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International Cooperation Framework For Next Generation Engineering Students

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INTERNATIONAL COOPERATION FRAMEWORK FOR NEXT GENERATION ENGINEERING STUDENTS

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ABSTRACT

International Cooperation Framework for Next Generation Engineering Students (NextGEng) is an Erasmus+ Cooperation partnership in higher education project which started at the beginning of October 2022 and will end at the end of September 2025. In this project, there are six full partners who are participating in all project's activities: Technical University of Cluj Napoca (main partner) and Robert Bosch SRL from Romania; Jamk University of Applied Sciences and Valmet Technologies Oyj from Finland; University of Jaen and Sensory Integration and Robotics from Spain. This project aims to develop an international cooperation framework that promotes international team-teaching aligned with the European Education Area 2025 and labour market needs, including actions to support collaborative, international and experiential learning in engineering. To achieve that end, NextGEng activities are based on three lines of action: a tailored training process for teachers, an international team-teaching pilot program and cases for experiential learning. This paper describes the aims and main activities of NextGEng, details of three lines of action, and achieved results during the first project year.

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1 INTRODUCTION

One of the main objectives of higher education is to provide its graduates with the skills needed to succeed in the labour market. This mission is especially important in the context of today's innovation-driven, skills-based and globalized economies. To produce graduates with strong technical and professional competencies, Higher Education Institutions (HEIs) are facing many challenges. They have to develop new teaching methods that motivate students to learn and become highly qualified graduates with the competencies to work in new kinds of jobs.
Additionally, the last pandemic has meant a sudden transformation in teaching and learning processes, especially in terms of digitalization. Under such circumstances, HEIs have had to adapt their teaching and assessment methodologies in a short time. Transitioning from traditional face-to-face learning pedagogies to virtual ones requires time, expertise, resources, and motivation. The speed with which changes have taken place has affected the learning process and some difficulties have arisen for students to follow lectures or to organize their tasks. Digitalization has fostered the implementation of virtual learning methodologies, which are needed to upgrade the existing materials and to create collaborative work with an international approach (Vincent-Lancrin, S., et al. 2019) and (Visvizi, A., et al. 2018).
New challenges are especially demanding in engineering degrees, where the theoretical complexity and the practical work at the laboratory to train applied skills, require adequate guidance of students from teachers, and the creation of quality learning material. Besides, the industry is one of the most innovative, changing labor agents, and therefore it is crucial to train and prepare future engineers for successful professional development. Based on the above-mentioned, it seems necessary to rethink the teaching methodologies to produce upgraded courses, featuring a student-centered approach and in cooperation with other international institutions and companies. In that sense, the European Commission is working in this direction through the creation of the European Education Area (EEA). Some of the main objectives are related to the improvement of the quality of education from a collaborative perspective, which considers digital transformation and inclusion.
HEI and company partners of the NextGEng project have cooperated for many years, so they know each other's skills and strengths and they have now a good possibility to deepen cooperation. HEI partners have already earlier done successful cooperation and reached good pedagogical outputs and results (Kakko, A. 2016), (Kakko, A., Matilainen, J., Satorres Martínez, S. 2017), (Satorres Martínez, S., et al. 2019), (Torres Jiménez, E., et al. 2019) and (Satorres Martínez, S., et al. 2020). This means that the International Cooperation Framework for Next Generation Engineering Students (NextGEng, www.nextgeng.eu) project is a safe and feasible opportunity to foster the transformation of engineering degrees in line with the aims of the EEA. This project for its part helps to adapt these studies to the changing environment, which demands students to have interdisciplinary, inclusive, cooperative and digital capacities, to quickly adapt to the labor market.

2 BASIC INFORMATION ABOUT THE NEXTGENG PROJECT

This project aims to develop an international cooperation framework that promotes international team-teaching aligned with the European Education Area 2025 and labour market needs, including actions to support collaborative, international and experiential learning in engineering.

2.1 Partners

In the NextGEng project, there are three Higher Education Institutions (HEIs) and three companies from three different European countries (Finland, Romania and Spain) as full partners. *Table 1* shows the countries, names, acronyms and websites of the participating organizations, and also which work packages certain HEI partner leads.

Table 1. Full HEI and company partners of the NextGEng project.

Country	Name	Acronym	Website	Leader of
Romania	Technical University of Cluj-Napoca	TUCN	www.utcluj.ro/en	WP1 and WP3
Romania	Robert Bosch SRL	BOSCH	www.bosch.ro/en/	
Finland	JAMK University of Applied Sciences	JAMK	www.jamk.fi/en/	WP2 and WP6
Finland	Valmet Technologies Oyj	VALMET	www.valmet.com	
Spain	University of Jaen	UJA	https://www.ujaen.es/en	WP4 and WP5
Spain	Sensory Integration and Robotics	ISR	https://isr.es/company/	

The group of partners consisted of two large companies which are well-known around the world and one small and medium-sized enterprise (SME). VALMET is a global, leading supplier of process technologies, automation, and services for pulp, paper, and energy industries. BOSCH is a leading global supplier of technology and services. ISR is a start-up that was born as a spin-off from UJA. ISR has extensive experience in developing new technology solutions and products based on sensory integration and advanced automation for the industry, especially the agro-food sector. Two HEI partners are academic universities while one HEI partner is a university of applied sciences. TUCN is the main partner and coordinator of this project. TUCN has strong academic and research experience, which covers a wide range of engineering and science fields with outstanding results in promoting multidisciplinary and transdisciplinary activities. JAMK is a pioneer of hybrid and virtual education and one forerunner of pedagogical methods in Europe. UJA is one of the most innovative HEIs in Andalusia, Spain, in terms of scientific production and teaching quality, collaborating in initiatives devoted to innovative, virtual methodologies for engineering. The consortium comprises a comprehensive variety of different types of organizations and professionals. This provided very interesting and fruitful cooperation with different perspectives on each aspect of the project. Also, associated companies and institutions and several external partners around Europe follow the progress, utilize the results and perhaps also take part in some of the project activities.

2.2 Work packages

In the NextGEng project, there are six work packages which are Project management (WP1), Tailored training process (WP2), International team-teaching pilot program (WP3), Cases for experiential learning projects (WP4), Quality management (WP5) and Dissemination & exploitation (WP6), as shown in *Fig. 1*.

Three of work packages (WP2, WP3 and WP4) are implementation work packages which are explained in more detail in the following chapters.
The WP1 is led by TUCN and it takes care of overall project management and implementation. The WP1 provides guidelines, communicates with all partners, and periodically evaluates the project's financial situation, ensuring that the activities are implemented on time and according to the project plan. The project managers of full partners and work package leaders form the steering committee. The steering committee has a meeting every six months and during the whole project, only two of its meetings are face-to-face meetings. These two meetings are combined with the annual conference which is named the International Forum of Mechanical and Mechatronics Engineering (IFM^{2}E) and which is hosted by one of the HEI partners in turn.
The WP5 is led by UJA and it provides guidelines for quality assurance, monitors compliance of objectives' evaluation level and it also takes care of risk management.
The WP6 is led by JAMK and it takes care that all promised dissemination and exploitation activities are implemented in time and that the outcomes of different project activities are shared with full and associated partners of the project but also with a large audience.
Most of the meetings and activities of work packages are organized in hybrid and online ways reducing the need for traveling between the partner countries and at the same time reducing negative environmental impact. If travel is necessary for the organized international project activities and meetings, the participants will be informed and guided to choose green travel solutions. All reporting documents of the project are developed in electronic format and stored on the NextGEng MS Team cloud server reducing the need for printing documents.

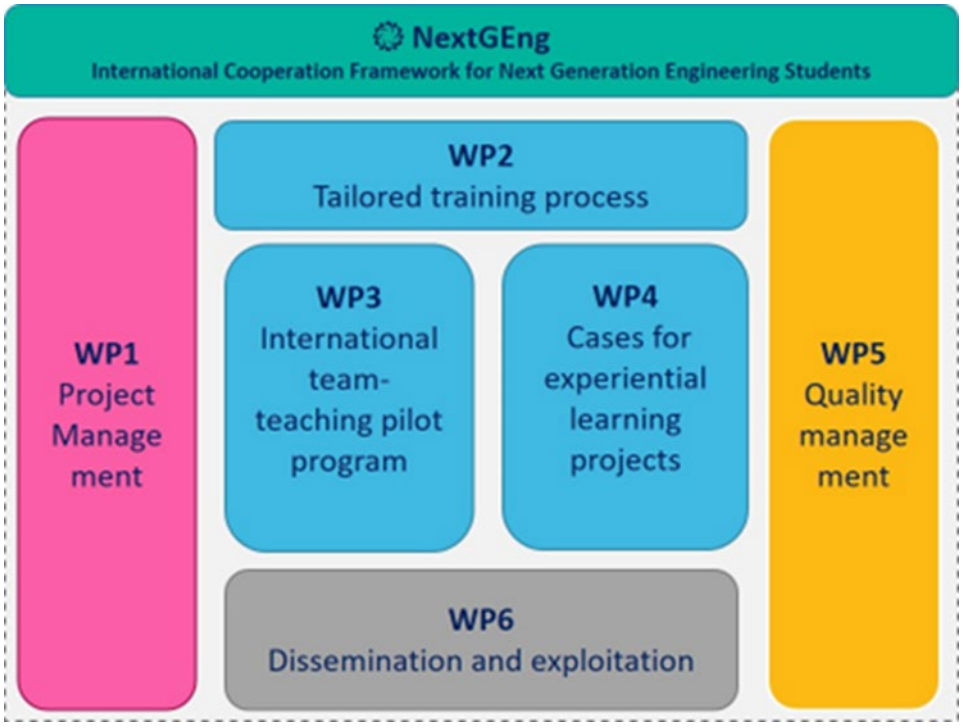

Fig. 1. Six work packages of the NextGEng project.

3 THREE IMPLEMENTATION WORK PACKAGES OF NEXTGENG

3.1 Tailored training process (WP2)

The main content of work package 2 is to design, develop and implement a pedagogical tailored training for the teachers of three HEIs. Experts in pedagogy and teachers with relevant expertise in new cooperative and international team-teaching methods sustain the skill improvement of teachers through workshops and guidance material. During the project, two rounds of tailored training stimulate teachers for innovative learning and teaching practices and the development of an international team-teaching pilot program (WP3). In the NextGEng project, the tailored training is organized by JAMK. JAMK as a forerunner in developing student-centered, competency-based education, digital learning, lifelong learning, and reforming work-related pedagogy and teacher training is the Leader HEI of WP2. The teachers involved in this WP are trained in team-teaching, problem-based learning, flipped learning, and student-centered learning methods. The teachers choose the most suitable methods and their combinations to be implemented in the activities of the following work packages (WP3 and WP4).
The first two-day tailored training seminar was organized at JAMK in January 2023. Many teachers from three HEIs and one expert from VALMET took face-to-face part in it while ISR and BOSCH experts were online. The first training day contained presentations and workshops in small groups. The topics of presentations were student-centeredness, international co-teaching, teaching methods, and digital tools. Also, a general presentation of the NextGEng project was part of the program. In workshops, teachers benchmarked each other's teaching methods and tools. The second training day started with workshops in six international co-teaching teams. During these workshops, teachers started to plan and design six chosen courses in a student-centered way. They also together settled the next course updating steps after these training days. Next in the program, there were six presentations of the workshops' results. The first intensive and innovative tailored training seminar ended with a summary. The second tailored training seminar will be carried out in the spring of 2024 and will be organized in a hybrid way to reduce the traveling of partners.

3.2 International team-teaching pilot program (WP3)

The aim of work package 3 is to develop a pilot program that implements international team-teaching as a part of the educational process in all three HEIs for the engineering courses in their curricula. The leader HEI of WP3 is TUCN. Six engineering courses of every HEI partner's curriculum have been chosen to be upgraded by applying new teaching methods and updating existing content in close collaboration with company partners. The selected six joint courses contain both fundamental and advanced ones, and they are Strengths of Materials (C1), Industrial Automation (C2), Design Project (C3), Quality Assurance and Applied Methods (C4), Computer-Aided Design (C5), Manufacturing Technologies (C6). For each course, an international co-teaching team was formed that includes teachers from all three HEIs and company experts working together to develop new teaching materials and teaching methods. The first face-to-face meetings of co-teaching teams were at the first tailored training seminar at JAMK in January 2023. During the first project year (10/2022-9/2023), the upgrading process started with four courses (C1, C2, C3 and C4) and two other courses (C5 and C6) will be added to the process in the second project year (10/2023-9/2024). During the second project year, cooperative teaching implementation of four upgraded courses will be implemented as a part of the

teaching semesters in all three HEIs. During the third project year (10/2024-9/2025), cooperative teaching implementation of all six upgraded courses will be implemented as a part of the teaching semesters in all three HEIs.
The course upgrade process supports the development of new course materials in electronic form that is shared using online platforms with the enrolled students and presented to students during hybrid team-teaching sessions in which teachers and students participate face-to-face and online. After these two teaching rounds, the learning results will be evaluated and compared with the students that have followed the standard course program. During the third project year, the best practice guide for international team-teaching in engineering will be created and it will be published as a result of WP3 at the end of the project.

3.2 Cases for experiential learning projects (WP4)

The aim of work package 4 is to design, develop and implement two rounds of new student semester projects called Cases for experiential learning (CEL) projects where international student groups are involved in solving research or an industry-specific topic in direct collaborations with HEI teachers and company experts. The leader HEI of WP4 is UJA. The design of the CEL projects is shown in *Fig. 2*. In both CEL rounds, three projects will be simultaneously implemented, one in each partner HEI and country. In every project, six students from every HEI will take part in, so together 18 students. In every project, there will be formed three international teams of six students that will solve the same topic and compete against each other to create the best solutions for the proposed challenge.

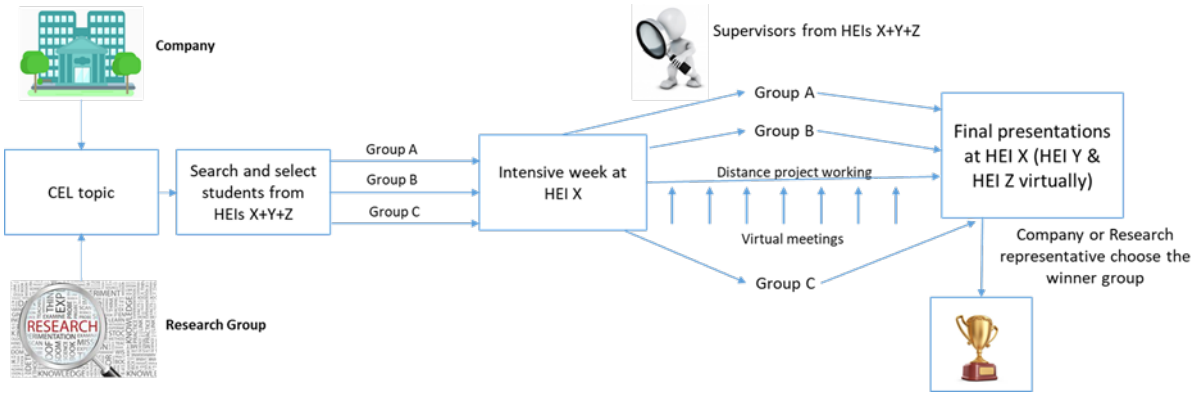

Figure 2. The design of CEL projects.

In the spring and summer of 2023, HEI teachers and company experts in three partner countries have together chosen the most suitable topics for three CEL projects. During autumn 2023, HEI and company partners will create info materials and write detailed plans for the first round of CEL projects. They also have info sessions for suitable student groups in their HEIs. After that, interested students will send their CVs to the teachers of their own HEI who will choose six students for all CEL projects. The first round of CEL projects will be implemented in the spring and summer of 2024 and the second round in the spring and summer of 2025.

At the beginning of every CEL project, there will be an intensive week in the HEI and the company where the topic will come from. All students, HEI teachers and company experts who will take part in a certain CEL project will participate in this intensive week. The student program during the intensive week will include tailored lectures, group work, group presentations, supervision meetings with teachers and

company experts, and also some free time activities. After the intensive week, the student groups will continue solving the project topic remotely. The groups will regularly hold their own remote meetings where they will discuss the progress of the project and share outputs. Student groups will also have virtual meetings with teachers and company experts. At the end of every CEL project, there will be oral final presentations of student groups which will be organized in hybrid. Student groups also will write their final project reports. Teachers and company experts will evaluate the work of the student groups, choose the winning group and give grades to them.

4 SUMMARY AND ACKNOWLEDGMENTS

The three-year NextGEng project started at the beginning of October 2022. During the first project year, HEI and company partners have done all scheduled activities with a good attitude and on time. Cooperation between HEIs and companies has been innovative and fruitful. All participating organizations can learn new and useful things from each other and from this project.

The Tailored training process (WP2) is the first implementation work package whose activities will end and be ready in spring 2024. The most suitable methods and their combinations learned in WP2 are tested and implemented in two rounds of the International team-teaching pilot program (WP3) and in two rounds of the Cases for experiential learning projects (WP4) during the two last project years. During the academic year 2023-2024, cooperative teaching implementation of four upgraded courses and the first round of experimental learning projects are implemented as a part of the teaching semesters in all three HEIs.

The NextGEng project implements green practices at individual, institutional, and project levels. The aim is to reduce the environmental negative impact by reducing and optimizing the necessary travel activities, using digital tools for document management, raising awareness, and developing new green competencies for the target groups in the project. If travel is necessary for the organized international project activities and meetings, the participants will be informed and guided to choose green travel solutions that reduce as much as possible the carbon footprint of this mobility.

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REFERENCES

Kakko, A. 2016. “Reshaped Partnerships for Competitiveness and Innovation Potentials in Mechanical Engineering.” In *Proceedings of the 44th SEFI Annual Conference 2016 - Engineering Education on Top of the World: Industry University Cooperation*, *SEFI 2016, Tampere (Finland), September 12-15*. ISBN: 978-28735201-44.

Kakko, A., Matilainen, J., Satorres Martínez, S. 2017. “Smart HEI-business collaboration for skills and competitiveness.” In *Proceedings of the 45th SEFI Annual Conference 2017 - Education Excellence for Sustainability, SEFI 2017*, *Azores*

(Portugal), September 18-21, pp. 331-338. ISBN: 978-989-98875-7-2. https://doi.org/10.1787/9789264311671-en.

Satorres Martínez, S., et al. 2020. “Real life Problem solving: a Successful Model for HEI student-company cooperation”. In *Proceedings of the 14th International Technology, Education and Development Conference, INTED2020, Valencia (Spain), March 2-4*, pp. 289-294. IATED.

Satorres Martínez, S., et al. 2019. “Bridging the gap between Higher Education Institutions and companies. The HEIBus cooperation models.” In *Proceedings of the 13th International Technology, Education and Development Conference, INTED2019, Valencia (Spain), March 11-13*, pp. 8114-8122. ISBN: 978-84-09-08619-1.

Torres Jiménez, E., et al. 2019. “Company mentoring program for engineering students”. In *Proceedings of the 13th International Technology, Education and Development Conference, INTED2019, Valencia (Spain), March 11-13*, pp. 5084-5091. ISBN: 978-84-09-08619-1.

Vincent-Lancrin, S., et al. 2019. *Measuring Innovation in Education 2019: What Has Changed in the Classroom?. Educational Research and Innovation*. Paris: OECD Publishing. https://doi.org/10.1787/9789264311671-en.

Visvizi, A., et al. 2018. *The Future of Innovation and Technology in Education: Policies and Practices for Teaching and Learning Excellence*. Emerald Publishing. ISBN: 978-1787565562.