holder typically obtains a hardcopy of the original diploma from the academic registrar that needs to be verified by a public authority as authentic. The system is anachronistic, costly and insecure.

3. The e-diplomas solution

Higher Education Institutes (HEI) and their Student Information Systems (SIS) have been operating in silos as far as the diplomas issuing and verification is concerned. This has been attributed mostly to privacy and security requirements but also to the lack of appropriate protocols and APIs that would foster the semantic and technical interoperability between the SIS and 3rd parties interested in consuming diplomas related information. e-diplomas platform acts as a broker of information between SIS and those 3rd parties with a focus on privacy.

e-diplomas is the online platform responsible for the verification of HEI degrees ownership. Through e-diplomas, the citizen and owner of degrees issued by greek HEIs is able, by using their national authentication system account, to authorize a client (public Institution or company) to receive information regarding their degrees. The platform uses technologies which ensure the protection of private data as well as the authenticity of the degrees' information. By making the submission and degree verification processes simple and fast for the holder as well as the client, it is, at the same time, attempted to eliminate the phenomenon of fake and counterfeit degrees.

e-diplomas is based on an OAuth2 architecture in order to provide granular access control per diplomas section (OAuth scopes) to registered 3rd parties (OAuth Clients) upon holder's consent by using the

Authorization Code Grant method. Access is granted for a limited time, and can be revoked at any time by the holder.

A key design principle of e-diplomas is not to store personal data or diplomas information besides transient encrypted tokens and matching Social Security Numbers (SSN) of the holders required to validate access requests.

In addition to the scenario where the holder grants access to 3rd party, another scenario is when authoritative state bodies perform ex officio diplomas authenticity checks.

4. Future Plans

The e-diplomas roadmap includes:

- In order to achieve cross border authentication align with the eIDAS Regulation
- Facilitate the exchange of digital transcripts with other participant HEIs by joining EMREX
- Participate in European Blockchain Services Infrastructure (EBSI) through a national blockchain node in order to provide e-diplomas information.

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The e-diplomas portal <https://ediplomas.gr/>

GUnet Portal <https://www.gunet.gr/>

6. AUTHORS' BIOGRAPHIES

Nikos Voutsinas Leads the Systems and Software Development Group of the University of Athens and has participated, as main architect, in GUnet's projects in the field of academia and public administration. His research interests include interoperability governance, digital identities management, federated authentication and authorization, and applied cryptography. He has participated in EU funded R & D projects in the topics of distributed computing and privacy enhancing technologies. Holds an MSc in Computer Science from the University of Athens.

Lazaros Merakos received the Diploma in Electrical and Mechanical Engineering from the National Technical University of Athens, Athens, Greece, in 1978, and the M.S. and Ph.D. degrees in Electrical Engineering from the State University of New York, Buffalo, in 1981 and 1984, respectively. From 1983 to 1986, he was on the faculty of the Electrical Engineering and Computer Science Department, University of Connecticut, Storrs. From 1986 to 1994, he was on the faculty of the Electrical and Computer Engineering Department, Northeastern University, Boston, MA. During the period 1993-1994, he served as Director of the Communications and Digital Processing Research Center, Northeastern University. During the summers of 1990 and 1991, he was a Visiting Scientist at the IBM T. J. Watson Research Center, Yorktown Heights, NY. In 1994, he joined the faculty of the University of Athens, Athens, Greece, where he is presently a Professor in the Department of Informatics and Telecommunications, and Scientific Director of the Networks Operations and Management Center.

His research interests are in the design and performance analysis of communication networks, and wireless/mobile communication systems and services. He has authored more than 200 papers in the above areas. He has served as the scientific director of the Communication Networks Laboratory of the University of Athens in numerous research projects, including the projects RAINBOW, WAND, MOBIVAS, WINE, EURO-CITI, POLOS, ANWIRE, E2R, E2RII, E3, Self-NET funded by the European Union. Dr. Merakos is chairman of the board of the Greek Schools Network, and member of the board of the National Research Network of Greece. In 1994, he received the Guanella Award for the Best Paper presented at the International Zurich Seminar on Mobile Communications.

OpenX: Verification of Record Transcripts via QR Code

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Keywords

Document Verification, Document Management, QR Code, SAP

1. Summary

At Münster University (Westfälische Wilhelms-Universität - WWU), we have implemented software functionality to provide Verification Services for WWU-issued documents (e.g. Transcripts of records, Diplomas, Invoices) stored in the document management system (DMS).

The need to assert the authenticity especially of paper documents for admission and validation purposes by non-IT background users requires simple access (i.e. QR-code) while addressing security concerns due to access to the university's document archives thus being made available.

We report on design considerations and implementation details of document verification service oriented on the requirements of or studies- and examinations departments, which we expect to greatly benefit our students in their (international) mobility.

2. Document creation, storage

While the process of document verification will be open to all relevant information systems of WWU, the primary focus lies on implementing the service for both Campus Management and Enterprise Resource Planning based on SAP systems. The documents are created using Adobe LifeCycleDesigner via batch processing or user's requests by app.

Since there is no adequate implementation available we developed the necessary front- and backend functionalities.

Prior to creating relevant content the document types need to be specified in advance so access restrictions can be imposed at the DMS and backend developments.

When creating a document the developed SAP-backend function request a DMS document id using SAP's 'archive link' interface.

A random key is created for each document and stored with the document's meta data in a separate database table.

The individual QR-code is created at runtime consisting of a partially hashed link and hashed meta data (ie. id, random key, user, document type, document name, source, timestamp).

The finalized document including the QR-code is handed over to the DMS for storage via the interface.

3. Verification via QR-code

In order to verify a document's authenticity, the embedded QR-code is scanned and the embedded website's link accessed. Login credentials are not used since the service is required to be available to anyone. After solving a recaptcha the (signed) document is fetched from the document archive and displayed to the user.

4. Security

Due to the website's worldwide availability and absence of credentials to be provided our prime focus was to protect the documents from brute force attacks.

The links contain hashed ids and meta data that is individually hashed for each document. A compromised primary key isn't sufficient to access documents.

When the QR-coded Link is accessed the website prompts the user to solve a Google captcha. To additionally limit automated scripted access, we implemented a honeypot to identify a certain amount of bots. Additionally, access frequency and volume are monitored both at the front- and backend.

The retrieved id is checked. Access is restricted to documents with a known reference at the backend and complemented by restrictions to defined document types at the DMS itself.

In case of a known id the additional meta data is checked and if validated successfully the document is fetched and provided to the user.

After final approval of security and data security authorities the verification service will be made available in the coming months.

5. Alternative Implementations

Comparable verification services by Hamburg University (2020) and Mainz University (2020) provide the document's details retrieved from the backend via web browser.

Commercial solutions like Qryptal (2020) rely on users decrypting the details encrypted by the issuer via 3rd party apps.

Known solutions do not provide secure anonymous document web access in our specific SAP setting as required, hence we realized the implementation described here.

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7. AUTHORS' BIOGRAPHIES

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Citizen Developers Driving the Digital Campus

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Keywords

Digital transformation, digital campus, citizen development, low-code platforms.

1. Summary

What could a university look like that has successfully entered the digital age? This question has been intensively discussed at three Swiss universities of applied sciences, which are currently in a merger process. The result is a holistic architecture for a *digital campus* that not only covers infrastructural aspects, but also contains content-, skills-, management- and culture-related building blocks for a comprehensively digitalized university. The deliberate active involvement of campus citizens as so-called *citizen developers* by guiding and supporting their hands-on participation in the university's digitalization efforts is identified as an important leverage for implementing the digital campus.

2. A Holistic Comprehension of the Digital Campus

There is hardly any other megatrend that currently affects society, companies, institutions and individuals as comprehensively as the digital transformation (Stone, 2019). Dealing with the raising opportunities and risks is prior - a development that is of course leaving its mark also in higher education: Curricula in practically all disciplines are expected to take the cross-sectional topic of digitalization appropriately into account, and the universities are doing their utmost to meet this existing demand.

Actually, universities are challenged in two dimensions with regard to the digital transformation:

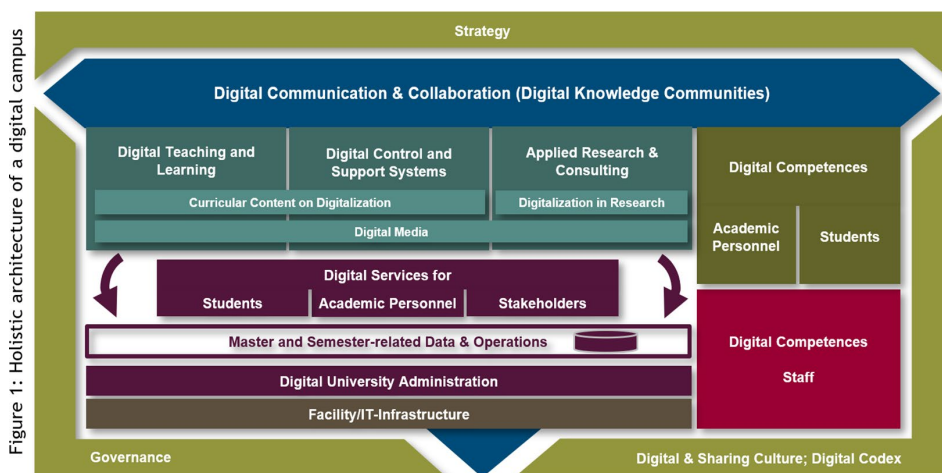
(1) *What* the university transports to the outside world, namely domain-specific teaching content, research results, consultations, etc., should take the topic of digital transformation with its respective technical, organizational, legal and cultural aspects adequately and well balanced into account.

(2) Furthermore, *how* (to what extend digital) a university operates internally and at its interfaces should keep pace with an increasingly competitive environment, while ensuring that learning objectives are best achieved, and cost are kept at reasonable levels.

Table 1 summarizes a selection of essential goals tackling these two challenges, and the corresponding components of an architecture implementing a digital campus according to the goals. Assembling the derived components leads to Figure 1 illustrating the *holistic architecture* of a digital campus.

Challenge		Goal	Comprised by architecture component	
(1)	Adequate balanced covering of the cross-sectional topic of digitalization	Setup systematic review of the curriculum and research focus to adjust them if necessary	Curricular Content on Digitalization, Digitalization in Research	
		Create opportunities for academic personnel and students to gather practical know-how in digital transformation	Digital Competences Students and Academic Personnel	
(2)	Learning objectives are best achieved	On a physically distributed campus, establish state-of-the-art teaching and learning methods utilizing digital means	Digital Teaching and Learning	Digital Media
		Ensure Learning Success	Digital Control and Support Systems	
	'Customer journeys' of (prospective) students, academic personnel etc. should meet expectations that are more and more determined by increasingly inspiring user experiences off campus	Provision of an end-to-end digitalization of the essential learning, teaching, research and administrative processes tailored to occasional users in the form of one-stop-shops	Digital Services, Digital Competences Staff	
		Establish an omni-channel CRM/Web-CMS approach that supports entire 'customer' lifecycles and helps to ensure that the university is optimally perceived by the outside world, so that its reputation gradually improves		
		Establish culture and digital means for a highly effective collaboration	Digital Knowledge Communities	
	Efficient administration	Provide end-to-end digitalization of administrative processes tailored for power users	Digital University Administration	
	The necessary infrastructural basis exists		Facility/IT Infrastructure	

Governance, Digital & Sharing Culture, Digital Codex



Challenges, goals and architecture were derived from a series of workshops on the design of a joint digital campus, which were conducted by delegates from the three currently merging universities of applied sciences, Buchs, Rapperswil and St. Gallen, in eastern Switzerland.

Part of the architecture is an application programming interface (API) as a managed shared service providing the essential master and semester-related data from a central source of defined quality, as well as secured operations on the data including the necessary authentication and authorization functionalities (Stone, 2019). It serves the applications of the central Digital University Administration and Digital Services for students, academic personnel and other stakeholders. In addition, it is part of the technological basis for scaling the implementation of the digital campus described in section 3.

3. Scaling the Implementation of the Digital Campus

One of the goals related to challenge (1) is considered in more detail: Creating opportunities for academic personnel and students to gather practical know-how in digital transformation - for these *campus citizens*, how could such opportunities look like? This goal arose from the finding that an in-depth and balanced view of the phenomenon of digital transformation is best achieved with a culture of 'not just talking about digital transformation but living it'. Enabling opportunities *on campus* for a hands-on, eventually experimental approach to digitalization is proposed as *one* possible measure to promote this "digital" culture, and thus to meet challenge (1). It is self-evident to take these opportunities from the stock of digitalization ideas implied by challenge (2): involve interested campus citizens in digitalizing their daily knowledge work, teamwork, courses, research or administration processes, empower them to digitally experiment in class, and so on. In other words, campus citizens cover parts of the digitalization of their own environment and thus learn to better understand the concept of digital transformation - their own digital campus as a 'lab for the digitalization of knowledge organizations'.

What is utilized here is the concept of *citizen development* (Everhard, 2019) (Stone, 2019): A citizen developer is a *user* usually with no particular ICT background who creates applications for consumption by others. More and more, *low-code* development and runtime environments sufficiently applicable for citizen development are employed; Microsoft's Office/Dynamics365 with PowerApps, Flow, etc. is one example, others are Mendix or Outsystems (Iijima & others, 2019) (Richardson & Rymer, 2016). These are *sanctioned* and *supported* by the organization's central IT (and often also used by themselves, to accelerate their own development speed); citizen development should not be misunderstood as an unguided 'shadow IT'. Particular attention must be paid to the topics of security and training.

By enabling and training interested campus citizens to take over parts of the university's digitalization efforts, they are just becoming citizen developers. In addition to a low-code environment they use the above-mentioned API, RESTful and conditioned for end-user usage. A proof-of-concept with selected campus citizen developers employing PowerApps and accessing an API prototype that provides first data via oauth2 is currently underway, the evaluation of results will be completed by 05/2020.

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Christoph Baumgarten studied computer science at the Technical University of Braunschweig, Germany, at Master's level (1995), and gained research experience as a visiting scholar at the Arizona State University as well as ETH in Zurich, Switzerland. In 1999 he received a PhD at the Technical University of Dresden, Germany, within a state-funded Research Training Group. His professional experience comprises various IT management positions, including CIO of the University of St. Gallen, Switzerland (2009-2017), and Head Capability Development AIM (Aeronautical Information Management) at Skyguide Swiss Air Navigation Services (2003-2009). Since mid-2017 Christoph Baumgarten is working as a lecturer in business informatics at the FHS St. Gallen.



Alex Simeon studied mechanical engineering at the HSR in Rapperswil, Switzerland, from 1982-85. He then worked as an assistant and from 1987-90 as a systems engineer in the mechanical engineering department. In 1991 he moved to Sulzer Ltd., where he held management positions in various departments and was responsible for the introduction of a wide range of IT systems. From 2000-2003 he was head of CAx/PDM systems at Sulzer's IT department. Alex Simeon was elected Professor of Mechanical Engineering and Head of IPEK (Institute for Product Design, Development and Construction) at HSR in 2003. Since September 2011, he has been Vice-Rector for Applied Research and Development and a member of the HSR's university management. In September 2020 he will take up his new position as Chief of Staff of the OST - Eastern Switzerland University of Applied Sciences.



Michael C. Wilhelm studied mechanical engineering at the Technical University of Karlsruhe, today KIT. From 1983 to 1988 he worked at the Institute of Production Science. His work focused on IT-Systems and methods for development and production, with focus on CAx-Systems for design and simulation, CAM (manufacturing) and CAQ (Quality)-Systems. After completing his doctorate, he worked as a consultant for automotive and suppliers as well as for mechanical engineering companies. In 1997 he moved to the University of Applied Sciences in Karlsruhe where he give lectures for Quality Management and Production. Since 2015 he is member of the university management and responsible for teaching at the Interstate University NTB in Buchs, Switzerland.

EUNIS 2020: Digimentors promote good practices and knowledge sharing

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Keywords

Digitalization, Network, Good practices, Digital environments, Digital skills, Peer support

Summary

The Digimentor network is a peer support network that promotes digitalisation across Tampere Universities. The digimentors not only encourage the faculties and schools to consider the benefits of digitalisation but also offer support for the use of digital tools and disseminate good practices within our higher education community.

The Digimentor network was established in January 2019 to support the new Tampere Universities community. Although all the members of the network are working towards shared goals, they can also define individual goals that are tailored to the specific needs of different disciplines. The network brings together representatives of our faculties and schools to share knowledge and good practices from the perspective of their own field. Knowledge and ideas are shared to promote the appropriate use of digital technologies and thereby support learning, research and community engagement.

1. BACKGROUND

Tampere University was established through the merger of the University of Tampere and Tampere University of Technology at the beginning of 2019. The Tampere Universities community comprises Tampere University and Tampere University of Applied Sciences (TAMK) that maintain close collaboration. In January 2019, the community-wide Digimentor network was established to strengthen the culture of collaboration across the new community and support the creation of a digital campus. More than 30,000 students study at Tampere Universities.

2. THREE LEVELS OF THE DIGIMENTOR NETWORK MODEL

The model was developed based on previous experiences of similar networks that operated in the predecessor institutions of Tampere University. The Digimentor network consists of nested levels. Students and staff who benefit from the network are placed at the centre of the model. While the activities are largely staff-oriented, the work undertaken by the digimentors will also benefit students as the utilisation of digital environments provides them with more flexible and diverse study options as well as opportunities for student involvement.

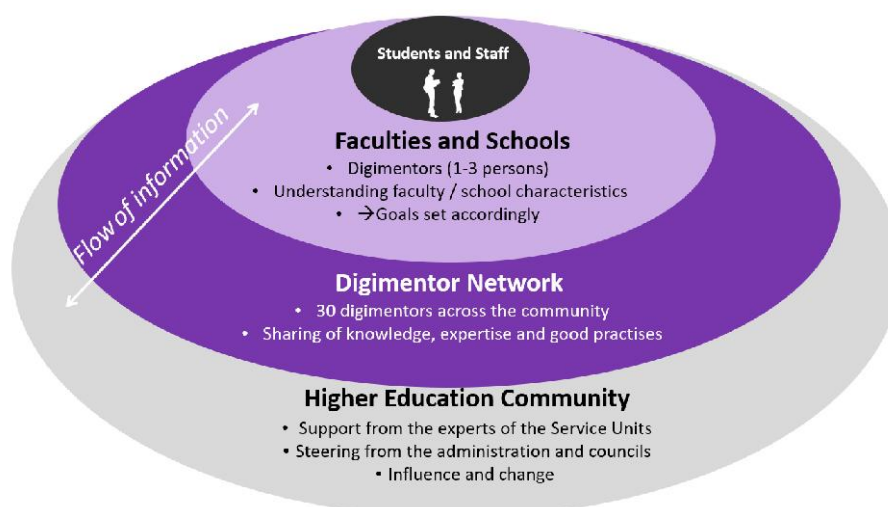


Figure 1: Three levels of the Digimentor network model

2.1. DIGIMENTORS IN THE FACULTIES AND SCHOOLS

The faculties and schools have appointed their own representatives (1-3 persons) to the Digimentor network. The designated digimentors are aware of the special characteristics of the disciplines they represent and therefore know how to maximise the benefits of digitalisation in their field. They understand the needs, strengths and weaknesses of their community and can support personnel accordingly. In each faculty/school, the digimentor serves as a facilitator and is involved, for example, in the coordination of development activities and projects, the dissemination of information, and the promotion of digital skills through training and guidance. All the digimentors share the same main goal, but their activities and means to achieve this goal may vary between the faculties and schools. It is also important that each faculty or school defines its own set of goals. It is easier to commit to self-defined goals, and this way the digimentor's work will be of the greatest benefit to the community.

2.2. DIGIMENTOR NETWORK

The Digimentor network brings together representatives of the faculties and schools to share knowledge, experiences and good practices from the perspective of their own field. The network consists of 30 digimentors and three coordinators. The digimentors meet face-to-face on a monthly basis to discuss questions, good practices and news. After the meetings, they convey the information and ideas to their faculty or school. The digimentors are drawn from across faculties and schools to ensure that the views of different fields and communities can be understood and expressed. The agenda for the meetings may vary from pedagogical themes to learning sessions where new digital tools are introduced. In between face-to-face meetings, the digimentors collaborate actively through the virtual O365 Teams environment. Questions can be brought before the network to be addressed and resolved collectively. The network model ensures that the digimentors can draw from each other's expertise and share resources.

2.3. THE HIGHER EDUCATION COMMUNITY

The Digimentor network maintains openly available resources, such as a website with over 100 tips and good practices, a Moodle area that offers support for teachers in using the Moodle virtual learning environment, and a monthly newsletter featuring the latest news, events, publications and research related to use of ICT in teaching and learning.

The experts in the service units of Tampere Universities are important partners for the Digimentor network. When necessary, the contact persons of the service units (such as the Library, Education and Learning, ICT services, People and Culture) are invited to the digimentors' meetings to share their expertise. The same goes the other way around: the service units can contact the Digimentor network to gather insights and ideas from the faculties and schools to facilitate their work. In addition, the coordinators of the Digimentor network report to the councils and the senior management about matters brought up by the faculties and schools. These contacts are an important avenue through which the network can influence decisions and processes relating to digitalisation.

3. FUTURE STEPS

Staff at Tampere Universities should possess the necessary skills and competencies to make the most of digital tools and environments. Students should also have the opportunity to develop their digital skills while working towards their degree. The efforts to foster a digital culture and develop digital ways of working and studying require not only support and collaboration but also new creative experimentations and an open-minded attitude. In 2020, the digimentor network will continue to advance its mission and promote the good practices identified last year.

4. AUTHORS' BIOGRAPHIES



Suvi Junes (M.Ed) works at the Tampere University. She works at the ICT Services and has 18 years of experience in supporting the use of ICT in teaching and learning, developing digital learning environments and working in national and international projects and networks.

HelsinkiUNI DigiHUB - space for creating digital services

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Keywords

lean, agile development, communities of practice, co-creation, service design, coaching

1. Summary

HelsinkiUNI DigiHUB is a shared space for creating digital services in University of Helsinki. It is based on Lean and agile culture and designed according to principles of co-working spaces. The purpose of DigiHUB is to develop digital services and solutions by experimenting together. All teams that develop digital services for the University of Helsinki are working in DigiHUB. After moving to shared space, people have become much more interested in working together and sharing best practices. Surveys conducted among DigiHUB users indicate that DigiHUB both as a space and as a way of working has brought a positive and sustained change to work culture in digital service development.

2. Extended Abstract

2.1 Timeline of agile adoption in University of Helsinki

University of Helsinki was an early adopter of agile software development already in 2005, with its in-house software projects experimenting with Scrum, a novel methodology in the software industry of that time. Since the founding of the university's IT Centre's own in-house agile software development team in 2008, agile and lean methodologies have been in continuous use.

In 2013 agile thinking gained ground on several fronts within the university. The IT Centre trained several of its teams to use Kanban in their daily work, while the HR department offered Scrum Product Owner Certification courses for over 60 people. The university also established a framework agreement for outsourced software development, where it was stipulated that only agile development would be accepted from the contractors. Selecting only contractors that were committed to agile practices made it possible for cultural change to happen.

In 2014 an informal product owners' network was founded with the goal of sharing experiences and ideas about agile practices across the organization. It has since provided regular peer support in the form of approximately bi-monthly seminars during the semesters, facilitated by a skilled agile coach.

2.2. Shared space as a prerequisite for cultural change

While those first steps were necessary, they didn't have a great impact on wider organization besides team level. A proposition was created about HelsinkiUNI DigiHUB for the leaders of the University, where it was stated that "a shared space and knowledge infrastructure for digital service creation and experiment lab for University of Helsinki in a central location in Helsinki will enable us to maximize our potential in developing and measuring value for the University and the users of the services."

Previously digital service creation functions were spread out across different teams and projects. Getting permission from upper management to create a specific shared space was crucial for the development of HelsinkiUNI DigiHUB. By consulting several software companies and comparing their recommendations for best practices in shared hub environments, four different kind of spaces were identified:

1) Open main area, 2) Collaborative team space, 3) Event space, and 4) Street setup (see **Figure 1**).

These types of spaces are based on four space principles (Bosch, 2019):

- Mountain - one-way communication, presenter space
- Watering hole - fast knowledge exchange
- Campfire - meeting situations, dialogue
- Cave - concentration without communication, private or not.

2.3. Shared spaces enabled community events

DigiHUB became reality in 2017 when several team spaces opened in City Centre campus and from 2018 onwards, the four spaces as described in **Figure 1** have been operational. All teams that develop digital services for the University of Helsinki are working in DigiHUB. There are around 20-30 teams sharing six team spaces. Team spaces are shared between teams in daily/weekly rotation: a team might occupy a space only during certain days of a week. When space allocation needs emerge, teams negotiate the necessary changes autonomously.

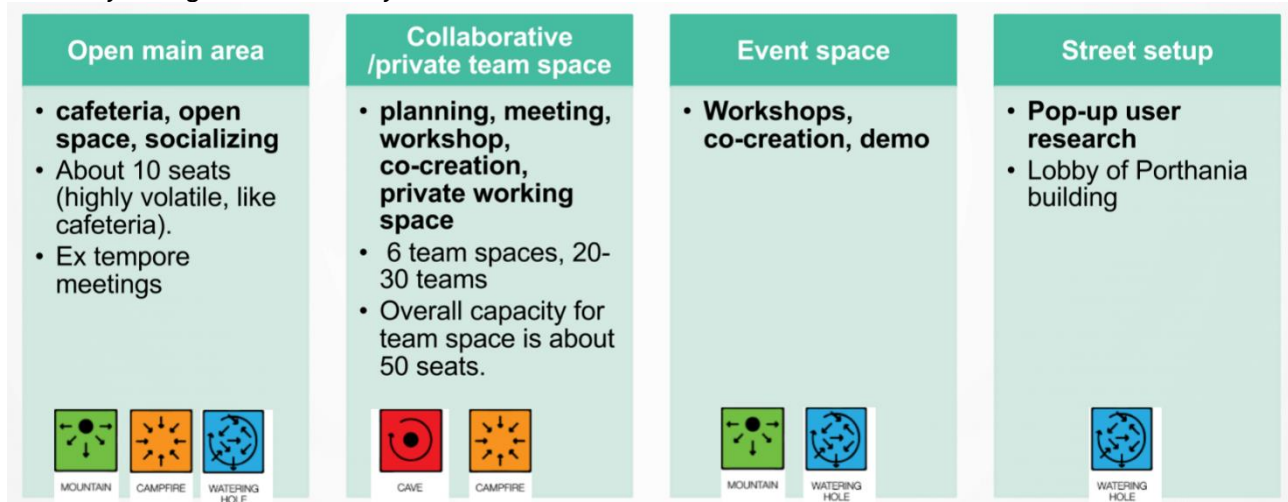


Figure 1. Spaces and space principles in DigiHUB

Methods used in DigiHUB complement an already thriving agile culture: co-creation, design lab, agile principles, lean ecosystem, lean start-up, service design and coaching are all used. Increased adoption of these methods was observed after all digital teams shared the same space.

After moving to shared space, people have become much more active in coming together and sharing best practices. When previously there were seminars and other events four to six times per year, in shared space the 'public demand' spontaneously increased to three to four community events per month. Specifically, more events covering specific topics were suggested and consequently three professional peer groups or 'guilds' were formed: service design, analytics and technology guilds. In 2019 there were total of 29 events organized for the DigiHUB community, on average an event almost every week during semesters.

2.4 Survey results indicate a change in work culture

In summer 2019, an online survey was conducted in DigiHUB in order to measure how much the work culture had changed. The response rate was 40% (75 of 186 active members). 73% agreed (somewhat, mostly or fully) that DigiHUB does support their work. 71% similarly agreed that their skills had increased because of DigiHUB. In open-ended questions there was plenty of positive feedback about the space and atmosphere, events and services. Negative feedback was mainly related to suboptimal conditions in team spaces, which resulted in teams autonomously reorganizing room allocations. Later it was verified that the teams were content with their new spaces. In 2020 a new survey was conducted with very similar positive results. These surveys indicate that the DigiHUB both as a space and as a way of working has brought a positive and sustained change to work culture in digital service development.

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4. Authors' biographies



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Using Action Research to build a software development community of practice

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Keywords

lean, agile development, action research, empirical software engineering research, communities of practice, knowledge sharing, knowledge management, organizational learning

1. SUMMARY

The software development teams creating digital services for the University of Helsinki have expressed a need for more engaging ways of collaboration, forming a community of practice within the university's co-creation space, HelsinkiUNI DigiHUB. They are looking for structures to collectively raise and solve technology-related issues, to learn from each other in ad hoc mentorships, and to share their good practices in a manner of informal, 'living' documentation. As knowledge is considered a strategic competitive asset, managing inter-team knowledge sharing within a modern agile software development environment becomes crucial.

A study using participatory research for empowering the developers to self-improve their knowledge-sharing practices was conducted in Autumn 2019 - Spring 2020 in DigiHUB. The themes explored in the study included: collaborative policy-making mechanisms, iterative just-in-time documentation and 'Experimentation Cards' facilitating developer's own lean experimentation cycles.

The preliminary results of the study suggest that development teams are extremely willing and eager to improve their knowledge management processes, given the right tools and empowerment to experiment and fail. This would further suggest that knowledge management can be cultivated 'organically', stemming from the community's own involvement instead of only 'top-down' policymaking.

2. EXTENDED ABSTRACT

2.1. Knowledge sharing as a strategic asset in agile software development

In the field of digital service creation, University of Helsinki was an early adopter of agile software methodologies, with its in-house software development having utilized methods such as Scrum since as early as 2005, and all of its outsourced development also required to adhere to agile methodology since 2013. With such a long tradition of agile thinking, there has evolved a strong culture of continuous improvement and self-organization on the level of individual teams. However, most of these teams have worked in isolation from each other, due to their positions within the established organizational 'silos' of the University, and consequently have suffered from lack of common good practices and shared insights.

Thus, the developers and other IT specialists working on digital service creation for the University have expressed a need for more engaging ways of collaboration, forming a community of practice. They are looking for structures to collectively raise and solve technology-related issues, to learn from each other in ad hoc mentorships, and to share their good practices in a manner of informal, 'living' documentation instead of excessive formal documentation that quickly becomes obsolete (Khalil & Khalil, 2019). They also want to avoid relying on tacit knowledge only, which is easily lost (Ouriques et al, 2019). This type of inter-team knowledge sharing reflects the way an agile software development organization considers knowledge as a crucial asset for competitiveness and uses it to scale agility to enterprise level (Santos, Goldman & de Souza, 2015). Knowledge is considered a strategic competitive asset so the need to manage knowledge within a modern agile software development environment becomes crucial.

Opening of Helsinki University DigiHUB, a new type of co-working space on the university's central campus in 2017 offered a physical and cultural platform for cultivating collaborative practices of this kind. DigiHUB was defined in its mission statement as "A shared space and knowledge infrastructure for digital service creation and experiment lab for UH in a central location in Helsinki". Teams that previously had worked in isolation were suddenly co-located and given a great deal of autonomy to get organized around their common purpose. The culture of co-learning is still in its infancy however. To foster the fresh community of practice, a study using participatory research for empowering the developers to self-improve their knowledge-sharing practices was conducted in Autumn 2019 - Spring 2020.

2.2. Action Research with Lean & Agile methodologies – a natural fit

Action Research is a qualitative, participatory research method that combines traditional observational methods with a very hands-on experimental approach (Coghlan & Brannick, 2001). The goal is not merely to report the current situation as-is but to design and conduct concrete experiments, aiming for permanent cultural changes and empowering the community for a process of continuous improvement. This method positions the researcher as a committed, active member of the community, openly participating in the process instead of distancing themselves, i.e. 'getting their hands dirty'. Moreover, the researcher is actively and iteratively reflecting on past progress while designing next steps.

There are many similarities between Action Research and Lean & Agile methodology – the cyclic and reflective nature of the process comes to mind first, but also the ideals of studying things 'where they happen' and delegating decision-making power to the participants are prominent in both. Action Research can easily be combined with Lean tools such as 'Gemba walks' (for an example, see e.g. Lot et al, 2018). This similarity makes Action Research a very compelling choice, almost a natural fit when studying Agile software development teams. The experimental cycle is easy to describe to agile professionals and straightforward to fit into the existing framework of Scrum sprints and continuous improvement.

Action Research, among other qualitative methods, has been used widely in Social Science, Educational Science and Organizational Studies but apparently very seldom in Science, Technology, Engineering & Mathematics (STEM) fields so far. The relatively modern field of Empirical Software Engineering Research is still in the process of establishing its methodological toolbox. Borrowing this kind of method from other fields seemed appropriate for this topic, allowing us to not only conduct an empirical study of software development organization, but also to further explore the usage of this type of qualitative data analysis in the field of Software Engineering.

2.3. Building a community of practice, one experiment at a time

In this study, we conducted a series of small, agile experiments with the active participation of the developer community. Each of the experiments have been explored in consecutive iterations, with brief reflections between each iteration affecting the formulation of the next one. In a true agile way, the direction of future experiments has also been affected by the results of previous ones, i.e., the study progression has not been set in stone from the beginning, but it is fluid instead and allows for pursuing new avenues of research when such new possibilities surface.

The themes explored in the experiments have come up from the community itself, and they include e.g.:

- A collaborative, informal decision-making mechanism regarding technological choices and policies
- Transfer of knowledge between developers and/or teams by way of iterative, just-in-time documentation
- 'Experimentation Cards' providing the minimal necessary structure and documentation for facilitating developer's own lean experimentation cycles

The experiments are still ongoing as of May 2020, and we will report on the results of the study as they become available in June 2020. The preliminary results suggest that development teams are extremely willing and eager to improve their knowledge management processes, as long as they are empowered to experiment and fail, and given lean and minimalistic tools for it, without too much emphasis on formalism or rigid organizational structures. This would further suggest that knowledge management can be cultivated 'organically', stemming from the community's own involvement instead of only 'top-down' policymaking.

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Attention, please: Appropriate soundscapes for student engagement in large learning spaces

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Keywords

acoustics, orchestration, clarity, cognitive load

1. Summary

This present paper examines the importance of audible clarity for teaching and learning. By drawing on educational theory, acoustics together with field work, tests and measurements in learning spaces ranging from 40 to 220 seats we realised commonplace clarity measures are rather inadequate to predict listener engagement and recall. Instead, the proximity of sound as perceived by the human auditory system should be considered when designing spaces and orchestrating learning activities.

2. SHOULD WE RETHINK ACOUSTICS IN LARGE LEARNING SPACES?

During the last decade or so combining lecturing with groupwork as well as discussions among all the participants have become quite commonplace in the University of Helsinki. Moreover, there may now be 130 people on a course originally designed for 80 participants. Thus, the problem is not just making sure anyone given the floor can be heard. All the participants should feel they are thinking together around a shared subject both during general discussions and groupwork. This is very much a question of classroom orchestration (Dillenbourg 2013). Acoustics and sound reinforcement are important in enabling such discussions as it is hard to feel included in a conversation which is even partially unintelligible or if you struggle to be heard. But what can we do to prevent the soundscape of the participants from creating unnecessary cognitive load, reducing motivation or hampering participation (Martin 2007)?

3. EXISTING AND PLANNED SPACES AND THEIR USES

The primary goal of this paper is to help evaluate learning spaces for increasingly larger group sizes for the purposes of active learning through discussion as one channel of sharing information. Therefore, we have selected two large rooms used for collaborative knowledge building around shared epistemic artefacts (see Hakkarainen 2009) both in small groups as well as through general discussion. These activities have enabled meaningful learning without unnecessary cognitive load or anxiety according to a) student feedback and course results, b) discussions with teachers and c) participant observations. Thus, we are currently in the process of analysing in what ways room acoustics and sound reinforcement aid the knowledge building activities in conjunction with other technical means such as visualisations and back channels.

This present paper draws on four main sources of information: Firstly, field work since August 2012 in Minerva Plaza, first of our two spaces. Minerva Plaza is a learning space comprising a central plaza with six adjoining rooms totalling a capacity of 170 seats designed and continuously developed for student engagement. Secondly, refurbishment and development work for increased student engagement in our second space, a 233-seat lecture theatre called Aurora 230. (see University of Helsinki 2020 for images) In these two spaces we have carried out tests, measurements and field observations. The third source is recent development work with steerable coverage microphones in three circa 40 seat rooms with a lot of reflected sound. Lastly, initial plans of a new 350 seat tiered learning space with a furniture layout similar to Minerva-Plaza made us wonder to what extent the current solutions can be scaled up or even transplanted?

4. WHAT SHOULD BE MEASURED AS CLARITY?

According to our initial measurements, room acoustics are not particularly good in either room when measured using the sound reinforcement system installed in the space. Especially in Minerva Plaza sounds reverberate up to two seconds as seen in Figure 1. Moreover, the numerous dips in the graph indicate different parts of the room sound different as reflected sounds cancel each other out in certain frequencies. Figure 2 shows roughly one third of the sound arrives late enough to reduce speech intelligibility. Nevertheless, it is not subjectively difficult to hold a general discussion using either throwable or handheld microphones. Nor is it hard to hold a group discussion around a table despite at least seven other discussions taking place simultaneously in the central plaza. When researching possible causes for this discrepancy between the subjective experiences and our measurements it turned out common measurements employed in acoustics like reverberation time shown in Figure 1 or C50 clarity measure displayed in Figure 2 are not suitable for measuring what human hearing perceives as clarity. David H. Griesinger (2013) has demonstrated the audibility of fine structure in the direct sound is beneficial to attention and recall as well as how and why the commonplace clarity measures do not measure it (Griesinger 2013, 5-9). So, acoustics and sound reproduction matter in active learning as they influence attention, engagement and memorising through the way human hearing and working memory function. Particularly the perceived proximity and intimacy of the learners' soundscapes should be considered whether building or retrofitting learning spaces or orchestrating learning as it is much more effective to avoid problems than trying to correct them by manipulating the sound or the listeners. We can offer some solutions but there seems to be room for improvement and innovation in many ways.

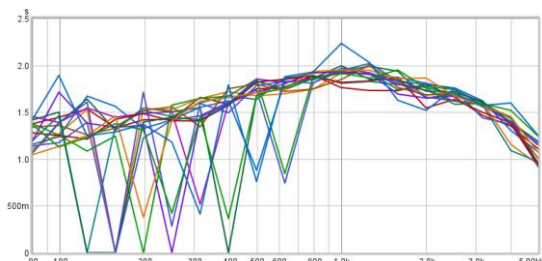


Figure 2

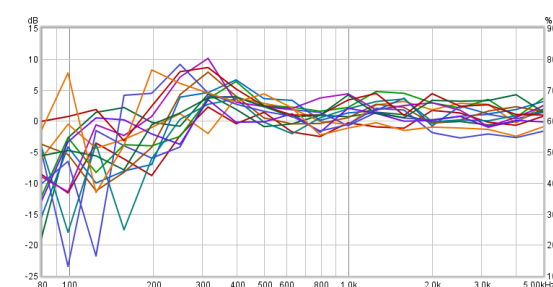


Figure 1

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CONTEMPORARY MANAGEMENT OF LEARNING SPACES AIMS AT EDUCATION QUALITY NEXT TO SEAT CAPACITY

Delft University of Technology (TU Delft) has been changing its management over learning spaces enormously. Student numbers have doubled since two decades resulting in a situation that classes could not fit any longer within education spaces of their own faculty building. Slowly a dynamic shift came into being where larger classes were scheduled over different university buildings. At the same time, a new challenge came up because the operation of the existing lecture halls and classrooms differed enormously over campus.

In 2014 a Taskforce Education Spaces was formed to cope with this shifting situation. They came up with a 10 years transformation plan proposing a two-fold strategy: 1) governance structure for all parties involved in education spaces (education, real estate, IT, facilities), and 2) guidelines defined in a Cookbook Education Spaces based on contemporary pedagogies in collaboration with teaching staff and students.

Today, TU Delft holds over 26.500 students and the numbers continue to grow. Lecture halls and classrooms are managed centrally, and the building policy aims at mono-functional buildings henceforth i.e. no more combined premises for research and education. TU Delft has been deciding to put education first with building projects. Quality of education features within education spaces took its place next to seat capacity and readability became very important.

This paper describes education features that influence readability including the visualization with our interactive education spaces configurator TUDesc.

Readability in Lecture Halls and Classrooms

Chalkboard-pedagogy is essential for teaching a talking-writing way of reasoning at our scientific and technical university. Natural science lecturers love the chalkboard when explaining theorems and proofs. While thinking aloud they simultaneously produce and write arguments in successive order on the board, which can be digital or erasable whiteboard too. In such way, their reasoning becomes visible. Students see the process and structure of the systematic arguments that appear on the board, they gain the ability to recognise patterns and interconnections with this chalkboard pedagogy. They have to take notes, because they must think with their eyes and hands themselves. Therefore, being able to discern every presented character is essential.

Readability is a complex set of ergonomic variables, such as strain free sightlines, eye height dependent on applied furniture and hall, distance of the presentation screen to first and last row, the screen's size and its position on the wall, and the quality of the presented image or written content. Readability is based on having a good visual acuity.

No clear figures were available to arrange a proper readability. Only rules of thumb, such as a character height - distance ratio of 1 to 200 or five times the diagonal of the screen. For such reason fieldwork was done to come about with figures to be able to read subject matter in education practices all over campus. Character heights of written formulas were collected from boards in lecture halls and classrooms. Followed by collecting PowerPoint presentations analysed in relation to the screen dimensions. Regulations for signage indoors and the optician's way of work to correct people having a visual acuity of 100% visus based on the Snellen Chart.

Proper readability needs a viewing angle of 17 arcminutes to be able to discern strange characters in unfamiliar formulas. It shall be at least 14' when using electronic displays due to the better contrast. The angles were tested in practice with independent people, although students as young people do sometimes have eagle eyes.

Cookbook Education Spaces and its Interpretation

The collected data was analysed and transformed into readability figures placed in tables in the Cookbook Education Spaces. However, interpreting these tables is not always straightforward for third parties, e.g. figures about reading distance and related ceiling height are continuously variable, but only a few are presented in the table. Table 1 presents a Cookbook table. Inter- and extrapolation make persons doubting and hesitating to make decisions of which they are not certain how it will work out for the education space.

Table 1: Advised minimum dimensions for projected image at given reading distances

(Taken from Cookbook Education Spaces version 2.0 April 2018)

Reading distance	Projected Character Height (17' - 20')	Minimum Projected Image Dimensions	Minimum Ceiling Height in Tiered Lecture Halls	Minimum Ceiling Height in Flat Level Lecture Halls
8 m	4.0 - 4.7	180 * 101 cm	158 + 210 + 20 = 388 cm	100 + 140 + 20 = 260
10 m	4.9 - 5.8	240 * 135 cm	186 + 210 + 20 = 416 cm	135 + 140 + 20 = 295
12 m	5.9 - 7.0	280 * 158 cm	214 + 210 + 20 = 444 cm	160 + 140 + 20 = 320
14 m	6.9 - 8.1	330 * 186 cm	242 + 210 + 20 = 472 cm	190 + 140 + 20 = 350
16 m	7.9 - 9.3	380 * 214 cm	270 + 210 + 20 = 500 cm	215 + 140 + 20 = 375
18 m	8.9 - 10.5	430 * 242 cm	298 + 210 + 20 = 528 cm	-
20 m	9.9 - 11.6	480 * 270 cm	326 + 210 + 20 = 556 cm	-
22 m	10.9 - 12.8	530 * 298 cm		-
24 m	11.9 - 14.0	580 * 326 cm		-

Visualizing Readability and Sightlines makes it easier

Now the Cookbook Education Spaces has been taking a step further. Misinterpretations must be prevented for parties working in lecture halls and classrooms. Thus, we have been deciding to visualize important education features, such as readability, sightlines, capacity and accessibility. With our application called TUDesc (TU Delft Education Spaces Configurator) one is able to define the several parameters important for proper readability.

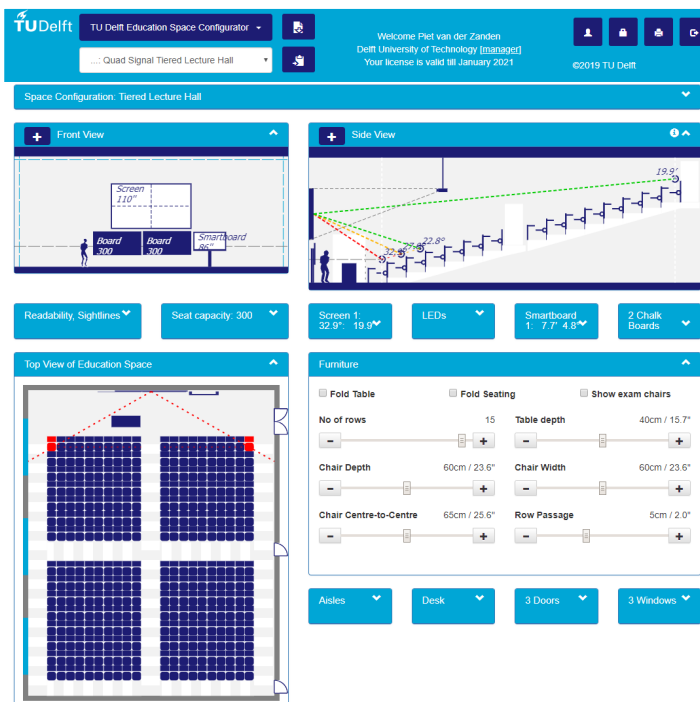


Figure 1: Impression of the TU Delft Education Spaces configurator TUDesc

Transforming a lecture hall into a multi-functional active learning space

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Keywords

learning space, lecture, multi-functional.

1. SUMMARY

The Amsterdam UMC, location AMC in the Netherlands, completed an overall renovation of a traditional lecture hall into an innovative multi-functional active learning space. In this single space, frontal teaching can be combined with group and stand-up education. Audiovisual (AV) technology forms an integral part of the space and enhances the interaction with the students like never before. The Amsterdam UMC believes that a suitable classroom is crucial for great and innovative education. The new lecture hall is an excellent and unique example of such an active AV enabled classroom.

2. EXTENDED ABSTRACT

In December 2019 the Amsterdam UMC, location AMC, in the Netherlands completed an overall renovation of a traditional lecture hall into an innovative multi-functional active learning space. In this single space, frontal teaching can be combined with group and stand-up education. Audiovisual (AV) technology forms an integral part of the space and enhances the interaction with the students like never before.

Educational programs in the faculty of medicine at the AMC are increasingly moving towards active and small-scale education. Students should participate as actively as possible during their classes and learn by doing and collaborating. Traditional lecture halls primarily facilitate frontal teaching and the AV capabilities are limited to supporting the teacher. The renovated lecture hall provides a novel view on providing small-scale active education in which also the students are supported by AV means.

The hall is transformed from a row-based capacity of 250 students to 18 group-tables of 6 students and a couple non-group seats, totalling to a capacity of 117 students. The two front students at a table can rotate their chairs to collaborate with other students at the table. Changing from group to frontal teaching becomes as simple as rotating chairs. In the back of the hall, a break-out room is created for stand-up education for around 30-40 students. This space is enhanced by integrated whiteboards, bulletin boards and folding tables. This space enables students to perform creative, design and collaborative work, or present their outcomes with (poster) presentations.

The hall has a bring-your-own-device philosophy. Every table has power outlets for all seats to enable students to use their electrical devices. Students can present their work via the lecture hall beamer using a HDMI connection available on every table or using a wireless connection that is especially suitable for smartphones and tablets. Via two gooseneck microphones, available on every table, the students can interact with the teacher and fellow students. The voice of students and teachers is amplified via the sound system and speakers in the tables. Both the teacher and student audio feeds are audible in the web lectures that can be recorded using the 4 available cameras. The cameras

provide tracking of the teacher and possibly a student asking a question. The student can 'ask' for attention by pressing a button on the table that lights up the table sign.

The audio streams are also available via a mobile app to support students with a hearing disability. Students with a physical disability can access the hall with their wheelchair via a stair-elevator. All chairs in the front row (in total 6 seats) can be removed to make space for the wheelchair to enable normal participation.

The lighting is adapted to LED with an effective color temperature. The walls are covered with wooden accents on top of isolation and acoustic materials to dampen noise. The climate control is renewed with state-of-the-art heat recovery technology. All-in-all to create a comfortable environment that is also climate-aware.

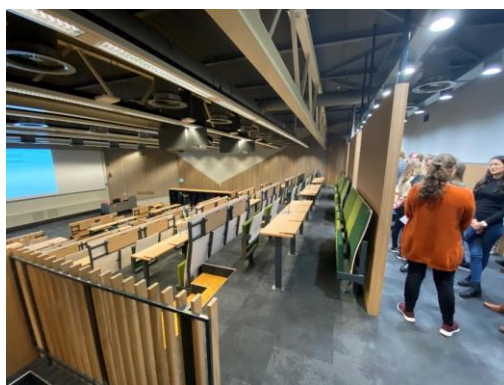


Figure 1. Overview of the hall and break-out section

The first months of use show that it is possible to create an effective active learning space by transforming a traditional lecture hall. It offers a unique approach where a static setup can effectively support multiple didactical working methods. Both student and teachers love the ambiance of the hall and the way it helps them to be active and spend 'time-on-task' on the learning content. We see that educational sessions are transforming from traditional lectures, in the old situation, to more active workshop in which frontal, group and stand-up methods are combined. Due to the static set-up and the integrated and ready AV mechanisms, the flow of education, meaning the time and logistics necessary to switch between working methods, is very efficient. Consequently, the risk of losing the attention of students is less prominent compared to traditional lectures halls or other types of active learning spaces with movable furniture and walls.

The AV mechanisms also help augmenting the learning content (i.e. double beamers, scrabble-screen BYOD presentation) and keeping contact with the student (i.e. amplified table microphones, attention signs, increased lateral pathways, hearing-aid). The camera's offer videoconferencing and recording facilities that opens up possibilities for future international classrooms. Education now needs to continue its transformation to fully use the potential of the hall and explore all its possibilities.

In conclusion, the new lecture hall provides possibility for flexible use of multiple didactical methods in a pleasant ambiance. All AV mechanisms are integrated in the learning environment and contribute greatly to the student's learning. We believe that a suitable classroom is crucial for great and innovative education. The new lecture hall is an excellent and unique example of such an active AV enabled classroom.

AUTHORS' BIOGRAPHIES

Tom H.F. Broens is an assistant professor at the AMC, active as the program director of the bachelor medical informatics of the University of Amsterdam. He was part of the design and implementation board of the new lecture hall with the role to help establish the educational vision that underpins this new educational space, based on viewpoints of the educational program and its lecturers. Additionally, he has the role of principal educator at the AMC, responsible for researching ways to use ICT for effective design and maintenance of education. He is very active in researching and developing a curriculum management system to facilitate structured constructive alignment of curricula and its embedded courses in a collaborative way.

Hence, he has an affinity with ICT related matters such as audio-visual mechanisms to enhance learning that are incorporated in the new lecture hall. He is very active

The hybrid virtual classroom@KU Leuven, an interactive, scalable and cost-effective classroom setting that enhances the (remote) learning experience

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Keywords

Hybrid virtual classroom, remote learning, synchronous learning, Flexible learning space.

1. Summary

The awarded LECTURE+ project shows innovation in research and design of a hybrid virtual classroom which has been implemented and evaluated at KU Leuven, campus Kulak in Belgium that improves decision support for teachers, room operators and learners which results in enhanced learner engagement. Through mechanisms such as behavior tracking, AV processing and automated video direction both the learning and teaching experiences exceeded the expectations of students and teachers as it makes remote teaching and learning as interactive and effective as traditional face-to-face learning.

2. Extended Abstract

By designing and implementing a synchronous hybrid virtual classroom, the project aimed to make distance learning as seamless and vivid as learning in face-to-face classrooms, without sacrificing the affective features of face-to-face instruction. The imec.icon project LECTURE+ is a research project bringing together academic researchers and industry partners. In this project the research groups ITEC, Distrinet and PSI of KU Leuven University, Belgium collaborated with the industry partners Barco, Televic Education and Limecraft. The LECTURE+ project was co-financed by imec and received project support from Flanders Innovation & Entrepreneurship.

To meet the goals of flexible learning crossing borders, KU Leuven University highly invests in the use of educational technology to facilitate collaborative learning and multi-campus education to broaden the international reach. The research, development and implementation of the hybrid virtual classroom@KU Leuven, campus Kulak Kortrijk in Belgium, is currently changing the educational landscape at our institution. The aim is to make education more flexible and accessible for a larger and more diverse group of learners. Our 'hybrid virtual classroom connects both on-site students and individual remote students during synchronous teaching and learning and makes high interactivity possible.

What makes our project unique is that it has been set up in close collaboration between academic and industry partners and has been systematically evaluated by all stakeholders. The project resulted in a hybrid virtual classroom that is innovative and unique compared to the previous video- and webconferencing platforms for several reasons. First, the system includes improved software to connect F2F students, remote students and the teacher to make spontaneous interaction possible. Second, we also invested in a redesign of the physical learning space to meet the challenge of offering all students comparable learning experiences regardless of their location. Third, the project resulted in a scalable and cost-effective virtual camera director making sure that the array of cameras in a classroom focusses automatically – and in real-time – on what is happening in the room.



Figure 1. Hybrid virtual classroom at KU Leuven Kulak with teacher.

As KU Leuven, campus Kulak Kortrijk was the first institution that implemented the hybrid virtual classroom, it was important to continuously assess the experience as it developed, revising the approach as necessary to support effective teaching and student learning. To be able to update the solution along the way, interviews were organized with the involved teachers to gauge their experiences. We also systematically evaluated students' experiences by sending them online questionnaires. Also, a within-subject experimental design study was set up to investigate the effect of launching quizzes on students' engagement during hybrid virtual learning. This study has been

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Annelies Raes holds a PhD in Educational Technology by Ghent University and is currently working as Postdoctoral Researcher at the Centre for Instructional Psychology and Technology (CIP&T) at the University of Leuven (KU Leuven), campus Kulak in Kortrijk, Belgium. Annelies Raes is also co-Principal Investigator within imec's Smart Education Program (<https://www.imec-int.com/en/articles/smart-education>). Her main fields of interest are new innovative education models as active learning and problem-based collaborative learning and how this can be supported by emergent technologies. From 2017 Annelies was in charge of the research conducted in the context of the TECOL project (<https://www.kuleuven-kulak.be/tecol?lang=en>), the research and development project on Technology-Enhanced Collaborative Learning at KU Leuven, campus Kulak Kortrijk. Annelies also conducted the research from a pedagogical perspective in the imec.ICON project LECTURE+ about effective remote learning (<https://www.imec-int.com/nl/imec-icon/research-portfolio/lecture>).



Marieke Pieters holds a Master in Geography and was teacher for more than 15 years in a secondary school in Kortrijk (<https://lyceumolvlaanderen-kortrijk.rhizo.be/>). In 2018 she joined ITEC, imec's research group at KU Leuven, campus Kulak in Kortrijk as a full time researcher in the context of the LECTURE+ project. In this 2-year project her role was to set up the research projects focusing on Technology Integration together with the secondary school. Since 2020 Marieke Pieters combines her job as teacher in geography with a job at the KU Leuven where she is responsible for the professional development of teachers who want to integrate the technology for collaborative and distance learning (including the hybrid virtual classroom) in their courses.



Piet Bonte is IT staff at KU Leuven and core member of the Technology-Enhanced Collaborative (TECOL) project. He provides central IT-AV support for education, research, administration and policy and manages the IT-AV infrastructure. He strongly collaborates with the Industry Partners (e.g. the one in the LECTURE+ project) for the rollout and implementation of the IT solutions.



Ine Windey is responsible for the overall team management, finances and personnel of itec. She coordinated the TECOL project and the LECTURE+ project.



Fien Depaepe is working as an associate professor at the Center for Instructional Psychology and Technology (CIP&T) and ITEC, imec research group at KU Leuven.



Piet Desmet is coordinator of itec and academic director of the imec smart education research program.

Idea Garden - Growing Your Ideas Organically

Julie Johnston¹

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Keywords

1. SUMMARY

The Idea Garden is disrupting the way higher education introduces emerging and innovative technology to students. This unique incubator space was carefully designed to inspire students to explore and create regardless of their field of study. The Idea Garden is a vibrant “thinker space” that offers an opportunity to engage in collaborative, cross-disciplinary experiences by providing them with hands-on interaction with cutting-edge technology and unique collaborative tools. Advanced AV technology is utilized in unique ways showcasing the power of technology for design and function.

2. EXTENDED ABSTRACT

Indiana University’s University Information Technology Services (UITS) has a long standing reputation of providing high quality technology solutions and learning spaces for students within an expansive and robust network. Learning Spaces – a division of Learning Technologies – UITS is redefining “bold” by creating innovative spaces with new mechanisms for delivering technology opportunities for students. The Idea Garden was born out of a concept to “think differently” and create a dramatically different space for students that introduces technology with a focus on solving problems and creating an entrepreneurial spirit.

The “bold” design of the space employs biophilic design (natural elements for health and inspiration) along with bright and bold colors to create an inspiring, yet serene atmosphere for its guests. The ambient music controlled through a wireless app plays continuously through the space from the Klipsch Spun Copper Titan Tweeter series encouraging students to stay as long as they desire. Nationally recognized for the installation of over 18 large, multi-panel tiled video display system, or “IQ-Wall, on the Indiana University campuses, the Idea Garden is home to one these high resolution, immersive displays. The interactive video wall displays a variety of engaging content including digital painting tutorials, inspirational video stories, and examples of software utilization setting a visual mood for inspiration. It sets the perfect stage for student presentations and guest presenters. As one student commented “I never want to leave” and while another student asked “Is this really for us?”

The Idea Garden is ever-evolving as it welcomes change as a natural and positive feature of a successful learning and technology space. A strong emphasis is placed on friendly staff which create an approachable learning environment for those experimenting with emerging technology for the first time. The Idea Garden staff incorporates emerging technology as a natural part of the learning environment.

Launched in the Fall of 2018, the Idea Garden is disrupting the way higher education introduces emerging and innovative AV and other interactive technology to students. The Idea Garden encourages opportunities for learning based on personal interest and passion as well as course curricula. In response to the changing dynamics of the future workforce indicating that by 2030, there will be a need for employees with advanced technology skillsets, The Idea Garden is providing an

incubator space to inspire and welcome all students to explore and create regardless of their field of study. The Idea Garden is a vibrant “thinker space” that offers all students an opportunity to engage in collaborative, cross-disciplinary experiences by providing them with hands-on interaction with cutting-edge technology, while offering unique collaborative spaces that are not available on any Indiana University campus.

The Idea Garden’s mission is to provide extensive, individualized support for students who are interested in acquiring skills in 3D modeling and printing, AR/VR, and digital art. The AV has been carefully integrated within the Idea Garden to create a symbiotic experience for the users of the space. In addition to the technology utilized for specific curricular projects, technology is also enabled for the aesthetics of the space.

Industry and community connections are a main priority at the Idea Garden. The Idea Garden is also a venue that allows for hosting activities and events supporting IU’s educational mission and offering opportunities for students to connect with technologists, entrepreneurs, and business executives. We believe students need to connect with the Industry. Students have been able to interact with a wide variety of experts including Sony executives from Japan. Google, Apple, and Adobe are active partners within the space to provide experiences beyond the classroom for our students. In addition, our goal is to inspire students to learn beyond the curriculum and acquire skills based on their interest and passions. We are designing spaces meant to inspire students, that will encourage them to find their passion and foster the spirit of lifelong learning. This concept supports the need for students to leave the university, having had the opportunity to explore, design, and create with new and disruptive technologies.



Figure 1. The Idea Garden is the perfect place for an engaging small group session.

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Video about the Idea Garden

<https://iu.box.com/s/54omkgsrcbr4pk3y35q8emsxnkzum5g0>

4. AUTHORS' BIOGRAPHIES



Julie Johnston is the Director of Learning Spaces for Indiana University. This position manages four entities of UITS Learning Technologies: Classroom Technology Services, Learning Space Design, Collaboration Technologies, and Student Technology Computing. Along with managing these services, she is ultimately responsible for the technology design of Learning Spaces for the campus, specifically active learning classrooms, informal learning spaces, and student technology center spaces. She was actively involved in assisting with the launch of Indiana University's new active learning initiative, Mosaic (mosaic.iu.edu) Julie has over 20+ years working in Instructional Technology Leadership positions in higher education. Julie is a team member on the Learning Space Rating System (LSRS) project provides a set of measurable criteria to assess how well the design of classrooms support and enable active learning. Julie also co-leads the Educause Learning Space Working group - a group of colleagues interested in learning space design. Linked in <https://www.linkedin.com/in/julieajohnston/>

Scalable IT for e-Assessment

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Keywords

e-Assessment, Electronic Examinations, Scalable IT

1. SUMMARY

Electronic assessments are a topic of growing interest for universities. Even though it is not a new approach, there is still no “common way” for implementing those assessments. This leads to a situation where universities start implementing a suitable approach themselves. However, it has to be ensured that such an approach scales to large numbers of students. This paper describes the technological necessities for implementing a software framework for electronic assessments that utilizes a BYOD approach.

2. ABSTRACT

Electronic assessment can be conducted in a computer lab of the educating institution. However, this approach has some drawbacks: high costs and a lot of management overhead are introduced (Biella, 2009)(Bücking, 2010). However, the biggest drawback arises for the students, as they have to work on unfamiliar devices. If some students have to work in an unfamiliar environment, this is unfair in comparison to students who do not have this handicap. Utilizing a BYOD approach, i.e. using the students’ own devices in the examination, is a solution to the aforementioned issues. However, a BYOD approach also introduces new problems. For example, the different capabilities of the students’ devices have to be taken into account to prevent unfairness. A possible solution at this point is to implement an approach that offers the possibility to offload computational intensive tasks to a server (Kovachev, 2017), therefore smoothing the differences between the students devices. A major issue introduced by this approach is *scalability*. The approach is not suitable for electronic assessments, if students have to wait too long for the server’s response. However, this problem can not be solved by simply adding more processing power, as potential bottlenecks in the process have to be identified to make the solution scalable.

This paper describes what has to be taken into account to make such an approach scale to large numbers of students. The focus is put on the capabilities of hardware, and software engineering decisions and how those affect the performance of a scalable software solution. A case study on a JAVA build server that also offers remote debugging capabilities is discussed and the lessons learnt from this project are presented. Additionally, a field test with about hundred students and the differences of performance in comparison to a mock-up lab test are discussed.

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Bastian Küppers, M.Sc. is research associate at the IT Center of RWTH Aachen University. His research focusses on e-Learning and e-Assessment technologies. He received his M.Sc. cum laude in Artificial Intelligence from Maastricht University in 2012. Since 2010 he works at the IT Center as a software developer and later as a teacher for parallel programming, robotics and other topics in computer science for the study program "Applied Mathematics and Computer Science" at FH Aachen University of Applied Sciences.



Richard Zameitat, B.Sc. received his B.Sc. in Scientific Programming at FH Aachen University of Applied Sciences in 2017. Since then he works as software developer at the IT Center of RWTH Aachen University.



Dr. rer. nat. Thomas Eifert is Chief Technology Officer of the IT Center of RWTH Aachen University and as such responsible for the strategy for technological development and the corresponding third-party funding of the IT Center. The focus in this function includes concepts for research-oriented storage infrastructures. He is also a lecturer for Calculus in the study program "Applied Mathematics and Computer Science" at the FH Aachen University of Applied Sciences, where he is involved in the processing and digitalization of traditional teaching content.



Prof. Dr.-Ing. Ulrik Schroeder received his Diploma degree as well as his PhD in Computer Science from Technische Universität (TU) Darmstadt. Since 2002 he heads the Learning Technologies Research Group in the computer science department at RWTH Aachen University. His research interests include assessment and intelligent feedback with a focus on learning processes, Web 2.0 applications and social software in education, mobile Internet and learning, gender mainstreaming in education, and Computer Science didactics.

EUNIS 2020: DIGITAL ASSESSMENT IN FINNISH AND NORWEGIAN HIGHER EDUCATION

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Keywords

Digitization, digital assessment, digital exam, electronic assessment, higher education, cross-institutional, exam premises

1. SUMMARY

As service managers for Digital Assessment services in Finland and Norway, we have made observations and experiences on cross-institutional collaboration with HEIs in our countries, as well as on the both possibilities and challenges we face in the digitization of assessment. We have found many similarities between our countries despite having different technological solutions. While CSC in Finland has developed their own system for digital assessment, Norway has Software-As-A-Service-contracts (SAAS) with international software providers. The Finnish model is based on exams taken in standardized, supervised exam premises and customized workstations whereas in Norway the exams are mainly done with personal computers (BYOD¹) with on-location supervision. This extended abstract and our following presentation will describe how we collaborate with HEIs and our experiences in digitizing the assessment processes, including current possibilities and challenges.

2. DIGITAL ASSESSMENT IN FINNISH AND NORWEGIAN HIGHER INSTITUTIONS

2.1. Model of co-operation between CSC and HEIs

During 2013-2014 small group of Finnish HEIs and CSC decided to start joint efforts to find new system for digital exams. Based on a market review, no suitable solution was available that time and they decided to start building their own system instead of acquiring one. Since then Finnish HEIs and CSC have been developing a concept and system for digital assessment called EXAM (Exam consortium, 2020). In 2020 EXAM consortium consists of 27/37 Finnish universities and universities of applied sciences. The EXAM consortium is open for any organization and the funding is mainly based on yearly fees based on development needs and consortium activities and it's formed by universities. With the help of Ministry of Education and Culture, EXAM source code was licensed under EUPL 1.1. -license. This provides opportunities to new user groups and wider development network, but so far only preliminary discussions outside HEI-network has been carried out.

Project manager (CSC) works as a product owner and closely together with a project owner group (formed of HEIs' examination officers), a consortium management group and developers from the subcontractor. A vast amount of work is done to define joint standardized processes and functionalities for the system. Service is installed on-premise and CSC is also maintaining some of the universities EXAM services.

EXAM concept for online exams in Finnish Higher Education Institutes

The Finnish EXAM concept consists of the exam software (EXAM), customized workstations and network environment, camera-controlled exam rooms and the process to supervise the students. Compared with other online exams e.g. home-based exams, these exams done in special premises can be controlled and the users are easily identified. Because students can freely choose their examination

¹ Bring your own device

time and date (in time range given by teacher and which varies from 1 day to 1 year) and are not taking the exam at the same time, the capacity issues are not a problem. EXAM is also integrated in SIS systems (courses, grades) so it saves teachers' time. Now further steps are taken in advancing the flexibility of studies for the students. Exam service supports an arrangement, where a student can take an exam of the "home institution" using the nearest HEI's exam facilities.

2.2. Unit and a Norwegian HEI collaboration model

In 2016 Uninett (now Unit) chose to acquire SAAS solutions on behalf of the higher education sector, and signed framework agreements with three software providers; UNLwise, Inspera, and Enovate (Unit The directorate for ICT and joint services in higher education and research, 2019). Unit provides national coordination and close collaboration on development of functionality and integrations with the HEIs and providers. Project managers and examination office workers at the HEIs collaborate on defining joint standardized workflows and development projects. We see that operating as one large united client grants higher priority and lower total development cost. Currently, 25 HEIs in Norway are part of the national collaboration on digital assessment, and the national coordination service and joint development projects is financed by the HEI members through a yearly service fee.

Digital assessment systems in Norwegian HEIs

While Unit offers framework agreements with three different providers, Norwegian HEIs ended up choosing either WISEflow (UNLwise) or Inspera Assessment (Inspera). The two systems are web-based and have integrations with the Student Information System (SIS), Felles Studentsystem (FS), which is used by all the HEIs. For closed-book exams, the systems require locked-down browser software. The HEIs mostly choose to conduct digital exams on campus using BYOD in large halls or rooms under supervision from invigilators and aid from IT support. Some of the larger HEIs in Norway have established "exam factories" which are available throughout the year, allowing the institutions to conduct exams at any point during the semester (course exam dates are not flexible for students). This provides the institutions with more flexibility in planning and conducting exams, especially with large course combinations.

3. COMPARING FINLAND AND NORWAY

Despite having very different software solutions for digital assessment, we have found that we face the same challenges in Finland and Norway. Especially supporting digital assessment for maths and sciences we have seen is difficult to develop quality solutions. Furthermore, harmonizing and standardization of complex workflows, in order to develop quality software or integrations, is often very time-consuming as the HEIs all have to agree on joint workflows. In addition, securing commitment among stakeholders also delays the process, as stakeholders at different levels must be involved in the decision-making. Using a SAAS-solution means that Unit and Norwegian HEIs have to inline their development with the providers' roadmaps. Developing one's own system, like in Finland, you define your own roadmap.

Table 1: Challenges and possibilities

	<i>Finland</i>	<i>Norway</i>
Cons/ Challenges	Functionalities to support maths and science. Harmonizing and standardization of processes to develop common quality software is time-consuming (different needs and processes, several SIS systems, HEI agreement and testing). Need and lack of other assessment forms (BYOD, exams at the same time). Small budget compared to needs.	Raaheim et al. (2019) highlight a lack of knowledge about: • Alternative forms of assessment • How to use digital technology in an assessment Harmonizing and standardization of complex workflows to develop quality integrations is time-consuming (HEI agreement and testing). Functionality to support maths and science.

	Small development volume. Mainly national collaboration.	Integrations with third party applications (such as Microsoft Excel, Matlab etc.) in a locked environment. Changes in laws/regulations requires new development in the systems (e.g. reassessment). Support for other assessment forms. Focus on digitizing closed-book exam might have stalled use of other assessment forms. Software providers might change focus/priority to other (new) customers internationally. All development must be done twice (once for each system)
Pros/ Possibilities	System is easy to use, and it is not complex. No software provider lock. Quick channel to get development needs and bug fixes done. Possibilities to advance an already widely used system for other ways of assessment (e.g. BYOD, entrance exams) Involvement of users and owners.	Automation of the test setup and management processes Integration with LMS Integration with QTI repositories More international collaboration Operating as a large united national customer, gaining higher priority and lower total cost. Software providers push Norwegian HEIs to use other assessment forms and think differently about assessment.

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Digital exams revisited - experiences of exam visits in Finnish Higher Education Institutes

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Keywords

digital exam, HEI, cross-institutional, exam premises, assessment, electronic assessment

1. Summary

Finnish HEIs and CSC have been developing a concept and system for digital assessment called EXAM since 2014 (e-exam.fi). In 2020 the EXAM consortium consists of 27 of 37 Finnish universities and universities of applied sciences. The Finnish HEIs wanted to deepen their co-operation, enhance student mobility and create more flexible ways for students to complete studies by sharing of resources related to the electronic examination process. By sharing resources the universities are able to reduce overlapping work, fill their own lack of resources and offer students more flexible opportunities to carry out studies and exams. At the moment, the EXAM concept is based on exams taken in standardized, supervised exam rooms and customized workstations, but vast development is going on in many levels. EXAM implementations are local, but there is now support also for cross-institutional activities e.g. EXAM visit and joint EXAM. The implementation of joint use relies on a proxy server which means that the information flows go only through a specific joint use server from a local EXAM instance to another one. Also a proxy implementation has been created to handle the IdP traffic. This way there is no need to build and open access between the local EXAMs. Currently the Finnish HEIs are deploying EXAM visits, where a student can take an exam of the “home institution” using the nearest HEI’s exam facilities. In this paper we will present the results and the experiences of pilots of exam visits organized during 2019.

2. EXAM CONCEPT FOR ONLINE EXAMS IN FINNISH HIGHER EDUCATION INSTITUTES

2.1. EXAM concept

EXAM follows the Finnish HEIs' future vision for digitalization e.g. advancing the flexibility and mobility of studies for the students, cross-institutional studies, versatile assessment and life-long learning. The EXAM concept for digital assessment consists of the exam software (EXAM), customized workstations and network environment, camera-controlled exam rooms and the process to supervise the students. Compared with other online exams e.g. home exams or open books exams, these exams done in special premises can be controlled and the users are easily identified. Because students are free to choose their examination time and date (in the time range given by teacher and which varies from 1 day to 1 year) and are not taking the exam at the same time, the capacity issues are not a problem. EXAM is also integrated in the SIS systems (courses, grades) so it saves teachers' time. At the moment the services are installed on-premise or maintained by CSC.

2.2. EXAM visit

EXAM visit means that a student can take an exam of the “home institution” using the nearest HEI’s exam facilities. In Finland it is possible to get considerable benefits from this concept, because of the long distances. Especially those online courses or programmes relying greatly on distance learning and

use electronic exams can offer better service for students. When the HEIs are networking their exam facilities for shared use, the students from all parts of Finland can participate in the studies.

3. PILOT PROJECT EXPERIENCES

First technical tests of the joint use of EXAM were done at the end of 2017 to ensure that the chosen technical architecture, implementation and basic data flows as well as the user identification worked as was planned. During the first actual pilots in 2018 many non-technical aspects were identified as well. Based on these the institutions formulated together agreements on the use of other institution's facilities (e.g. access control, surveillance and monitoring of student performance, instructions) and also outlined common features for accessibility for the actual exam rooms and for the service itself. Since not all facilities can be totally barrier free the institutions had to come up with a common understanding of what is accessible in the terms of exam rooms.

During the autumn term of 2019 the implementation of exam visit was broadened in the EXAM consortium, and the total number of exam visits at the end of the year was appr. 1200 exams. EXAM visit is a feature that the students have been waiting for as long as EXAM has been used and the overall experiences are very positive.

The biggest challenges are related to instructions and the variety of EXAM versions that the universities use and the differences in using the IdP attributes. In addition, the differences in the workstation set-up and the different software resources in each university can hinder the deployment of exam visit. It has been also noted that it can be difficult for the end user to understand properly the process where several universities are involved and to know who to turn to (the home university or the one you are visiting) if there are problems. So, there is a need for close cooperation between the admin users of exam service.

4. FUTURE STEPS

Common follow-up procedures for exam visits were introduced also at the beginning of 2020 for the institutions to be able to monitor the number of exam visits between universities and the distribution geographically, as well as the need for technical support. Based on this the EXAM consortium can better make decisions on the future development of the service. Also policies concerning the system maintenance and implementation process have to be developed further.

The workstation set-up should be more uniform to enable taking different types of exams as exam visits in all institutions participating in the joint use. A project to study different possibilities to solve this started in the Spring 2020.

The next step in the system development will be piloting the concept of a BYOD exam (Bring Your Own Device) which could be used e.g. as a final exam in lecture halls. A POC has been developed using Safe Exam Browser to control access to resources and turn the device into a secure workstation. A first pilot of the BYOD exam will be started in the Autumn 2020.

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Digital strategies in Higher Education: A comparative study of digitalization at law and medicine

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Keywords: Digital strategies, Higher Education, Digital infrastructure

1. Summary

In order to identify and understand digital strategies in higher education, we investigated two cases, from medicine and law, at the University of Oslo. We found that the two faculties used very different approaches. One used an incremental strategy governed by internal sources; the other was driven by requirements from the market and used a transformation strategy where education and exam were fully digitalized.

2. INTRODUCTION AND RELATED RESEARCH

Higher education is a key pillar in constructing the new knowledge economies for the 21st century (Sam and van Der Sijde 2014), and a central focus area for the national authorities (Norwegian Government 2017). As digitalization of higher education poses new challenges to the sector, a strategic viewpoint is essential (European Commission 2012). There is, however, an inherent tension between the various professional specialties need for self-management and control (Clark 1983), and the government's ambitions to use centralized strategies inspired by the private sector (Pucciarelli and Kaplan 2016). Since strategic approaches to digitalization may differ in each discipline we ask, *what strategies do university faculties pursue to solve challenges regarding digitalisation of higher education?* We investigated two classical disciplines, law, and medicine, at the biggest university in Norway. To develop our argument, we frame the research within digital infrastructure theory (Henfridsson and Bygstad 2013), in order to identify how strategy is contributing to infrastructure expansion or consolidation.

3. CASES AND FINDINGS

Case 1: E-learning in medicine. The faculty of medicine has since the 1990s been developing e-learning resources to improve the teaching. E-learning is particularly important to improve the students' mastery of communication, practical procedures, visual analysis, and clinical decision-making. The recent emergence of modern IT like apps, smartphones, and other equipment has increased the need for e-learning, but this requires strategies that address these requirements including how solutions shall be implemented. The section for medical informatics, consisting of three people, has created a digital infrastructure that gives access to a comprehensive amount of digital resources but has challenges in maintaining and further developing it. This can also be attributed to the big responsibility granted to the small section.

Case 2: Digital sources of Law. The faculty of Law has a long history of IT innovations. The late Professor Jon Bing was central in establishing a foundation called Lovdata, back in the 1990s. Lovdata is an IT system for storing and managing laws and sources of law. From 1990-2017 the faculty of law used an emergent and slow strategy (Mintzberg 1978). In 2017, the faculty management decided to announce a tender, which Lovdata won. The requirements for winning the tender were comprehensive including sophisticated functionality for referring to various sources of law. The reason for the tender were requirements from the market demanding digital competency amongst the students of law. During 2018 and 2019 using Lovdata, the faculty digitalized completely the education and the exam.



Figure 1: Digital resources at medicine (left) and law (right)

On the left side of figure 1, we see how the probe can be used to inspect what happens in the ultrasound graphic and on the anatomy figure. The right side is an example from Consumer Purchases Act and the different references (in yellow, red and blue) are various sources of law that shed light on how the law is usually applied. The use of colors, drawings, etc. is comparable to previous paper aids, but in Lovdata it is possible to create references directly to the source by using links. We compared the two cases, and their effort to digitalize their digital infrastructures, in order to identify and understand the strategy behind their approaches. Table 1 summarizes our findings.

Table 1: comparison of the cases from medicine and law

Theme	Digital infrastructure, e-learning	Digital infrastructure sources of law
Trigger and driver	Professional culture	External sources. IT
Strategy	(Slow) Emergent strategy with bottom-up implementation	From emergent to planned strategy with (fast) top-down implementation
Role of the faculty	Supportive regarding strategy, governing regarding technology	Governing both strategy and technology
Content	Visualization and sound	Text. Sources of law.
Maintenance	Section for medical informatics	Lovdata, an external foundation.
Result	"The students use e-learning to varying degrees"	"In autumn 2019, all exams at the Faculty of Law are digital"

4. DISCUSSION AND CONCLUSION

While the faculty of law chose a *digital transformation strategy* enabled by a solid and effective infrastructure governed by an external organization (Lovdata), the faculty of medicine chose a slow and incremental innovation process governed by internal resources. This can be understood by the differences in digital resources in the respective areas. While medicine has to deal with 3D, visualization, and sound, Law deals with text and references. Our contribution is two models for describing the different strategies.

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MOOCs in a young Applied Sciences University: Participants' behavior and metrics

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Keywords

Moocs, metrics, behavior, applied sciences university, strategy

1. ABSTRACT

This paper presents the global MOOC experiment conducted by the University of Applied Sciences Western Switzerland (HES-SO) since 2013. It shows how a young institution with a mainly local anchorage has taken hold of this new teaching approach. The HES-SO MOOC system is described after having been introduced worldwide and in Switzerland. Thereafter, the participants, their behavior and their requirements are highlighted with the help of metrics consolidated from the MOOCs presently provided on the dedicated platform.

The HES-SO MOOC platform offers six MOOCs reflecting the variety of domains in which the HES-SO provides expertise: Public Speaking, Hypertension, Comics Drawing, Mental Health, Sustainable Finance and Teaching at the digital era.

Other Moocs are under development on topics such as bridging courses in financial mathematics, digital transformation of firms, digital marketing, or various forms of written communication.

About 45 % access by mobile device (40% mobile phone, 5% tablet) and 55% by desktop computer. If 59% subscriptions to the platform are registered via an internal HES-SO address, there are only 7% to attend a MOOC. 41% subscriptions to the platform are outsiders to the institution (or their connection takes place via a private address) and represent 93% of the course subscriptions. 28% still attend the course actively by the last week and at the end of a MOOC, 23.5% of the active participants obtain a certificate for successful completion or attendance.

On average, participants access a MOOC, on Mondays and Tuesdays (20.45% and 15.45%) preferably between 12:00 and 16:00 (34.23%) and in the evening between 17:00 and 22:00 (30.76%).

A questionnaire was sent to participants at the end of each MOOC, in order to collect their opinion. 10% returned the questionnaire. To the question item "Overall did this MOOC meet your expectations?", 99% of the participants answered "yes". 100% claimed that the MOOC content was interesting. More surprisingly, 98% wished a MOOC level 2 on the same topic.

The paper presents more detailed metrics and concludes how strongly the support from the rectorate is required when launching the production of MOOCs, in a top down logic. Financially, but mostly strategically, such courses must carry the vision of the educational approach the institution wishes to sustain. Moreover, the teaching teams are insufficiently prepared to produce distance courses.

Designing Digital Higher Education: Case Aalto Online Learning

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Keywords

Online Learning, Blended Learning, Higher Education, Case Study, Learning Experience Design

1. Summary

In this paper we report about a model and experiences in designing digital higher education. Our case is Aalto Online Learning—an Aalto University wide strategic initiative for educational development. Since the kickstart in year 2016 our activities have been to create online and blended learning experience designs, related learning materials and media, and as its foremost ambition to transform and improve educational setting and structures of the university and beyond. Instead of starting from a single platform or technology with all of its constraints, Aalto Online Learning starts from ideas to improve learning, and selects or develops a design to bring the idea to reality in an agile and collaborative activity. We have evaluated the whole process—from the call for idea proposals to funding, design, development and dissemination at courses—via nine consecutive rounds from early 2016 to early 2020. To overcome identified challenges in each round we have clarified the model, introduced new training and production approaches, and identified and ran online learning theme groups and development actions of needed tooling and platforms. The model has been used to identify learning improvement ideas and to develop them to solutions for over 200 courses at Aalto University.

2. Learning to co-create in collaboration with peers

Students seek for digital materials and tools to support them learning in a lifelong learning fashion where they can easily access contents both within courses and beyond. At the same time educators at universities and trainers in companies wish to learn how to create those contents, and use tools and platforms to edit and share them. The problem our society is facing is thus two-fold: 1) how to *train the educators/trainers* and also 2) how to *help learners to learn to learn*. We argue that it is necessary to substantially design digital higher education and understand what range of approaches are there to use and employ, and share training models and learning experience designs widely for others to learn from. In this paper we aim to do exactly that, and to improve learning at scale.

Figure 1 shows an overview of different approaches we have identified as learning related activities in Aalto Online Learning, the case study for this paper. For instance, there are a number of ways to represent information and knowledge for learners. However, for instance the production of professional videos requires a model to be followed. A video production model should include training, pre-production, recording, post-production and sharing (Guseva and Kauppinen, 2018).

Similar designs are needed for all different categories, for student inquiry, knowledge testing, knowledge application, reflection/documentation and feedback. Sometimes they can also be creatively combined, like in the case of the dynamic and visual self-assessment tool (see Kivimäki et al., 2018) or playable concepts (Kultima et al., 2020). In this paper we also report about the course design formats, assessment types and ways for automating course tasks and activities.

Our conclusion is that it is vital to identify the range of online approaches and systematically provide learning experience designs to all of them, and to create a community and network of practice to use those designs. In the case of Aalto Online Learning and its over 200 pilots¹ the range is quite full, from virtual reality to online textbooks and automatic assessment and from educational videos to serious games, or from online social interaction to location-based storytelling with augmented reality.

Learning related activities applied in Aalto Online Learning pilots

Course level					
KNOWLEDGE PRESENTING	STUDENT INQUIRY	KNOWLEDGE TESTING	KNOWLEDGE APPLICATION	REFLECTION/ DOCUMENTATION	FEEDBACK
Video lectures Guest lectures (offline/online) Online textbook Interactive textbooks Digital Blackboard Learning Glass Introducing real-life project problems and solutions through video-based stories Video conferencing Tutorial videos (how to) Interactive visualisation Micro learning	Self-Inquiry Community of inquiry Decision-making practices Voting	Online/mobile quizzes (also during lectures) Online exams	Group projects Individual project Problem-based learning projects Portfolio development	Learning Diary/Journal (online) Student reflection videos Collaborative reflections Reflection papers Blogs Vlogging	Peer feedback Teacher feedback (individual, group) Personal guidance Dynamic feedback exchange between teachers and students
	Free form assignments	Discussion forums Online discussions Face-to-face discussion Video conferencing	Peer discussions - facilitated sparring Fishbowl conversations		
		Structured assignments	Peer instruction		
Virtual Reality	Mixed Reality	ARIS	Games	Gamification	Storytelling
Experiments	Simulation	Augmented Reality (for 3D models)			
Behind-the-scenes teacher activities					
COURSE DESIGN FORMATS	ASSESSMENT	AUTOMATISATION			
Create blended learning Flipped classroom Purely online courses	Assessment by Teacher Peer assessment Essay/Text assessment Automatic assessment Continuous assessment Interactive self-assessment form Online automated exam	Attendance Assessment Conveying knowledge Documenting and archiving methods			

Figure 1 What kind of activities should support learners online, and improve learning?

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¹ <https://onlinelearning.aalto.fi/pilots>

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Malmi has been leading the national Center of Excellence in Education at Helsinki University of Technology in 2001-2006. He has chaired Koli Calling, international conference in computing education research in 2004 and 2008, and he is a frequent PC member in several other computing education research conferences. He is a member of the editorial board in IEEE Transactions of

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Does video-lectures has an effect on learning results? Lessons learned from a three-year experiment

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Keywords

Video Lectures, Learning Outcomes, Student Satisfaction

1. SUMMARY

Interest towards videoing lectures has increased during the past years. According to literature, the effect of the video lectures is controversial. Some studies indicate a positive effect on learning outcomes while others did not find any effect at all. In this paper, the results of a three-year experiment on university undergraduate course are reported. The results indicate that using pre-recorded lectures had a statistically significant positive effect on grades and positive effect on students' satisfaction levels. However, using an online web-meeting to deliver live-lectures instead of traditional class-room lectures had no effect on learning outcomes. As such, teachers are encouraged to use modern technology while delivering live lectures, and to use pre-recorded lectures to increase learning outcomes.

2. EXTENDED ABSTRACT

Basics of Information System Management (TJTA114) course is a mandatory course for undergraduate students in the Faculty of Information Technology, University of Jyväskylä, Finland. As such, it is one of the mass-courses having typically 150 - 200 students. The course consists of nine lectures, each focusing on a certain theme. To pass, students were required to pass an exam and writing an assignment in groups of 4. All interaction besides the lectures took place in an online learning environment.

Between 2017 and 2019 the course has run three times. In 2017, all lectures were traditional live-lectures. The lectures were also recorded and made available to students. Therefore students were not required to attend the actual lectures at all. In 2018, first four lectures were pre-recorded in front of a green-screen and edited by the lecturer. The rest of the lectures were delivered and recorded in the same way than in 2017. In 2019, all the lectures were live lectures, but using Skype for Business web-meeting (besides the first introduction lecture). As such, students could attend the lectures from wherever they liked; only requirement was a working internet connection. Students could also interact with the lecturer either by asking questions in a similar way than in traditional lectures or by typing questions or answers to the chat. The lectures were also recorded and made available to students.

In 2017 the course had 240 attendants, in 2018 197, and in 2019 166. The drop-out rate in 2017 was 12 % and in 2018 and 2019 22 %. The previous research (Syynimaa, 2019) showed that grades were 0.323 points higher in 2018 than 2017 ($p=0.000$) on scale 0-5. Also course feedback was slightly higher in 2018; for teaching and working methods 0.023 and for learning results 0.322 on scale 0-5.

When the grades were compared between 2018 and 2019, the results were opposite. The grades in 2019 were 0.307 points lower than in 2018 ($p=0.002$). Also the feedback in 2019 for teaching and working methods were 0.320 and for learning results 0.397 points lower than in 2018.

When the grades were compared between 2017 and 2019, the results were similar between the years. The grades were 0.016 higher in 2019 than in 2017, although the difference was not statistically significant ($p=0.881$). The feedback for teaching and working methods was 0.297 points lower in 2019 than in 2017. Learning results were the same.

As a conclusion, the grades indicate that replacing half of the live lectures with pre-recorded lectures increases the learning outcomes. Thus, author encourages teachers using them in their courses. However, interestingly, there were no differences between live lectures in 2017 and 2019, even though the used medium was different. This indicates that using Skype for Business instead of traditional live-lectures does not affect the learning results. As such, author encourages teachers also to use modern technology when delivering their courses.

The reasons why using the pre-recorded lectures had a positive effect on learning outcomes remains unsolved. One possible reason is that as they were edited, the teacher was able to rephrase parts that seemed to be too difficult. Nevertheless, this is an interesting area for further research.

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Next Generation Eportfolios as Personal Learning Environments - Lessons Learned from Early Adopters

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Keywords

Next generation eportfolios, personal learning environments, 21st century skills, lifelong learning

1. SUMMARY

Eportfolios arguably provide a powerful pedagogical design solution to foster the 21st century skills in a student-centered manner. There exist many software solutions for eportfolio work, however, the institutional-scale eportfolios seem to pose a challenge for higher education institutions due to the increasing demand and the variety of options. The concept is further complicated by what seems to be a gradual advancement towards the next generation eportfolios that move beyond the idea of eportfolios as archives to eportfolios as versatile personal learning environments (PLEs).

Furthermore, it has been noted that eportfolio pedagogical designs need to be especially carefully planned and students need to understand the goals of the tasks particularly clearly in order for the eportfolio learning to be successful (Butler, 2006). In 2019, the University of Helsinki - a research institution of approximately 30,000 students, faculty, and staff - launched pilot cases to implement a novel type of eportfolio system. The following report presents initial conclusions regarding the pedagogical designs and technical aspects of the institutional-scale eportfolio pilots, including the feedback and lessons learned from multiple pilot courses from a variety of academic disciplines.

2. THE CHALLENGE OF EPORTFOLIOS

Eportfolios as elearning tools have developed significantly in the last years, from the notion of a place for collecting one's learning artefacts to more fully fledged interactive pedagogical solutions that provide tools for structured assignment submissions, including reflection assignments, peer review activities, as well as work documentation logs and accomplishment badge systems. Today, we may refer to these kinds of 'next generation eportfolios' as personal learning environments which enable student-centered learning well beyond the traditional notions of an eportfolio. Moreover, eportfolios have been noted to encompass powerful pedagogical design potential to foster the 21st century skills or work life skills: e.g. collaboration, problem solving, social skills, scientific thinking, and critical thinking (Ananiadou & Claro, 2009; Nykänen & Tynjälä, 2012; Chang et al., 2013).

According to Tuononen et al. (2019), the capability to describe one's own knowledge and skills plays a significant role in the future employment of higher education students and is connected to deep learning approaches. As such, eportfolios provide potentially an excellent tool for mapping, documenting, and understanding one's own knowledge and skills, and eportfolio work has been seen to provide students with more agency in their own learning (Butler, 2006; Bennett et al., 2016), an important future skill (Linturi & Kuusi, 2018). However, it also has been observed that in eportfolio pedagogy it is challenging to build assignment designs that are structured enough and yet provide enough freedom to students. The students need very clearly set guidelines and portfolio examples to support their deep learning approaches in, for example, academic reflection (Butler, 2006).

3. UNIVERSITY OF HELSINKI EPORTFOLIO PILOTS 2019-2020

In 2019, the University of Helsinki launched pilot cases to implement a novel type of eportfolio system, Pebblepad, which is a Software as a Service program that enables students to create eportfolios with multimedia. In addition, Pebblepad integrates to the LMS through an LTI, and as such fosters various pedagogical workflows between the LMS and the eportfolio system. In order to establish pedagogical best practices, feedback from these pilots was gathered at the end of 2019

through email correspondence and discussions with faculty and students, and complemented by usability testing sessions as well as a post-pilot questionnaire. The student questionnaire was completed by 15 undergraduate students. Most of the students who responded were Bachelor's degree students (86,7%). The survey consisted of statements answered to on a five-point Likert scale. Students also answered open-ended questions.

The pilot cases stem from multiple academic disciplines at a large-scale research university, and as such posed field-specific challenges for the eportfolio learning designs. For example, the art students' requirements for an eportfolio are much more specific in terms of the visual tools within the program, whereas in a reflection portfolio for work life skills in the humanities, the ease of use in general and usability for text editing were emphasized. In more structured task examples in the medical sciences, the eportfolio assessment tools' capabilities were focused on. The responses to the open-ended questions reflect the fact that the program is new, the concept is new, and the whole idea of using an (e)portfolio is new. The responses also reflect the wish for authenticity: students hope for connections to working life and real life use for the eportfolio. There exist clear differences rooted in the academic disciplines. In the visual arts, an eportfolio is seen as inherently useful due to the need to present multimedia in course assignments. Contrariwise, in courses with only text-based assignments, the rationale for using an eportfolio is not as clear to students, especially when used only within the context of one course.

These conclusions corroborate the notion of next generation eportfolios as versatile, but challenging tools that require careful pedagogical designs and development of novel design examples, to be implemented effectively. Moreover, the pilot case experiences also suggest that the traditional categories of eportfolios seem to rapidly be developing more multifaceted as the next generation eportfolios gain more popularity across higher education institutions, and more pedagogical designs need to be devised and further researched. Finally, though Pebblepad is not the only modern eportfolio solution available, it has proven quite versatile. Due to its versatility, the program is arguably well-suited for creating novel pedagogical best practices within the kind of extended eportfolio course work or personal learning environment (PLE) activities that seem to rapidly be gaining significant traction across the higher education sector.

"Getting to know Pebblepad was interesting and the program could benefit me for instance when looking for a job. I got to consider aspects that I haven't considered before."

"Best features in Pebblepad are creativity, banner, quote, videos, and user interface. Due to attention challenges I don't like exams. This kind of platform is very motivating and adds value to my learning."

"What should I do with this program?"

Figure 1: Quotations from students (translated from Finnish)

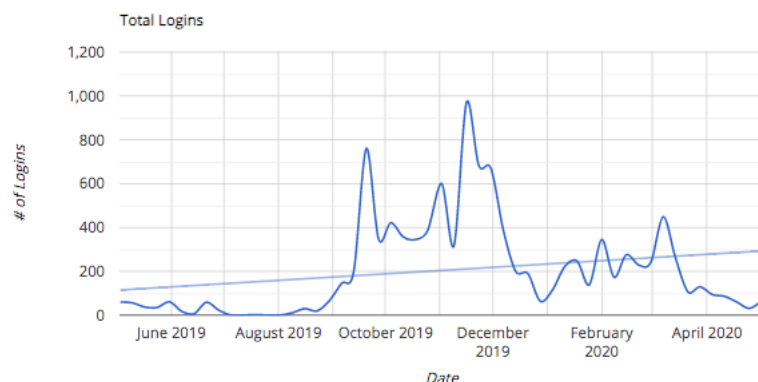


Figure 2: User statistics from the University of Helsinki Pebblepad SaaS pilots

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IMPROVING ACCESSIBILITY IN HIGHER EDUCATION - LESSONS LEARNED FROM FINNISH NETWORKS

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Keywords

Accessibility, higher education, online learning

1. Summary

Accessibility is a highly topical issue in higher education institutions (HEIs). Online learning enhances the opportunities for diverse students by offering flexibility and making higher education studies available for all students, regardless of their disabilities, personal life situation, or geographical location. Accessibility of digital environments is not only ethically important or desirable, but also a statutory duty. European higher education policies are strongly committed to enhancing the opportunities of diverse learners (European Commission, 2010; European Commission, 2017). The European legislation (Directive (EU) 2016/2102) also demands HEIs to be responsible for accessibility issues while developing their online practices (European Commission, 2016). Nevertheless, based on research and student feedback, digital services and environments are currently not accessible to all students. In this presentation we describe good practices for improving accessibility in HEIs.

2. A NATIONAL HIGHER EDUCATION DEVELOPMENT PROJECT

At the end of 2016, the European Parliament adopted the Directive on the accessibility of the websites and mobile applications of public sector bodies, including HEIs and libraries. In Finland, the Act on the Provision of Digital Services entered into force on 1 April 2019. For HEIs, this means much stricter accessibility standards and thus they are facing many new challenges. To answer these challenges, Finnish HEIs have formed networks for sharing knowledge and cooperating. This is a productive approach in a geographically large country with a small population and language group but relatively many HEIs (13 universities and 22 Universities of Applied Sciences).

One of the established networks supporting HEIs to achieve the demands of the legislation is a national DigiCampus project (DigiCampus, 2020). It is a Finnish 2018-2020 higher education development project funded by the Ministry of Education and Culture. The project seeks to create an accessible digital campus: a shared digital learning environment, pedagogy and services for HEIs. For example, it offers a digital cloud learning environment for Finnish HEIs to support year-round and cross-institutional study opportunities. The Accessibility subproject aims to ensure accessibility of the activities, environments and contents developed. It helps to create established and exemplary accessibility practices and models along with mechanisms for the continuous assessment of practices in DigiCampus. The materials and training produced within the project will be accessible to all HEIs.

3. IMPROVING ACCESSIBILITY VIA COOPERATION

When new electronic environments and services are developed and deployed, it is crucial to incorporate accessibility from the start. Accessibility issues concern all actors of HEIs. Thus cooperation and communication between administration, digital support services, course designers and teachers is essential. Both technical and pedagogical issues have to be considered. Practice has shown that this also includes staff's professional development needs. Even a relatively small technical or pedagogical solution can greatly improve the accessibility of learning environments and other facilities.

Digital learning environments play a key role in HEIs. Several factors should be considered when evaluating the accessibility of digital learning environments. To begin with, service providers and ICT

services are responsible for the technical accessibility of the platform and user interface. However, “content is the king”: teachers and other content providers should produce accessible materials. Content must be easy to follow and understand. Also pedagogical choices such as using providing materials in many formats (e.g. text, audio and video) and offering optional communication channels are essential

Overall, institutions also need a clear strategy and policies for accessibility. Students should be included in the process as they are experts of their own needs.

Therefore, the Accessibility subproject has implemented following actions to improve accessibility in HEIs via following actions:

- 1) Tested key shared digital study services, systems and learning environments in HEIs and evaluated their accessibility using a range of testing methods (e.g. accessibility testing tools, diversity of students, and students and staff who use a range of assistive technologies).
- 2) Developed technical and pedagogical solutions that improve the accessibility of the identified and tested systems and learning environments.
- 3) Produced information for the DigiCampus’s pedagogical support service for students and staff on practices, equipment, applications and accessibility tools that can facilitate study.
- 4) Contributed to the development of a learning environment quality indicator for measuring the accessibility of environments.
- 5) Provided webinars, blog posts, hands-on training and a technically and pedagogically exemplary online training about accessibility to support the professional skills of teaching, guidance and other staff in higher education.

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Digital university from student perspective: a step forward

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Keywords

Student experience, digital education, Higher Education, learning and teaching, on-line, survey

1. Summary

The paper presents a summary of the findings from the student digital experience insights survey carried out among students of Bachelor and Master studies at the University of Warsaw in the summer semester 2018 and 2019. It provides an overview of how students use technology at the university for their own learning purposes and how they perceive the university digital provision as well as the digital teaching and learning on their courses. The results of the survey help to understand how the students' expectations on digital education change in the course of gaining more experience, self-awareness and are more oriented towards their professional career.

The dataset is valuable in its potential to explore the digital experiences of students and in highlighting what exactly makes a difference to them. The findings of the survey are of use in identifying which areas of the digital education at the university should be developed as priority ones and deliver data upon which strategic decisions about digital improvements (including academic staff trainings and e-services) can be made. The findings obtained enable benchmarking for other HE institutions.

2. Background and method

University didactics is challenged by the accelerated process of digitalization in Higher Education and pervasive use of information technology for the support of teaching and learning is already a fact (Thoring, Rudolph, Vogl, 2017). Although there are studies focusing on the digitalization in the field of HE, they are often designed as a quantitative study and therefore allow only for a very general view of the subject (Dahlstrom, 2015). A broad study has been delivered by Jisc (Newman, Beetham, Knight, 2018) within a 3-year project and it is of use for other European HE institutions as their reference point. However, the relevant strategic planning for an individual institution requires an insight into own existing digital infrastructure and quality of services provided.

2.1 Method: the survey

A pilot paper questionnaire has been distributed among 61 students of the first and the second year of Bachelor degree (aged 18-27) during summer semester 2018. In a second step, the survey has been extended and the questionnaire was distributed in summer semester 2019 among 21 students of higher years of study, ie. the third year of Bachelor degree (aged 21-24) and of the first year of Master degree (aged 22-25).

The survey contained both closed (multiple choice) and the open questions referring to:

- individual digital learning habits,
- Technology Enhanced Learning in the courses they have taken, digital services & tools delivered by the university
- overall performance of the university in the Technology Enhanced Learning

The questions focused on the availability of the tools, their usefulness and frequency of use. Potential areas of improvement were asked to be indicated and all sorts of comments (open questions) were welcome within the survey.

3. Key findings

3.1 Individual learning habits and digital experience

The students were requested to assess their own ICT skills scored from 1 (very poor) to 6 (excellent) and experiences with digital technologies.

The results have shown the highest excellence has been achieved in using mobile applications rating them as at least very good ones for over 85% of students and in high activity in social media (80%). On the contrary, their experience with webinars and videoconferences is very low pointing to 75% declaring it as poor.

The average skills and experience (fair to good) were reported for activities such as usage of MS Office, collaborative tools like Google drive docs and on-line courses, by 55% of students.

Most of them (60%) have already taken part in the university on-line courses offered at the university educational e-learning platform but only 25% enrolled in MOOCs (at Coursera or edX) outside the university.

Students regularly used digital technologies in their own learning time. Half of them use digital devices on a regular basis (at least weekly) for managing their learning time, taking notes or discussing informally their learning with other students via social media.

The pandemic circumstances, however, have imposed the digital transformation in learning, and thus the above individual habits may have rapidly changed in order to adapt to the new situation and demands. Therefore, another survey is planned to check how this new circumstances influenced on learners.

3.2 Technology Enhanced Learning at the course

The use of VLE in the consistent way is highly appreciated by students. They have been eager to take part in more on-line courses. They rely on virtual access to learning and appreciate having lecture notes in advance and recordings they can revise from afterwards.

However, at no more than 30% of in-class courses the technology enhanced learning approach is applied on a weekly basis, according to the replies of students. Surprisingly, at 30% of classes the digital technologies are reported not to be used at all. The specific activities include: accessing on-line resources, on-line collaboration within the group, using educational games, quizzes and simulations. The activities mentioned are exactly what students expected to explore more at their face to face classes, stating (more than 50%), that they enhance their learning experience in this way, and thus they have a chance for better understanding of the lecture content.

On-line group collaboration was of particular importance for students of Master degree who explicitly admitted it is insufficient (80%).

3.3.Digital services & tools provided by the university

An overall performance of the university in the Technology Enhanced Learning was assessed in the survey. Among the priority needs a reliable wi-fi was pointed out.

Alike other European students (Thoring, Rudolph, Vogl, 2017), access to e-books and on-line literature was very welcome. A free MS Office license package for student was frequently pointed to be gladly seen within the university provision. Other professional software and program licenses (eg. AutoCad, ArcGIS, GeoStar) are expected to be provided free of charge for students as well.

Overall, digital technologies are expected to be used more both at the course and at the university level by 70% of all students, whereas 25% of them were happy with the amount of digital technology currently in use.

4. Conclusions

Virtual Learning Environment is highly appreciated by students and more on-line courses are welcome as well as better digital collaboration within the students' group. Masters' degree students value particularly the possibility to access the specialized software within a free license delivered by the university. The Bachelor degree students emphasize that such a need exists for even more basic software such as MS Office as well, that university does not provide.

In general, the university didactic offer should be more digital according to 70% of students. Of importance is however, that the issue is not just to use the digital technologies, but to use them in a wise and balanced manner with didactic awareness in mind, even if there is no one-size-fits-all solution.

It is worth to collect information on how moving to digital education, during the Covid-19 outbreak (from March to September 2020), influenced on the quality of teaching provision and learning results, when all the teaching and examination were run on-line. It will be also of value to compare the results obtained in this survey with the post-pandemic ones. Therefore, a similar survey is planned to be carried out among students and the academic staff in order to get to know what kind of digital practice they have found useful and what has failed.

Even though the survey was run for the University of Warsaw purposes, it can be scaled with other questionnaires. The outcomes of the survey deliver an overview of young people digital literacy skills, needs and expectations towards the digital education, and gives some indications on how the digital transformation should be shaped.

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EUNIS 2020: STUDENT PARTNERS AS DIGITAL AGENTS OF CHANGE

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Keywords

Student partners, change agents, digital practice, organisational change, student-staff partnerships, digital capabilities

1. Summary

This presentation explores the role that student partners are playing as digital change agents and drivers for change in the development of individual and organisational digital capabilities. It draws on case studies and institutional examples from participants engaged in the Jisc change agents' network (Jisc, 2015-19) and other related initiatives across the UK. The change agents' network was established to support staff working in partnership with students and to drive change in implementing technology enhanced learning. The change agents' network has successfully transitioned from a Jisc funded project that evolved over several years to a community owned network with an annual conference.

By offering insights into institutional practice from across UK higher education we aim to demonstrate the value of partnerships where students, staff and, in some cases, employers work together on initiatives to enhance practice and to make a positive change within their institutions in areas such as curriculum design, the development of staff and students' digital capabilities and employability skills. Student partnerships are driving forward innovation and digital practice across Europe and the resources from the Jisc change agents' network can further support and extend these initiatives.

2. EXTENDED ABSTRACT

Building digital know-how is an economic priority

Within Europe there has been a focus on developing digital skills for all with the implementation of the European Digital Competence Framework (DigComp) (European Commission, 2018). Significant investments are needed to ensure all citizens have the digital capabilities to live, learn and work in a digital society. It is anticipated that the new Digital Europe Programme (European Commission, 2019), will focus on building the strategic digital capacities of the EU and on facilitating the wide deployment of digital technologies, to be used by Europe's citizens and businesses.

Within the UK, the government expectation that by 2037, 90% of all jobs will require some element of digital skills (Skills Funding Agency, 2016), there is an acknowledged need to invest in building digital know-how (Beetham, 2015), capability and resilience. 'The value of digital capability in economic terms for the UK' is acknowledged as 'enormous' (House of Lords Select Committee on Digital Skills, 2015), and technological innovation features heavily in the 2017 government white paper *The UK industrial strategy* (GOV.UK, 2017).

Yet other reports show a mismatch between the skills employers need (both now and in the future) and the preparedness of the workforce to meet or rise to these demands. An international review (IPPR, 2017) noted that graduate work is being transformed by cognitive automation. Almost all high-value jobs now require excellent digital skills, while routine white-collar work is being replaced by algorithms. The Government's report on Digital Skills for the UK Economy (ECORYS UK, 2016) found that 72% of large firms were suffering a shortage of high-tech labour and pointed to the 'challenges in

matching the speed of change in the education sector... to the rapidly changing skill sets needs in the economy and society.' The UK is falling behind many other Organisation for Economic Co-operation and Development (OECD) countries when it comes to young people's digital literacy (OECD, 2016) and we still have a way to go before staff in UK colleges and universities have the required skills to meet these challenges.

Student-staff partnerships model behaviours that will help to establish digital agility and resilience and provide processes and protocols that can support future work, study and personal ambitions.

Digital student partnerships - an effective way of building a digitally capable and resilient workforce

Through the Jisc change agents' network (Jisc, 2015-19) we have seen evidence that the student-staff partnership approach is enabling universities to deliver effective student engagement activities. This approach also engages students in meaningful and active dialogue about the digital aspects of their learning experiences.

Partnership approaches create opportunities to explore the role of technology in supporting students' studies and in preparing them for employment. They provide opportunities for all parties to bring varied skills, knowledge, expertise and enthusiasm to the table. They facilitate personal and collective growth, giving rise to new learning.

Wider institutional benefits include the development of unique student-led approaches to obtain a goal, non-compartmentalised results, 'fresh-eyes' and importantly the benefit of working with people with the passion to make a difference.

This presentation will discuss how student partners are supporting the development of digital innovation in the following ways:

- Digital partnership initiatives that support the development of employability skills
- Partnership approaches designed to develop and embed digital practices within curricula
- How student partnerships are supporting the development of both organisational digital capability as well as the digital capabilities of individuals

Feedback from participants show that student partnership initiatives are effective and engaging. The impact is particularly powerful and empowering for those directly involved but when implemented in a holistic way can have a much wider reach and value. They add to the student experience over and above study ambitions and offer valuable and authentic learning and developmental experiences. The reasons for engaging are usually intrinsic from both the student and staff perspectives - wanting to develop new skills, professional and curriculum practice, or seeking to make a difference to the student experience or the university generally. Reward and recognition for achievement and the contribution partnership work makes is important. This may be financial, via Higher Education Achievement Record transcripts and university awards, as a clearly mapped route to professional recognition or through professional development review processes.

Student partnership models with a digital focus are perhaps an easy and non-threatening way in to partnership working with an open acknowledgement that all parties bring different skills sets (but don't assume it is students that have all the digital skills). This can help to establish an equal partnership process and relationship as articulated by Healey et al (Healey et al., 2014:7).

Different models are emerging of how students, staff and employers are working together: these may involve research, curriculum design, producing digital artefacts, providing consultancy, delivering and supporting training, mentorship and more. Many digital student partnership projects have a strong focus on developing the digital capabilities and employability skills of students but the potential outcomes are so much richer. Not all partnership models will have digital as an explicit focus but it is very likely that digital capabilities and their development will feature during implementation.

What is clear is that student partnership models are not just models for change, but models that facilitate lasting and meaningful change. With the student partnership projects in evidence across

Europe, students are driving forward innovative digital practices. Lessons learnt and resources from the Jisc change agents' network can further support these initiatives and encourage the wider sharing of practice.

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Biographies

Sarah Knight

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Sarah is Head of Change: Student Experience at Jisc. Sarah manages the teams supporting the Digital experience insights service (digitalinsights.jisc.ac.uk) which is researching staff and students' expectations and experiences of the digital environment and the team who are developing the Jisc Building digital capability service (digitalcapability.jisc.ac.uk) to support the development of staff and student digital capabilities.

Sarah has established the Change agents' network (<https://can.jiscinvolve.org>), a national network to support staff-student partnership working on technology enhanced curriculum projects. In recognition of Sarah's work and influence on research into students' experiences of technology, she held the vice-chair position of ELESIG (<http://elesig.ning.com/>) from 2017-2018. ELESIG is a community of researchers and practitioners from higher, further and skills sector education who are involved in investigations of learners' experiences and uses of technology in learning.

Sarah established and runs the Jisc Student Experience Experts Group, an active community of practice, which provides valuable consultation and dissemination opportunities for Jisc.

Sarah has worked for Jisc for 16 years and during her time at Jisc has led large transformation projects on curriculum design, digital literacies and learners' experiences of technology. Prior to Jisc Sarah worked for Becta developing staff development programmes for college staff and Gloucestershire College as Information learning technology co-ordinator.

Sarah has a Master of Science degree in Chemistry and is a Certified Member of the Association of Learning Technology (CMALT).

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Clare Killen

Clare has 24 years of experience in supporting providers from the higher and further education skills sectors with various aspects of staff development, including in effective use of digital technologies to support educational practices and ambitions. She has led teams delivering national initiatives and provided consultancy services focusing on: whole organisation improvements, transformational change, curriculum design and improving professional practice through peer coaching. Clare has authored several guides for Jisc on topics such as student-staff partnerships, emerging digital practices and digital capability development.

Clare joined Jisc in 2018 as Content curation manager for the Building digital capability and Digital experience insights services.

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