EUt+

European University of Technology

Deliverable 37

D.3.5.1 Virtual mobility tool

Del. Rel. No 3.10

WP 3

Description: formalization of the virtual mobility and tool deployment plan and integration in curricula

Comments:

Dissemination level: **PU**-Public

https://www.univ-tech.eu/phase-1-results

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FOREWORD TO DELIVERABLE 3.5.1

The main objective of D3.5.1 Virtual Mobility Tool deliverable is the formalization of shared project-based learning (PBL) virtual mobility deployment plan to integrate PBL activities in EUt+ curricula.

The implementation of project-based learning (PBL) virtual mobility tools will help our EUt+ graduate to possess necessary skills to participate successfully in a knowledge-based economy but also to assume their responsibilities as citizens in an increasingly interconnected world. Such skills as self-awareness, decision making, ability to work under pressure, leadership, time management, creative problem solving, commercial and sustainability awareness, adaptability, confidence, and initiative are desirable by employers and wider society.

Two virtual mobility tools: Educational Data Centre and cloud-based university-business collaboration educational platform TELANTO, were selected to test their feasibility to become EUt+ common PBL learning platforms embedded into existing modules and potentially into new modules, which can be approved by all partners and might be taken by all students not only Erasmus+ ones.

This deliverable is composed of the following elements:

- Introduction to Project Based Learning criteria and essential elements.
- Summary of Project Based Learning activities within EUt+ partner institutions supplemented with examples of PBL modules and other related activities in the Appendix 1.

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- Brief description of Project Based Learning platforms which will be tested by EUt+ partners, including Educational Data Centre and TELANTO (cloud-based university-business collaboration educational tool)
- Detailed implementation plan of the EU+ Virtual Mobility Tool

The main output of task 3.5, as detailed in this deliverable is a detailed Implementation Plan including the Month/Year of delivery, Activity Name, Objective/Planed activities, Responsible persons/Participants, Inputs, Outputs and Status.

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1. Introduction

As Karl Popper noted, "we are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline." Not only are problems borderless with regard to disciplines, but many problems also permeate geographic boundaries – problem solving, and the pursuit of knowledge are international. For academics and students to realise the complexity and contour of global challenges captured in the UN SDGs, international education and research collaborations are essential. Such collaborations are necessary if we hope to build broad intellectual coalitions, which in turn influence how global UN SDGs are conceived, and then how alternative solutions are considered and be implemented.

Since 1990, when Paul Romer published a landmark article on Endogenous Technological Change, economists have collaborated in developing a theory of growth that puts knowledge at the centre of economic change and progress rather than the traditional measurements of land, capital, labour or natural resources. Consequently, the 21st century economic paradigm has shifted towards the primacy of knowledge. For Europe and the World, increasingly, this means connecting higher education systems more closely to economic development strategies. Therefore, from a policy perspective, the aims of a publicly funded university within such a higher education system should be in pursuit of the benefits of the economy and society. Traditionally, university activities have delivered on these aims through their two principal missions of teaching – i.e., creating an educated population and research – creating new knowledge. However, in recent years, another mission is being considered to reflect all contributions of universities to society, what is generally known as 'Third Mission'.

Of course, a new knowledge economy makes the traditional academic first and second missions ever more important. However, it is also clear that they neither sufficiently encompass nor describe all the activities in which today's university should engage. The higher

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education system addresses the full range of responsibilities towards society, including business, local communities, the wider education sector and the wider international world. Activities such as knowledge and technology exchange, public outreach and dissemination, community engagement, partnerships with employers, continuing education and international cooperation are services that demonstrate the university's interaction with society. These are all 3rd mission activities.

EUT+ participative workshops were organized on 30th-31st March 2021 to understand the vision of EUt+ based on skills of graduates who are not only capable of participating successfully in a knowledge-based economy but also of assuming their responsibilities as citizens in an increasingly interconnected world . A few groups of academics held a discussion about the twelve features of the European degree and which skills students must acquire during their EUt+ journey. Subsequently, participants elaborated a narrative describing the life of a student during one EUt+ semester using both the features and the associated skills. Table 1 presents a summative view of the suggestions. Several underlined degree features can be addressed by innovative pedagogical approaches, including the Project Based Learning using virtual mobility tools which is the main aim of this 3.5.1 task.

Table 1. Summative view of EUt+ degree features.

Embedded Mobility	Multilingualism	Innovative Pedagogies	Student-centered learning
• Putting forward modularity and self-created learning tracks • Need to prepare paths for each students • Teaching mobility and its benefits, it is not self-evident • **Mobility might be embodied in final year projects** • Mobility concerns teachers as well as students	• Culture experience matters as much as the language • Promote not only English but also less known languages • **Set cultural exchange, multicultural and interlinguistic activities** • Focus on specific support for both technical and everyday language • To promote immersion in a foreign culture: not send group of students together	• **Encourage student-centered pedagogy for autonomy and self-learning** • Work on pedagogical interactions with industry • Free up time for the lecturers • Create micro-credentials based on skills	• Align method with academic rigor • Also focus on developing students' soft skills: problem-solving, resilience, creativity, etc • **Create bonds between students** • Redesign lecturers role from teachers to mentors • Set flipped classroom techniques

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Challenge-based experiential learning	Modularization & Flexibility	Self-Customization of study track	Interdisciplinary
• **Give students unique experiences of learning (not just academic courses)** • Internships are required for student's maturity • **Interdisciplinary projects allow to address societal issues**	• Allow and encourage changes in the modularization structure of courses • **Bring together optional modules from different disciplines (thematically connected blocks)** • Balance between encouraging students to think outside the box and help them structure their choices • Keep post-university studies and micro credentials in mind	• It is flexibility within a framework • Help students to differentiate him/herself • Facilitate a percentage of the curriculum (e.g. 50% compulsory, 50% open to flexibility) • Should be aligned with future market needs	• A "must" have for future jobs • **Allow and encourage the transgression of disciplinary boundaries** • Redefine the role of technology: not built in a vacuum, it is built in and for society • **Create multi-disciplinary situations**
Exposure/engagement to research	**Alignment with future labor market needs**	**Civic Engagement**	**Academic Rigor**
• Research projects in undergraduate courses • Management support for academic inclusion • Lower the distance between research and teaching • **Set 'learning by doing' research**	• Align competencies/skills to work market needs and consider disciplines between countries • Distinct training (companies) and education (university). • **Create a virtual portfolio**	• Students should become technologically responsible citizen • **Connect studies with real world and professional life** • **Immerse students in real life projects to learn from the world** • Promote outside university engagement to help student grow and mature	*Not addressed during the workshops*

The main objectives of Work Package 3: Task 3.5: Shared project-based learning platforms

The main objective of *D3.5.1 Virtual Mobility Tool* delivery is the *'formalization of the virtual mobility and tool deployment plan and integration in curricula'*. The main output of this task is a detailed *Implementation Plan* including 'Month/Year of delivery', 'Activity Name', 'Objective/Planed activities', 'Responsible persons/Participants', 'Inputs, Outputs and Status'.

A virtual mobility will be achieved by a shared pool of on-line modules which will be available for lifelong learning and apprenticeship students and will be automatically recognised via ECTS.

One dimension of internationalisation could be realised via the cloud-based platform 'TELANTO'. TELANTO is the university-business collaboration platform in which students solve real challenges provided by companies. These companies are looking for creative ideas and to hire standout talent. A community of supervised students solve challenges bringing them real-

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world experience, credits, and potentially job opportunities. Task 3.5 is examining the use this platform to create international teams of students and lecturers/ professors across all EUt+ campuses.

Another dimension to shared project learning could be provided by the UTT Educational Datacenter (EDC). This platform would provide opportunities for EUt+ students to work in a virtual space on the development of a project about cloud-computing and web services, with an unrivalled opportunity for experimentation.

Definitions and Distinctions of Project-Based Learning

Project-based learning (PBL) is a dynamic, comprehensive approach to teaching and learning designed to engage students as they explore real-world problems and challenges. The goal for PBL is for students to not only master the standards-based content, but also to demonstrate mastery of skills such as critical thinking, problem-solving, collaboration, communication, and self-efficacy so they become self-directed, independent learners. Students learn by doing and applying ideas as they engage in real-world activities that are similar to the activities in which professionals engage. PBL leads students to deeper understanding of material when they actively construct their understanding by working with and using ideas.

Individual student progress is monitored through a process of receiving feedback, revising the project and presenting the project publicly. Formalizing a process for feedback and revision during a project makes learning meaningful because it emphasizes that creating high-quality products and performances is an important purpose of the endeavour.

Problem-based learning is an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning. Project-based learning can be defined briefly as "a model that organizes learning around

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projects". Even though assigning projects to students in traditional classrooms is not a new phenomenon, project-based learning is quite different from the usual application. There are six major criteria for a method of learning to be called project-based learning:

- project-based learning projects are central, not peripheral to the curriculum,
- project-based learning projects are focused on questions or problems that "drive" students to encounter the central concepts and principles of a discipline,
- projects involve students in a constructive investigation,
- projects are student-driven to some significant degree,
- projects are realistic and focused on real-world problems, and
- projects are conducted in a collaborative setting of multidisciplinary and international nature.

The rapid development of information technologies led to project based learning development, using internet / cloud technologies to support students and lecturers working on PBL. Students are actively involved in PBL through the use of real-world examples, collaboration with peers' process, developing critical thinking and purposing solutions or making products. Essential elements of PBL are summarized on Fig 1. diagram below[1].

[1] Lorin, M. (2013). The Essential Elements of Project Based Learning. [online] Available at: http://www.shsu.edu/centers/project-based-learning/k-12.html

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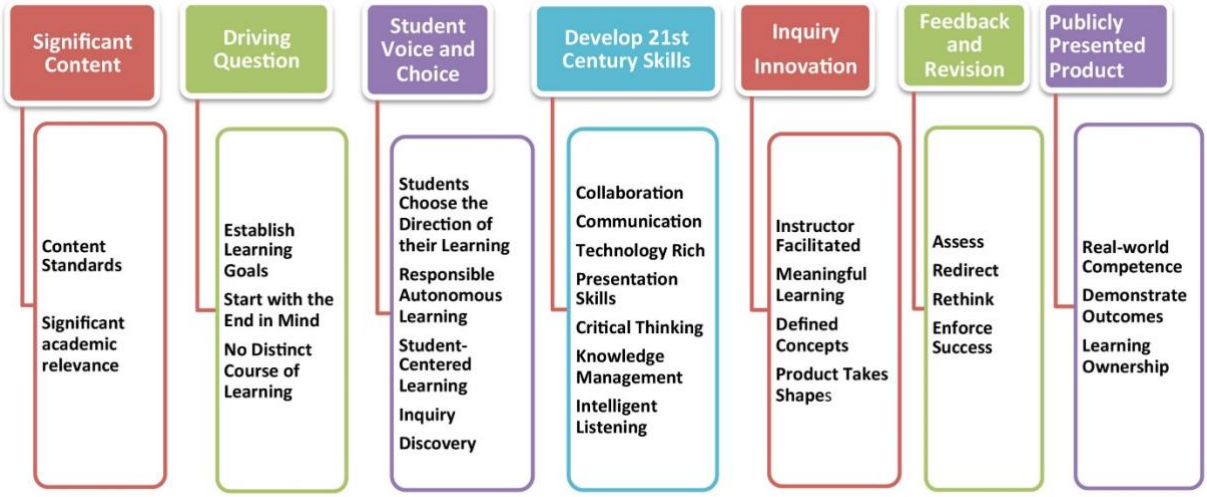

Figure 1 Project based learning

It is worth emphasizing that the 3.5 task is focused on Project-Based Learning, which is often multidisciplinary and longer, and not on Problem Based Learning, whereas is more likely to be a single subject and shorter. Generally, project-based learning follows general steps while problem-based learning provides specific steps. Importantly, project-based learning often involves authentic tasks that solve real-world problems while problem-based learning uses scenarios and cases that are perhaps less related to real life.

2. Summary of Project Based Learning Activities

Project Based Learning activities at EUt+ can be grouped in the following categories:

- embedded in modules with particular focus on community engaged learning and research, e.g., Learning with Communities Programme or Architecture, Collaboration & Society at TU Dublin, Building the Garden of Knowledge at h_da, Virtual Exchange: Youth Entrepreneurship for Society, at CUT,

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- design and build type modules, including students' competitions, e.g. TU Dublin Robosumo or UTCN BattleLab Robotica,
- standard PBL modules, e.g RTU dedicated for Erasmus students, UTCN Electronic Instrumentation or Home Automation and Building Management Systems, UTT Company Datacenter Design or MPLS operator architecture design, CUT Industry Exchange Network (IXN) model or ENGINITE: ENGineering and INdustry Innovative Training for Engineers via PBL
- modules with elements of PBL, e.g., TUS, UTCN, RTU
- national or international competitions, TU Dublin Engineers Without Borders or ESB Inter-Colleges Competition, UTCN Diligent Design Contest Europe

Specific examples of PBL activities are included in the Appendix 1: Examples of Project Based Learning Activities.

3. Project Based Learning Platforms

Existing Virtual Mobility Tool Platforms at EUT+ partner institutions

Task 6.4 provided the identification of shared and common digital tools across EUt+ to build best practice in technologically enhanced and blended learning technologies and techniques. The development of a common position on technology-enhanced and blended learning will be key to the implementation of virtual mobility and the ability of staff and students to communicate and work together at a distance. In the main, seven of the eight partners tend to rely on local rather than cloud-hosted solutions (TU Dublin, the largest university, is primarily cloud-based). There are distinct commonalities in Virtual Learning Environment and associated tools, and all partners use Microsoft as part of their communications and personal productivity suite: however, it should be noted that while seven of the eight partners rely on Microsoft's Cloud solution (Office365), Hochschule Darmstadt

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maintains a local installation due to concerns over GDPR. There is little focus or emphasis on mobile apps across the partners (which is perhaps surprising, given that student web access tends to be via mobile phone), while MOOC development has not featured among six of the eight partners.

See Appendix 2: *Digital, blended and online learning tools* (Deliverable 6.4.1) for detailed information about existing learning tools which can be also used for the PBL learning activities.

Proposed PBL platforms to be tested within the WP3.5:

TELANTO

The cloud-based platform TELANTO (https://telanto.com/how-it-works) is the university-business collaboration platform in which students solve real challenges provided by companies for creative ideas and the ability to hire standout talent. A community of supervised students solve challenges for real-world experience, credits, and job opportunities. TELANTO develops and provides a cloud solution that addresses these issues for a much stronger involvement from the European higher education sector, which consists of around 4,000 higher education institutions (HEIs), 19 million students and 1.5 million academics. Talent shortages within companies continue unabated. The working population is declining, forcing employers to select from shrinking talent pools. Technology is evolving quickly, changing the skills needed for jobs and shortening the life cycle of those skills. To address talent shortages today, businesses cannot fall short to collaborate with academia and in particular with young future talents. Traditional recruitment practices won't yield the required results, so it is time to harness contemporary employer branding, recruiting and selection practices, that build talent relationships very early in the life of a student. Employers need to foster an open innovation and learning culture within their organizations that encourage employees to support their quest for knowledge and talent transfer from academia. Although

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the interface between the public-private sector is already highly interactive and productive, the university-business cooperation lags collaborative technologies that equip youth, while in education, with future skills that match labour market demands. TELANTO estimates that providing challenge-based education, which is increasingly international, multidisciplinary and intersectoral, at larger scale, through TELANTO's Academic Business Network will shorten the school-to-work transition and increase employability for nearly 250.000 students by 2020.

A typical TELANTO process is presented in Fig. 2. below:

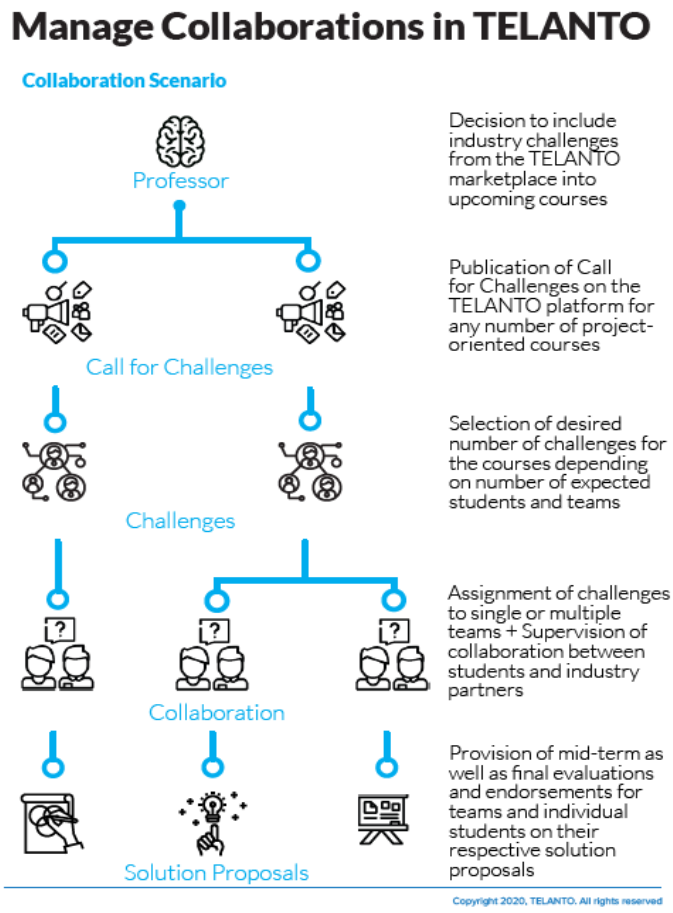

Figure 2 TELANTO platform

A typical timeframe for a PBL module / challenge with collaboration with industry/NGO partners on a TELANTO platform is 14 weeks long which suits a typical academic module – Fig. 3.

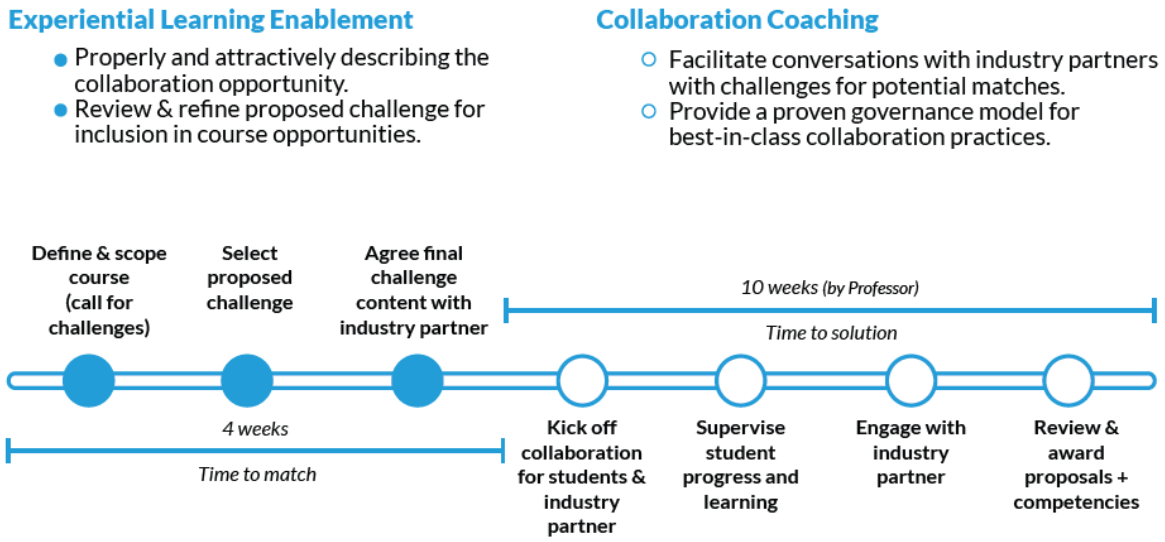

Figure 3 Typical timeframe

UTT Educational Data Center (EDC) (DataCenter Pédagogique)

EDC is a physical computers and networking infrastructure dedicated to full scale teaching experimentation in the wide field of Information Technology IT. Here is a short presentation of what it is, of how it is today useful in UTT, and in the end ideas are given concerning how it could be exploited to compose curriculum proposal in EUT+, through partners' proposals combination.

When the master program « Networking and telecommunications RT» was created in UTT in 2010, IT services production was chosen as one of the three main focuses (two others being « Communications Security » and « Internet of Things »). First investments were decided, and computing servers and storage servers came, allowing real experimentation and culture

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building concerning virtualization and services production in both companies and operators infrastructure. Partnerships were established with one of the main operating systems, Cisco and exploitation software suite editor for data centres: VMware ensuring access to «up to date » systems, the most recent hypervisors and the most recent networking technology like Cisco Software Defined Networking.

The EDC is now 350Ghz of CPU strength, 3 To RAM and 20 To of mass storage. Networking equipment ensure data transfer and is also a place where new paradigms for networking automation is explored. It is scaled to satisfy activities of about 300 hundred students enrolled in the program by remote access, both for synchronised and also free access activities. UTT strongly supports EDC with an engineer dedicated to its exploitation.

The EDC is a full-scale tool to be studied to go further in virtualization, services production, automation of production, and networking. It gives both professors and students a powerful tool to strengthen knowledge and practice « how to do ». It is an ideal support for EUt+ project-based teaching because of free remote access, and flexibility of software production which make it possible to let run several hundreds of heavy virtual machines at the same time.

The use of the EDC is today focused on UTT's Telecommunications program's pedagogical needs. These activities may be seen as ingredients of wider application domains. For example Internet of Things (IoT) is today one of the main motivators for internet traffic growth, and is an application domain where innovation is very strong in multiple sectors: medical, supply chains, energy management, complex system instrumentation, smart cities, environmental protection, etc. The technical capabilities of the EDC also support innovation and entrepreneurship amongst students.

Knowing this, it would be possible to compose a shared curriculum, or part of, with the EUt+ partners though the evolution of already existing modules, with the idea of « putting together what we have best ».

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4. Implementation plan - EU+ Virtual Mobility Tool

Stages of Implementation

The five PBL stages of implementation proposed by Butvilas et. al. 2016[2] (see Fig. 4 and 5. below) were adapted in this task.

No	Stage	Description of the stage
1	Decision	The managerial decision has to be made by the higher education institution administration and teaching staff
2	Preparation	During the preparation phase, some organizational changes are also foreseen. The main goal remains involving the business sector (i.e. social partners) in a more active manner
3	The integration of PBL into study curricula	In order to integrate PBL, the program committee revises the existing study programs. Eventually, the committee decides to move some of the programs to the modular structure of curricula. Thus, such a decision allows PBL to become a part of the study process in each semester.
4	*Business sector involvement*	It has to be stressed that this is one of the toughest stages. The implementation of PBL requires a lot of effort in order to show the business sector that this is a learning process, not a free labor force created especially for commercial purposes
5	*The preparation of teaching staff*	At this stage, the preparation and organization of original training courses for lecturers is required

Figure 4: five PBL stages

[2] Butvilas, T., Butvilienė, J., Vasilienė-Vasiliauskienė, V. & Vasilis Vasiliauskas, A. (2016). Education and business through project-based learning: A college case description. In: Aholaakko T., Komulainen K., Majakulma A. & Niinistö-Sivuranta S. (Eds.) 2016. Crossing Borders and Creating Future Competences. Laurea: Laurea-Ammattikorkeakoulu

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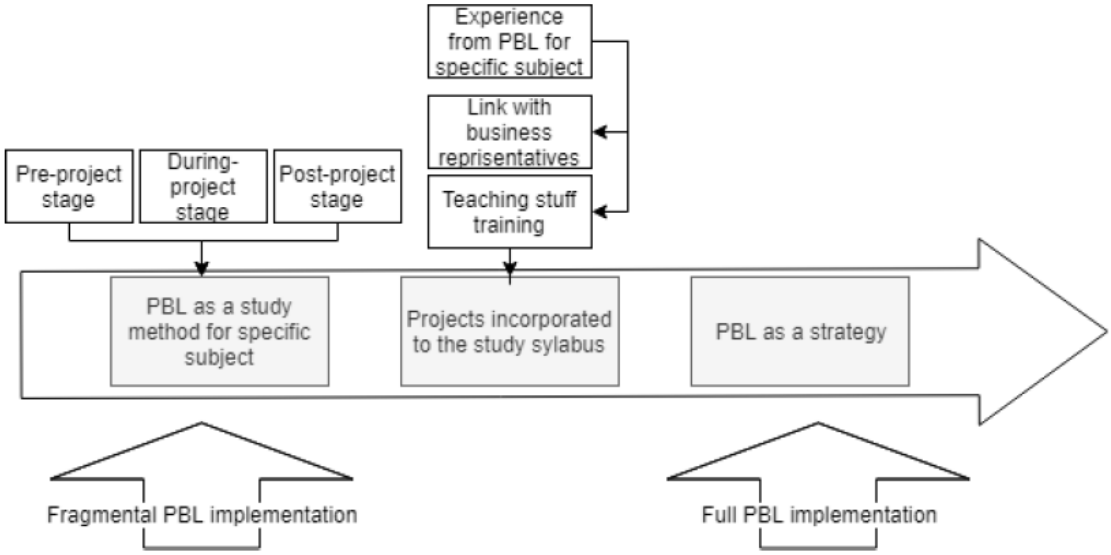

Figure 5 PBL stages

The implementation of the EU+ Virtual Mobility Tool is organized in three phases over the calendar for the following academic years: 2021-2022 & 2022-2023 in line with the above stages of PBL implementation using two proposed on-line platforms: TELANTO and Educational Data Center (EDC) at UTT.:

- Preparation Phase Feb 2022 – July 2022,
- Pilot Phase Sep 2022 – Dec 2022
- Roll-out Phase Feb 2023 – June 2023

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The EU+ Virtual Mobility Tool plan:

Month/Year	Activity Name	Objective/Planed activities	Responsible persons/ Participants	Inputs	Outputs	Status
Preparation Phase Feb 2022 – July 2022						
Feb/ Mar 2022	Meetings with representatives of 3 EUt+ Bachelor and Master Degrees Clusters Demonstration sessions of TELANTO/EDC PBL platforms	- increase awareness of two PBL platforms: TELANTO and EDC among EUt+ lecturers - explore how these two platforms might be incorporated into existing modules or potentially into new modules, including CPD or Vertically Integrated Project (VIP) modules with the PBL approach - demonstrate functionality & characteristics of two proposed PBL platforms: TELANTO and EDC to EUt+ lecturers, - initial feedback about the benefit of these platforms and how they might be used by lecturers	- Task 3.5 representatives / Clusters representatives - lecturers interested and/or involved in PBL also outside current 3 EUt+ Clusters, e.g. Business, Architecture	- information leaflets and presentations about TELANTO and EDC - agenda and list of participants - invitations to lecturers / agree on the most suitable dates/time slots, - agenda and list of participants	- agree on demonstration sessions for potential users of PBL platforms - notes from the meeting - feedback from participants - notes from demonstration sessions	
Mar 2022	TELANTO/EDC champions	- each EUt+ partner institution identify at least one bachelor or master program lecturer per PBL platform (TELANTO or EDC)	- Task 3.5 representatives - Clusters representatives	- information leaflets and meetings with lecturers	- Names & email list of all lecturers who will be involved in the	

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		and invite them to participate in the pilot phase in Sept – Dec 2022-			pilot phase of PBL platforms in Sept – Dec 2022	
April 2022	Involvement of EUt+ industry/NGO/ local community partners	- discuss with EUt+ industry/NGO partners their potential involvement in PBL type modules using TELANTO and EDC platforms - explore a potential EUt+ SDGs challenge competition or other national/international competitions with industry/NGO / local community partners using PBL platforms	- Task 3.5 representatives - lecturers	- information leaflets and meetings with potentially interested industry/ NGO/ community partners	- list of industry/NGO/ local community partners interested in taking part in the pilot phase or EUt+ challenge competition	
Apr/- Jun 2022	PBL platforms training sessions	- schedule and complete 2-3 training sessions of two PBL platforms (TELANTO and EDC) for lecturers / PBL champions	- coordinators of TELANTO and EDC platforms - lecturers who will be involved in the pilot phase - potential industry/NGO representatives	- agreed schedule of training sessions	- feedback after training sessions	
Apr/ Jun 2022	Development and approval of module descriptors with two PBL platforms for the pilot phase	- two PBL platforms (TELANTO and EDC) incorporated into existing modules as learning platforms and potentially into new modules, including Continues Professional Development (CPD) or Vertically Integrated Project (VIP) modules with the PBL approach	- coordinators of TELANTO and EDC platforms - lecturers who will be involved in the pilot phase with help of partner institutions QA committees	- existing module descriptors within 3 EUt+ clusters and other programmes, - meetings with QA committees in partner institutions	- existing module descriptors approved for using two PBL platforms in the pilot phase - new PBL type module descriptor approved and arrangements for its	

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				- development of new PBL type module descriptor which can be approved by all partners and might be taken by all students not only Erasmus+ ones.	implementation agreed, e.g. fee issue, access to learning resources.	
Jun 2022	Evaluation of the preparation phase	- evaluate the preparation phase of two PBL platforms (TELANTO and EDC)	- WP3.5 representatives, - coordinators of TELANTO and EDC platforms - lecturers who will be involved in the pilot phase - potential industry/NGO / community representatives	- preparation phase report - agenda and list of participants - feedback questionnaire platform	- feedback summary on the preparation phase - recommendations for further improvements	

Pilot Phase Sep 2022 – Dec 2022					
Sep/ Dec 2022	Pilot Phase Implementation	- deliver at least one module (existing one or new one) in each EUt+ partner institution using two PBL platforms	WP3.5 representatives, - coordinators of TELANTO and EDC platforms - EUt+ Erasmus students or students who can take EUt+	- list of modules - list of lecturers - list of participating students	- modules successfully delivered

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		- deliver EUt+ SDGs competition or other national/international competitions on the TELANTO or EDC platforms	PBL common module at home institutions - lecturers who will be involved in the pilot phase - potential industry/NGO / community representatives		
Jan 2023	Feedback from all participants	All participants in the program provide feedback using a dedicated questionnaire platform. The data are collected and analyzed by Task 3.5 representatives from each university.	- students from partner university - lecturers and administrative staff that participated in the pilot program	- feedback forms for students - feedback forms for lecturers and support staff	- feedback report from the participating students/lecturers /support staff
Jan 2023	Evaluation of the pilot phase	- evaluate the pilot phase of modules based on two PBL platforms (TELANTO and EDC)	- WP3.5 representatives, - lecturers who will be involved in the pilot phase - potential industry/NGO / community representatives	- pilot phase report - agenda and list of participants - feedback questionnaire results	- feedback summary on the pilot phase - recommendations for further improvements in the roll-out phase

Roll-out Phase Feb 2023 – June 2023					
Feb/ Jun 2023	Roll-out Phase Implementation	- deliver at least 2-3 modules (existing ones or new ones) in each EUt+ partner institution using two PBL platforms	WP3.5 representatives, - coordinators of TELANTO and EDC platforms	- list of modules - list of lecturers - list of participating students	- modules successfully delivered

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		- deliver EUt+ SDGs competition or other national/international competitions on the TELANTO or EDC platforms	- EUt+ Erasmus students or students who can take EUt+ PBL common module at home institutions - lecturers who will be involved in the pilot phase - potential industry/NGO / community representatives		
Jun 2023	Feedback from all participants	All participants in the program provide feedback using a dedicated questionnaire platform. The data are collected and analyzed by Task 3.5 representatives from each university.	- students from partner university - lecturers and administrative staff that participated in the pilot program	- feedback forms for students - feedback forms for lecturers and administrative staff	- feedback report from the participating students/lecturers /support staff
Jun/ Oct 2023	EUt+ Virtual Mobility Tool Final Report	- 2 evaluation meetings of the EUt+ virtual mobility tools based on two PBL platforms (TELANTO and EDC)	- WP3.5 representatives - WP3 leader / representatives	- draft of the final report - agenda of meetings and list of participants	- the final report and recommendations approved

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5. Discussion and next steps

As described above, task 3.5 plan the implementation of the EU+ Virtual Mobility Tool in three phases: Preparation Phase Feb 2022 – July 2022, Pilot Phase Sep 2022 – Dec 2022 and Roll-out Phase Feb 2023 – June 2023 using two proposed on-line platforms: TELANTO and Educational Data Center (EDC).

In the implementation of this task, the following areas should be considered:

- indentification bachelor or master program professors from ideally each EUt+ partner who would like to participate in the pilot phase,
- provision of an appropiate training and support for staff/ professors prior and during the delivery of their modules,
- development of a common EUt+ PBL module which will be open for all students not only those who are on a physical moblity
- organisation of a EUt+ PBL competition which can be deployed for all EUt+ students

Further discussion and evaluation of both the Telanto platform and the UTT EDC is required in order to move forward with this plan.

6. Conclusion

EUt+ partners have extensive and varied experience of organising project-based activities which can be positively applied in the on-going work of task 3.5 and help to ensure its success.

TU Dublin has an award-winning programme ‘Students learning with communities’ and a collaboration with EWB Ireland and the Development Technology with the Community Research Group on the design competition, ‘Where there is no Engineer ‘. RTU have a number

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of course advancing project and problem-based learning and TUCN two PBL student competitions; The 'Diligent Design Contest Europe' and 'BattleLab Robotica'.

TUS typically include project-based learning in their bachelor's and master's degree courses as do h_da, in their Media department. One example is the '*Building the Garden of Knowledge'* with students of the study programs Expanded Realities and Expanded Media. The idea was to use Augmented Reality technologies to enhance the real campus. As well as the EDC, UTT has a MindLab which fosters innovation and entrepreneurship skills through the development of student projects. CUT's project ENGINITE: ENGineering and INdustry Innovative Training for Engineers aimed to design and promote a postgraduate Vocational Education and Training (VET) programme based on a Problem Based Learning (PBL) pedagogy.

All these programmes are detailed in the annexes of this deliverable. They share a similar aim: to teach the students skills such as working in teams, organizing projects, solving problems on their way, writing concepts, designing interfaces, applying and implementing various technologies.

Task 3.5 will continue to meet to discuss the different elements of the EU+ Virtual Mobility Tool from February 2022 with the aim of entering the pilot phase by the end of 2022 for an eventual roll-out in 2023 using the two proposed on-line platforms: TELANTO and UTT's Educational Data Center (EDC). The successful launch of these initiatives will depend on the implication of teaching staff/ professors to guide students and the engagement of the students themselves. The main efforts in coming months will be focused on adequate support and training for lecturers who would like to participate in the PBL pilot phase planned for the first semester of the next academic year.

Appendices

Appendix 1: Examples of Project Based Learning Activities

Technological University Dublin (TU Dublin)

The award-winning Programme for Students Learning With Communities supports staff, students and community partners to engage in community-engaged learning and research (also known as service-learning, community-based research, or Science Shop) across TU Dublin City Centre campus. Students Learning With Communities involves TU Dublin City Campus staff and/or students collaborating with underserved community partners (local groups, not-for-profit organisations, charities etc) to develop real-life projects for mutual benefit. Learning comes alive for the students as they work on these projects with community partners, developing professional transferable skills, and enhancing their understanding of their specialist subject skills and of the community they work with. Students receive course credits for their work, as these projects are embedded into their studies. Community partners become part of the teaching process through the collaboration, contributing their knowledge and expertise, and increasing the relevance of TU Dublin research and programmes of study. The processes and outcomes of the collaborative projects are designed to further the community's goals. These projects give all participants the opportunity to engage in critical thinking, and ultimately aim to energise participants to work for social change.

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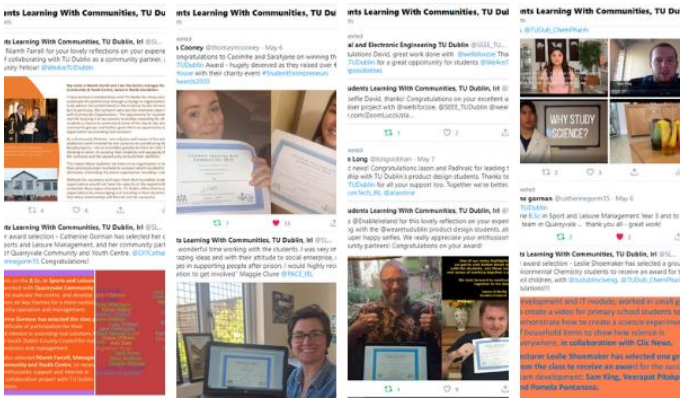
The Programme has supported projects involving over 12,000 students in collaboration with well over 100 Community Partners, since it started in 2008. Approximately 1 in 3 TU Dublin City Centre undergraduate programmes offer students opportunities to become involved in collaborative projects with communities.



https://www.tudublin.ie/connect/communities/slwc
https://screencast-o-matic.com/watch/crh16kVeWP8

"Where There Is No Engineer – Designing for Community Resilience" is a collaboration between EWB Ireland and the Development Technology in the Community (DTC) Research Group within TU Dublin. The program brings the world into the classroom to re-imagine the way we teach engineering. Each year we develop a set of design briefs with our development partners around the world, based on the real-life challenges faced by communities within a specific country. Students are challenged to innovate and develop solutions and products which are appropriate to the people and the environment. Student teams participate in interactive workshops to design, build and test their concepts. The best teams showcase their innovations at a National Final, where the winning team is sponsored by Davies Ltd. to travel to the selected country to work with the community. The EWB innovation academy also works

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with a number of teams to develop their concepts. The initiative is supported by a range of flexible learning resources which empower lecturers to challenge the next generation of engineers to be problem solvers and innovators and to contribute in a practical way towards achieving the UN Sustainable Development Goals (SDGs).

The design brief is based on a set of six global development themes, each linked to the UN SDGs:

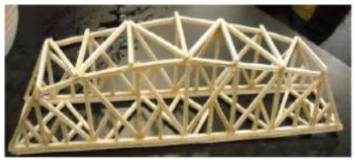
- Climate Resilient Infrastructure
- Self-Supply Water and Sanitation
- Community Participatory Health
- On and Off (Micro) Grid Energy Systems
- Food Security
- Applying Big Data in the Community

Design of Intervention

'Design a pedestrian bridge to span 5m across a river for use in emergency situations in Nairobi'

Design of Intervention

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Form Team	Research	Analyse	Presentation	Build	Test



https://ewb-ireland.org

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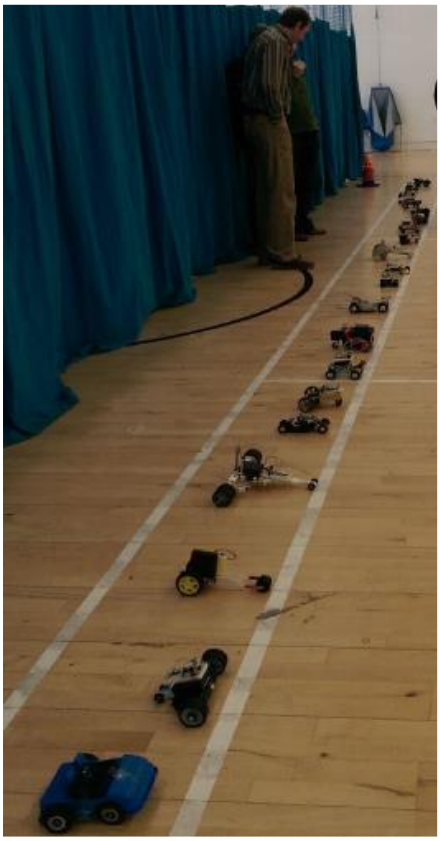
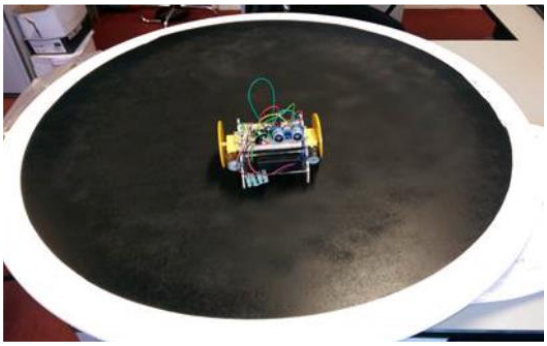
Programme: Engineering (General Entry), Award: Bachelor of Engineering (Hons), Module: Design Projects, Robosumo - Project description

Over the course of one semester, students work in teams of (usually) three to design and build a robot that will compete in a RoboSumo tournament. The tournament consists of a series of bouts in which two robots at a time compete to push each other off a table (thearena). The tournament rules (together with a small number of additional local rules) impose constraints on the cost, weight, physical dimensions and various other elements of the robot design. It is up to each team to improvise within the specified constraints to produce the most competitive robot they can.





RoboSumo ring. This figure shows the RoboSumo kit used for the Engineering Society competition. The RoboSumo kit has been developed by the RoboSumo staff at TU Dublin. The ring is called a Dohyo. Inside the ring a sumo robot waits to do battle

Robot Race Line-up. This figure shows the beginning of the robot race where all robots line-up and are inspected by race judges. https://arrow.tudublin.ie/heit162/12/

Design Build Studio under the umbrella of the Options Elective (OE) module: Architecture, Collaboration & Society.

Two built projects resulted from this module:

- 'Moore than a Stall' (2019), a prototype for a market stall in collaboration with the Moore Street Action Group.
- 'Crossframe Pavilion' (2018), a covered bench with tables, and external planters for growing flowers, herbs, and vegetables constructed in St Mary's Secondary School in Glasnevin. It was a result of collaboration with the School's transition year students and Zl-Holzbau carpentry-joinery training centre in Biberach, Germany. The project was part of the Irish Architecture Foundation (IAF) National Architects in Schools Initiative (NAISI).

From the pedagogic perspective, the main advantages of carrying out live, design build projects lie in exposing the students to the life-like work environment with real client (community group) and to the problems of construction. Both significantly change the group work dynamic and contribute to better understanding of realities of the profession.

ESB Inter-Colleges Competition

A team representing TU Dublin recently competed in the ESB Competition which took place virtually in November 2020. A team of two Mechanical Engineering Students along with two students from the College of Business represented TU Dublin in the ESB. The challenge presented to the teams was the Decarburization of the Transport systems in Ireland, making Hydrogen the centre of the fuel and energy of the Irish economy. The TU Dublin group researched and

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presented a highly innovative solution to the aerospace industry addressing the Key problem Statement - To develop a green hydrogen transport system to aid in the pursuit of the ESB's goal of zero carbon emissions by 2030.

The students identified the key transport polluters in Ireland and developed a detailed Technical, Marketing, Commercial, Financial and implementation plan. The science was advanced and innovative; the commercial plan was sound with opportunities for growth and the potential job creation for Ireland was world-class, leading to a win-win situation for the economy and meeting CO2 reduction targets.

https://www.tudublin.ie/explore/news/tu-dublin-team-take-on-esb-inter-colleges-competition-2020.html

Riga Technical University (RTU)

There are two PBL modules. The modules are mainly offered for Erasmus students.

- Economics students: https://international.rtu.lv/wp-content/uploads/sites/65/2021/01/ERASMUS-module-autumn.pdf
- Architecture students: https://fsd.rtu.lv/wpcontent/uploads/sites/65/2020/04/Spring_provisional_FACULTY-OF-ARCHITECTURE.pdf

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Main function of these modules is to ensure that courses will not overlap. Also, the module system ensures that Erasmus students get enough credit points (18-25 ECTS).

A short list of courses, which are advancing project/problem-based learning methods:

- ***Portfolio Management: https://stud.rtu.lv/rtu/discpub/oe.31093***
- ***Research Project in Business Finance: https://stud.rtu.lv/rtu/discpub/oe.31114***
- ***Contemporary Problems of Strategic Management and Marketing: https://stud.rtu.lv/rtu/discpub/oe.17265***
- ***Strategic Financial Management: https://stud.rtu.lv/rtu/discpub/oe.31112***
- ***Aircraft Maintenance and its Technical Management: https://stud.rtu.lv/rtu/discpub/oe.14481***
- ***Design Automation of Machines: https://stud.rtu.lv/rtu/discpub/oe.12749***
- ***Applied Continuum Theory: https://stud.rtu.lv/rtu/discpub/oe.14047***
- ***Manufacturing Plant Design: https://stud.rtu.lv/rtu/discpub/oe.32427***
- ***Knowledge Management: https://stud.rtu.lv/rtu/discpub/oe.9682***
- ***Calculation of Traction Performance (studies project): https://stud.rtu.lv/rtu/discpub/oe.18027***

Technical University of Cluj-Napoca (TUCN)

Electronic Instrumentation, in the laboratory/field works, at the Faculty of Electrical Engineering. Last semester (2020) on Microsoft Teams.

Home Automation and Building Management Systems, as a “pilot-project”, at the Faculty of Installation on Microsoft Teams from 2021, second semester, 1st year Master degree.

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In each class, the students (alone or in teams of two) have to realize a complete functional project, related to course material (starting from idea, conceptualization, project work and implementation), and to present the final result in front of their colleagues.

Within TUCN there are two PBL student competitions.

1. Digilent Design Contest Europe, in Cluj-Napoca, Romania

It is organized by Digilent Romania in co-operation with Digilent Inc. (USA) and the Technical University of Cluj-Napoca, Faculty of Electronics, Telecommunications and Information Technology, Department of Applied Electronics. So far, there were 15 editions (until 2019, the 2020 edition was postponed due to Covid pandemics). The Digilent Design Contest is an international contest open to all students studying in a technical school, college, university, or other educational institution. The contest provides an opportunity for students to present their work and receive feedback from international industry representatives.

Teams of students (up to three members) from universities all over Europe are invited to put in practice their ideas. Teams will have approximately 5 months to design and implement a project of their choice and present the final version during the contest finals (projects defending and award ceremony) held in Cluj-Napoca, at the Digilent Romania Office.

The competition aims to encourage creativity, originality and increase their mobilization in the implementation of projects of high complexity.

Enrolled students receive as donation the Digilent hardware platforms (FPGA systems, Pmods and accessories) and develop their own projects, to present in the final stage (oral, practical demonstration and documentation). Only the teams that are defending the projects can keep the hardware platforms, regardless of the final ranking.

The jury is composed of top international industry representatives. The best projects are rewarded with consistent prizes. Finalists are published on the contest site: www.digilentdesigncontest.com. The previous editions of the contest included students from

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Romania, Hungary, Poland, Czech Republic, Finland, Switzerland, Germany, United Kingdom, Greece, Turkey, France, Italy, Estonia and Serbia.

2. BattleLab Robotica

The BattleLab Robotica phenomenon is the result of the collaboration between the Faculty of Electrical Engineering within the Technical University of Cluj-Napoca and BEST (Board of European Students of Technology) Cluj-Napoca, which joined forces to create a unique event in Cluj-Napoca, an international robotics sumo contest. The theme of the competition is the implementation of autonomous sumo-robots, able to identify and eliminate the opposing robot from the playing surface. This concept appeared in the late '80s in Japan, as an attempt to combine tradition with technology. The phenomenon is constantly growing, evolving from robots covered in wood and plastic to real demonstrations of the latest technologies.

So far, there were 9 editions (until 2019, the 2020 edition was postponed due to Covid pandemics). The contest is addressed to all students from technical universities in Romania and around the world, eager to exploit their creativity, team spirit or passion for the technical field.

The theme of the competition is the implementation of autonomous sumo robots, able to identify and eliminate from the playing surface the opposing robot in "1 to 1" type competitions.

The contest is addressed to all students from the Technical University of Cluj-Napoca and from technical universities in the world, regardless of the specialization or year of study from which they are part of. Former students who have already participated in previous editions of the contest are also admitted. Into the teams from outside Romania are also admitted members who are not students. Teams are allowed up to 4 students and the

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competition respects the international rules of robotic sumo in terms of the dimensions of the playing surface and the rules of development and commitment.

Robots will have to comply with the constructive provisions of the middle class (total weight: maximum 3kg, dimensions 20 x 20 cm, without height limit). A match is played between two teams, each team having up to 4 competitors. A single team member can approach the competition area, the other members must watch from public. According to the rules of the game, each team competes on a Dohyo (playing surface) with an autonomous robot built by them in accordance with the specifications presented in the regulation of the competition.

Technical University of Sofia (TUS)

There are project-based subjects and course works at TUS:

- for bachelor degree (8 semesters) there are 4 subjects - from 4 to 7 semesters per project. They are assessed with a separate assessment, have 2 or 3 ECTS credits and extracurricular hours (self-preparation) for 60 or 90 hours.
- there are no exact requirements for a master degree, but almost all curricula have 1 project per semester.
- In addition to course projects in the curricula there are also project tasks that are not assessed separately but are part of the assessment in each discipline.

University of Technology of Troyes (UTT)

Example 1: Company Datacenter Design

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In this project, students have to design a company datacenter in order to deliver information system services. The aim is the datacenter design, building and exploitation, all three depending on the nature of information system services that are to be delivered. Example of context may be basic information system services (DNS, LDAP directory, web services, etc…), database system, IoT services.

Students have to use their know-how and skills to explore :

- Basics of networking : Ethernet, IP, Virtual LANs
- Advanced networking : management structure, different types of fabric (Ethernet, VXLAN), specialized protocols (iSCSI), specialized forwardong strategies (Q in Q, tunnels)
- Basics of operating system prerogatives
- Advanced operating system prerogatives : virtualization, hypervisor, storage specialized operating systems
- Datacenter architecture : ressource dimensioning, servers composition and interconnection, network design (for servers interconnection, datacenter administration including remote access, and services delivery)
- Datacenter exploitation : ressource allocation including dynamicity management, high availability, crash recovery tools, services instrumentation and monitoring, multi-site datacenter exploitation

Other aspects of project management are also there: relationship with the client, team animation and working load sharing, time and delay management, reporting, cost dimensionning, performance proof and load testing, transfer of expertise, etc…

Until today, this activities were lead and proposed to the students in two different forms : classroom training project in variable sized groups of students (typically two or three), with

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free physical access to the equipments, and limited time (typically four sessions of four hours each, in the presence of the professor), and « supervised project » (two students) with internet remote access to dedicated ressource, with fixed due date and appointment with professor scheduling.

The physical resource is a datacenter itself (in which students experiment the construction of datacenters : « nested datacenter »). It is today composed of physical equipments exclusively dedicated to pedagogical activities. Remote internet access is available, making possible for the students to work anytime, wherever they physically are. UTT financial investments, founding partnership with cisco and vmware companies, and UTT support with attribution of a system administrator engineer whose job is to maintain this datacenter and give the ressources to the students, make together a very confortable and efficient platform for project based learning.

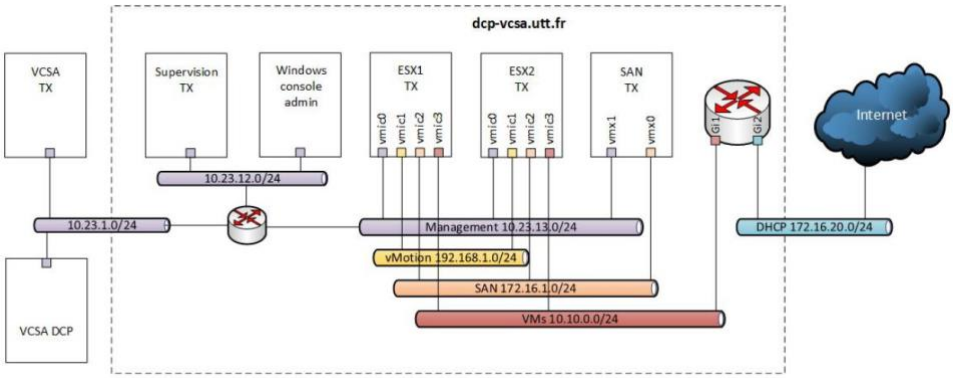
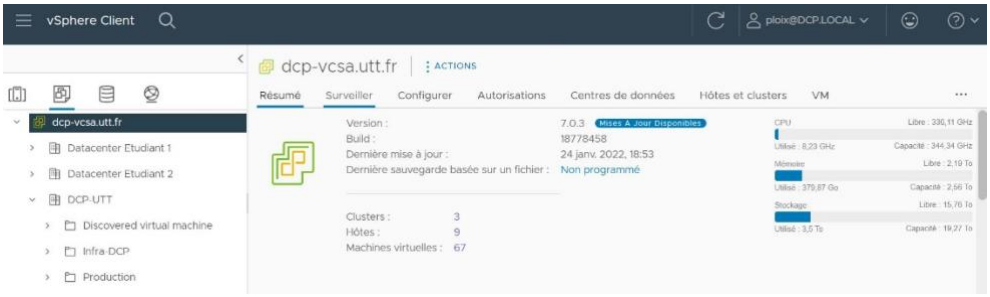


Figure 6 Example of student datacenter architecture



Example of creation of student datacenter in vmware management tool

Figure 7 Example of grafana dashboard, showing supervision of a student datacenter

Example 2: MPLS operator architecture design

In this project, students have to design an operator IPv4 backbone, in order to deliver interconnection and Internet access services. Knowledge abilities and know-how concerned are:

- Basics of networking : Ethernet, IP, Virtual LANs

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- Advanced networking : management structure, forwarding structure, and the dependance between the two
- Definition of a new need and service : non routable IPv4 private packet transportation
- Definition of isolation tools : Virtual Routing and Forwarding creation
- Design of control structure : LDP and MP-iBGP
- Design of forwarding strategy : double MPLS encapsulation
- Scaling issues : definition of deployment strategy
- Project leading, time constraint respect, delivery documents redaction, etc.

Again, Educational DataCenter (EDC), available in UTT make it possible for the students to work « in project mode », with no obligation to be physically in UTT and even not all participants at the same place. Variable kinds of support is possible, depending of students level and objectives.

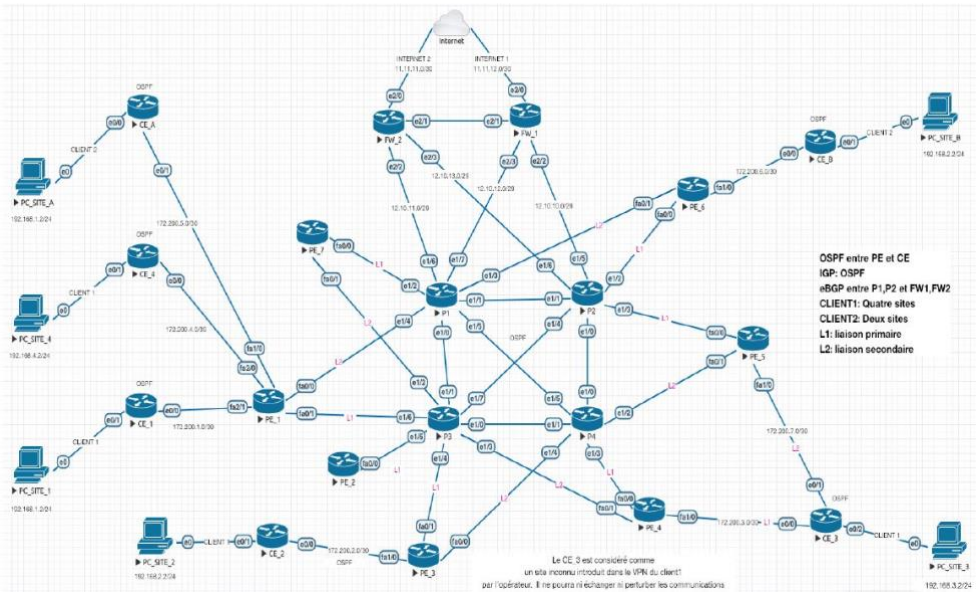

Figure 8 Example of operator MPLS backbone architecture result of students project

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Hochschule Darmstadt, Darmstadt University of Applied Sciences (h_da)

Examples from the Media department

In nearly all study programs of the Media department project-based learning is a central part of the semester. Students work in groups on tasks and projects with partners from companies, social affairs, and other organizations. Often 3rd mission or Service Learning activities are the focus. The main aim is to teach the students skills such as working in teams, organizing projects, solving problems on their way, writing concepts, designing interfaces, applying and implementing various media technologies. Coaching and input sessions are guiding the students on their way to the final project results.

Here are some examples:

Example 1: Building the Garden of Knowledge

Paul Grimm, Philip Hausmeier, Claudia Söller-Eckert, Georg Struck with students of the study programs Expanded Realities and Expanded Media

The task was to build a rememberable application to support the onboarding to our university. The idea was to use Augmented Reality technologies to enhance the real campus. A group of 20 students worked together on this project for one semester. They have had input sessions about the requirements, the context of the application, ideation, concept, technology, project management, and more. Mainly organized in three phases the group of students found the idea of the main concept, build a first prototype based on a more detailed concept, and finally set up the final presentation.

Some of the results were shown at the h-da premiere in October 2021: https://youtu.be/6DzIcpoJNZM?t=7526

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Example 2: The big online party on May 23, 2019: Basic Law with a difference!

Thomas Pleil, Lars Rademacher, Martin Wessner, Pia Sue Helferich, and external colleagues with students of the study program online communication

The students work in this study program in so-called learning agencies and develop, for example, marketing concepts, learning units, or PR strategies. In this example, 60 students in the fourth semester have undertaken PR campaigns for the 2019 summer semester. 13 campaigns from the 4th-semester learning agency are causing a sensation on Instagram and Twitter. On the occasion of the 70th anniversary of the Basic Law for the Federal Republic of Germany, the students dealt with the question of how the outdated topic of "fundamental rights" can be communicated in a fresh and inspiring way. Their approach: an interactive online party on Instagram for the birthday of fundamental rights on May 23, 2019, as well as networked campaigning, to increase reach.

This course resulted in 13 campaigns related to the Basic Law, 115,000 impressions on Twitter, and 50,800 on Instagram.

Cyprus University of Technology (CUT)

Example 1: Virtual Exchange: Youth Entrepreneurship for Society

The aim of this practice was to provide Internationalization at Home (IaH) and civic engagement opportunities to students. The practice has been applied in many educational contexts with well documented success in enhancing students' intercultural, linguistic, as well as a number of transversal skills. Three virtual exchange projects were implemented at the Cyprus University of Technology between 2015-2018. The projects engaged first-year students of CUT in sustainable interaction over the period of one semester in each project with students at the university of Valencia in Spain studying similar degrees. Within the framework of the exchanges which were facilitated by academic staff, the students interacted in computer-

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mediated environments using English as a lingua franca, engaged in intercultural dialogue, and co-constructed digital artifacts relevant to current social challenges while receiving mentorship from local NGOs.

Key achievements of the virtual exchange projects implemented for three consecutive years include the enhancement of students' cultural awareness, particularly of the CUT students who study at a highly monolingual and monocultural educational institution. The projects contributed towards the internationalization at home of the students who might lack the opportunities to become mobile across Europe or elsewhere for various reasons. The virtual exchange projects optimized virtual mobility through computer-mediated sustained rich interaction and constructive collaboration, embedded in students' regular academic curricula. As virtual exchange involved stakeholders from the society (NGOs, volunteer groups) in both contexts apart from the students, it also optimized students' civic engagement through the collaborative pursuit of solutions to current social problems relevant to the Sustainable Development Goals (SDGs).

Example 2: Greek Foundation Course for African Students

Intensive Greek Language and Culture Course for Foreign Students

The aim of this good practice is to give to third country nationals the opportunity to learn the Greek language and get an adequate knowledge of the culture of Cyprus in order to be able to live in Cyprus and study at the Cyprus University of Technology. The course also aims at developing communicative skills both in oral and written speech, raising awareness regarding intercultural issues, promoting collaboration in language learning and enhancing the use of basic and emerging technologies in education. The students participating at this course have zero knowledge of the Greek language. The course consists of 650 hours (two semesters) of teaching the Greek Language as well as the culture of Cyprus aiming at a smoother adaptation to their new life inside and outside the university. Moreover, the language lessons

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are tailored to meet the needs of their specific field of study (Greek for Nursing or Greek for Agricultural Studies). After the completion of the course, the participants begin to study at the CUT, where the language of instructions is Greek. The course has been running since 2010 having now a number of graduates as well as undergraduate students.

Example 3: Industry Exchange Network (IXN) model

The aim of this practice is to support industry engagement during the development of university projects. The practice concerns the fields of Informatics and New Media and Technology, focusing on the two-way opportunity for CUT students to participate in and develop projects for the industry and other sectors. Specifically, undergraduate, and postgraduate students are able to take an active role in technology-driven projects which are within the scope of interest of the CUT. The model aims to develop students' understanding and authentic experience gained through external collaborations and real interdisciplinary applications, combined with a robust and well-structured program of studies. In effect, undergraduate and postgraduate students are given a significant opportunity to acquire a tailored experience in various industry areas, while enhancing their future career prospects. The model will be applied as part of an initial pilot implementation in specific study programs at CUT as of September 2021.

Example 4: ENGINITE: ENGineering and INdustry Innovative Training for Engineers via PBL

ENGINITE aimed to design and promote a postgraduate Vocational Education and Training (VET) programme based on a Problem Based Learning (PBL) pedagogy. ENGINITE combined advanced applied academic topics with hands-on aspects, in order to endorse the knowledge and skills of graduate engineers, preparing them for the industry of the 21st century. Via a PBL approach to training, ENGINITE captivated the career and employability skills of the new engineers (innovation, entrepreneurial skills, efficient quality, health and safety management, problem-solving, communication and presentation skills), while it

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enhanced technical knowledge in critical fields of engineering. Upon the completion of the postgraduate VET programme, participants entered the labor market.

ENGINITE was addressed to graduate engineers with a degree in biochemical, chemical, electrical, electronic, environmental, food, industrial, mechanical, petroleum, safety engineering and/or of a relevant field. Eligible will also be Chemists and Food Technicians graduates. In particular the target group includes: (a) Graduate Engineers, who seek for a job and/or who wish to follow a post graduate/VET programme; (b) Junior Engineers, who are partly-employed and/or working in a different field and wish to follow a post-graduate/VET programme.

Key Achievements:

> 35+ students benefited from the ENGINITE pilots; Most of them were unemployed or part-time engineers, who earned a position in the company of their placement thanks to ENGINITE.

> 20+ companies in Cyprus and Greece took part in the ENGINITE training programme and reinforced their staff with trained young engineers.

> Educational content for eight unique courses (technical and soft skills) typically missing from engineering programmes.

> A Handbook for PBL/VET methodology.

> Specifications of a complete programme for successful training and placement in the industry.

> 400+ unique users interacted with the ENGINITE online platform during the project.

> 3000+ engineers and other relevant stakeholders were reached through our dissemination and communication activities.

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Appendix 2: *Digital, blended and online learning tools* (From deliverable 6.4.1)

7 Full institutional profiles (Summer 2021)									
Common Digital Tools	**TU Carthegena**	**TU Cluj-Napoca**	**Cyprus UT**	**Hochschule Darmstadt**	**TU Dublin**	**Riga TU**	**TU Sofia**	**UT Troyes**	Comment/ Summary
Students (90,075)	6,500	22,000	3,000	15,000	29,700	14,000	9,419	3,056	
Academic staff (6,735)	600	1,400	500	340	1,500	1,043	889	463	
Virtual Learning Environment	Moodle (Local, moving to cloud hosted)	Moodle (L) MS Teams	Moodle (L)	Moodle (L)	Brightspace (Cloud) Moodle (Cloud)	Moodle (L)	Moodle (L)	Moodle (L)	Moodle (L)
Webinar	MS Teams	MS Teams	Big Blue Button Zoom	Big Blue Button Zoom	Bongo Adobe Connect MS Teams	Zoom	MS Teams Google Meet Big Blue Button	Zoom	MS Teams Zoom BBB
Assessment	Moodle	Moodle MS Forms	Moodle	EvaSys	Brightspace/ Moodle	Moodle	Moodle	Moodle	Moodle
Plagiarism	Turnitin	Turnitin	Turnitin		Urkund	Turnitin	Plagramme	Compilatio	Turnitin
Lecture Capture	Local app	Camtasia MS Teams		Local app	Screencasto matic			OBS Studio	Local apps
Email	MS exchange (Office 365)	MS exchange (Office 365)	MS exchange (Office 365)	MS exchange (Local)	MS exchange (Office 365)	MS exchange (Office 365)	Roundcube/ MS Exchange	Zimbra	O365
Personal Productivity	Office 365	Office 365	Office 365	Microsoft Office	Office 365	Office 365	Office 365 Google	Office365	O365
Asynchronous	Moodle MS Teams	MS Teams	Moodle Mahara	Matrix	Brightspace/ Moodle/MS Teams	MS Teams	Moodle MS Teams	Moodle MS Teams	Moodle MS Teams
Synchronous	MS Teams	MS Teams	Moodle/Zoom/BBB/ MS Teams	Skype for Business Matrix	Brightspace/ Moodle/MS Teams	MS Teams	MS Teams	RocketChat	MS Teams

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