HERA
Higher Education Re-engineering through Active learning for Growth
#2

Output 1: a theoretical framework

Educational requirements and problem-based learning methodologies for re-engineering Higher Education to address emerging industry needs.

HERA Project's first output is out. Titled "*Educational requirements and problem-based learning methodologies for re-engineering Higher Education to address emerging industry needs*", it defines the theoretical framework of the HERA Project. This framework combines active, problem-based, and gaming approaches for building the skills desirable for young scientists in the 21st century, full of complex challenges that require integrated, effective, and equitable solutions. The development of these skills in Higher Education (HE) students is the main goal of the project.

The focus will be mostly on engineering and economics principles, which are an essential combination for addressing effectively industry and societal issues in a realistic and pragmatic manner, taking into account technology and viable implementation budgets. The idea is to expose students to industry practices well before they enter the professional world, enabling them to practice both specific and tranversal skills in a safe environment while containing educational costs.

This theoretical framework aims to:

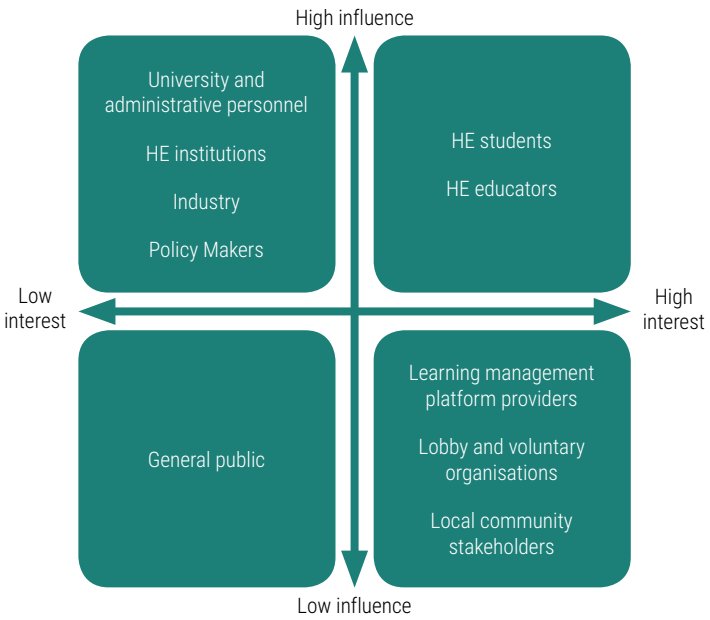
- Establish a map of stakeholders that may gain directly or indirectly from the proposed objectives of the HERA project;
- Identify desirable skills for young scientists;
- Establish the current situation in multidisciplinary engineering and economics offerings HE on building skills required for 21st century students;
- Review other research and development work in terms of promoting emerging active, problem based learning approaches in engineering and economics;
- Perform a needs analysis of direct stakeholders, namely HE students and educators, in terms of building skills required by global industry in multidisciplinary engineering and economics practices;
- Introduce the HERA active, problem-based learning educational framework for building non-routine problem-solving skills.

Definition of a map of stakeholders

A map of all the stakeholders that, directly and indirectly, stand to gain from HERA objectives and outcomes was produced. It introduces a high level view of how the HERA objectives and outputs positively affect different societal groups, describing the characteristics of each group and the way they benefit from project results.

Direct stakeholders are HE students and educators, university administrative personnel and HE institutions involved in the HERA project.

Indirect stakeholders are the industry (companies), learning management platform producers, lobby and voluntary organizations, local community stakeholders, the general public and policy makers.

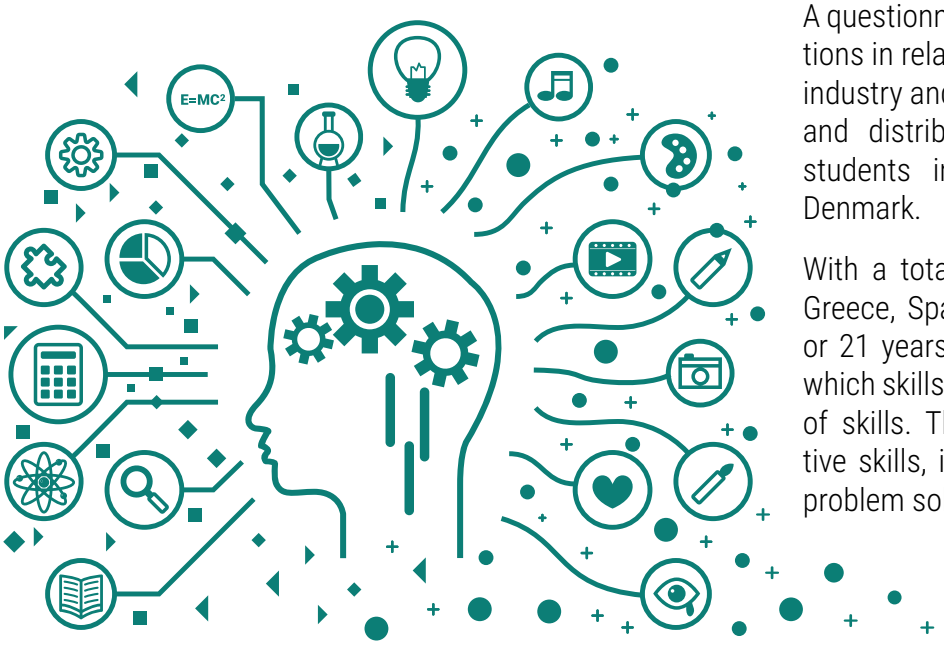


Identification of desirable skills for young scientists

The challenges faced by society in the 21st century require solutions that weave skills and knowledge from diverse subject areas and sectors towards introducing integrated, viable, and sustainable solutions to pressing issues.

In the HERA proposal, the following skills were identified:

- Formal, basic knowledge in engineering and economics
- Integration of knowledge from diverse thematic areas
- Collaboration, sometimes in multidisciplinary teams
- Open mindedness
- High level thinking
- Critical, analytical and innovative thinking
- Independent and autonomous learning
- Problem solving
- Ability to prioritize
- Evaluation of information particularly when coming from diverse sources
- Follow systemic design processes
- Implementation and validation of solutions from the perspective of the end users
- Analysis of the factors that contribute to an unwanted situation
- Design and evaluation of alternative interventions towards solving a problem
- Implementation and assessment of the effectiveness of a solution
- Integrate and transfer knowledge to the real world
- Work with limited resources
- Presentation skills



Status quo in engineering and economics HE: best practices

A best practice is an activity that has been proven to produce good results, and is therefore recommended as a model. It is a successful experience, which has been tested and validated, in the broad sense, and deserves to be shared so that a greater number of people can benefit from its adoption.

The following set of criteria helps determine whether a practice is a "best practice":

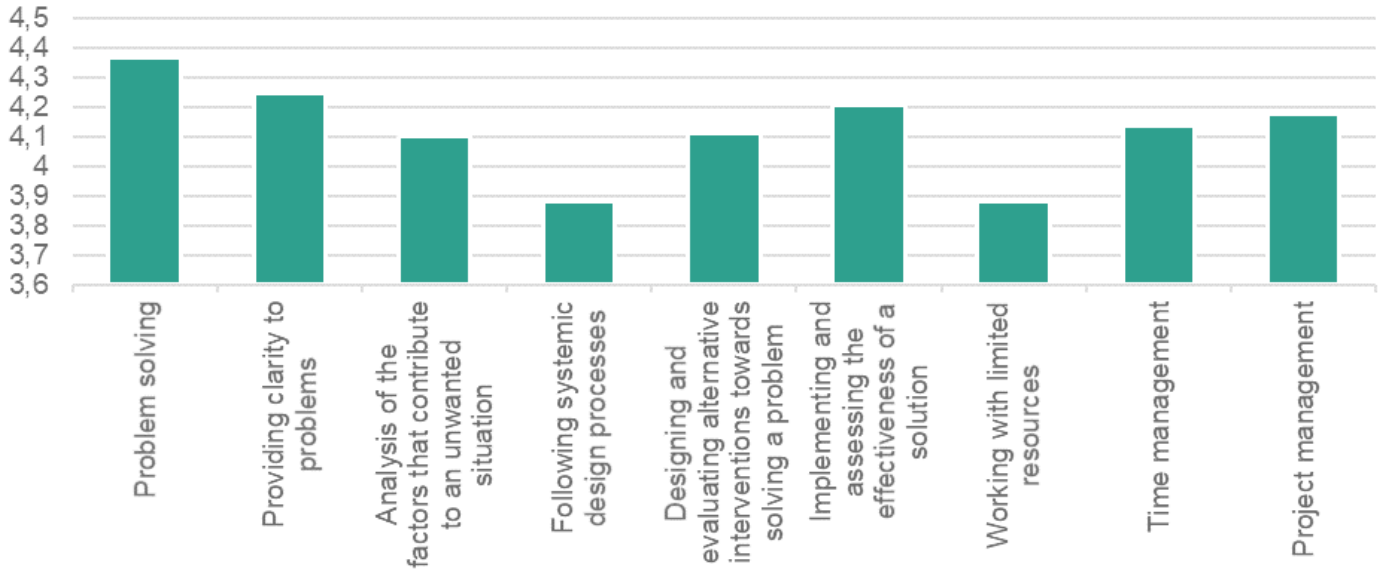
- Effective and successful: A "best practice" has proven its relevance as the most effective way in achieving a specific objective; it has been successfully adopted and has had a positive impact on individuals and/or institutions.
- Socially sustainable: A "best practice" meets current needs of the stakeholders, without compromising the ability to address future needs.
- Technically feasible: Technical feasibility means that the "best practice" is easy to learn and to implement.
- Replicable and adaptable: A "best practice" should have the potential for replication and should therefore be adaptable to similar objectives in varying situations.

Several best practices on the deployment of active learning in engineering and economics education were found within institutions involved in this project, which used gamification, problem based learning, team work, etc. with success.

Questionnaire-based study on student expectations regarding the build of HERA skills

A questionnaire, aimed at establishing student expectations in relation to the development of skills required by industry and society in the 21st century, was composed and distributed to HE Engineering and Economics students in Greece, Estonia, Portugal, Spain, and Denmark.

With a total of 184 participants, most of them from Greece, Spain and Portugal, and with an average age or 21 years old, the questionnaire asked the students which skills were the most important within several sets of skills. These sets are: technical skills, metacognitive skills, intrapersonal skills, interpersonal skills and problem solving skills.



Results of one of the most popular categories, problem solving skills.

Overall, all skills were considered as relatively important or important. The highest rated skills were "willingness to learn", "open mindedness" and "problem solving" while the least rated skills were "economics and financial literacy" and "health and wellness literacy".

Analysis of the deployment of ICT-based solutions

This work documents ICT-based services, commercial and non-commercial that are or may be deployed in the context of HE education for fostering the development of desirable skills. This task is important for ensuring that other related work is taken into account before endeavouring into the design and implementation of the proposed HERA digitally enabled learning interventions.

Serious Games

Serious games enhance soft skills development by facing different situations, challenges and problems and therefore make it possible to put learning into practice.

Simulations

The use of simulations and simulation based learning has been extensively explored as an appropriate approach to teach soft skills, also in large classes.

Gamification

Using gamification for online courses involves game/play elements and/or game-design techniques, such as score and points, challenges, progress bar and leaderboards.

E-learning environments

Current e-learning environments offer support for collaboration and team work to enhance soft skills.

Expository	Guided	Active
Lecture	Discussion	Brainstorming
Seminar	Workshop	Role play
Conference	Case study	Business game
Demonstration	Project work	Visits, journey
	Simulation	Outdoor trainning
	Mentoring	Coaching

Learning methodologies for the development of soft-skills.

MOOCs and OERs

It is possible to find MOOCs focused on the development of soft skills. Learning and innovation skills are found as the most covered, where communication was the most representative. A lot of importance was also given to critical thinking and problem solving.

VR and AR

Virtual Reality (VR) and Augmented Reality (AR) technologies are being explored as training tools for soft skills. The existing proposals of VR/AR are usually research proposals, still not used in educational settings.

Assessment

The assessment of soft skills can also be supported through ICT tools, as found in recent research.

Analysis of learning requirements for students

This study focused on documenting and analysing the learning needs of students, trying to establish what the students expect or desire from their education in order to become well-functioning and effective professionals. Namely, it includes needs related to core knowledge, employability, mobility, lifelong professional development, etc. These are their thoughts:

- Exposure to industrial and entrepreneurial processes
- Building analytical thinking and critical thinking skills
- Be flexible and adaptable to change
- Build higher order thinking skills
- Be creative
- Build leadership skills and understand different roles in a team
- Collaborate effectively in a team
- Build effective communication skills, both oral and written
- Build project and time management skills
- Learn in a supportive and harmonious environment
- Prepare for their transition to the workplace environment
- Be able to integrate knowledge from diverse thematic areas
- Be able to prioritize
- Work with limited resources
- Build presentation skills

Partners

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Analysis of learning requirements for educators

This activity focused on the establishment of the needs of educators in terms of building their capacity to apply emerging pedagogical approaches in their instructional practices for building desirable skills for their students in relation to industry needs. It further focus on what educators need in order to effectively deploy ICT as a learning tool in wider instructional practices. A series of interviews with teachers were conducted by the Estonian team, as this country enjoys a highly successful educational system.

The results show that interdisciplinarity is a priority and considered very important. However, sustainability is not a common topic, but its importance is growing and teachers feel the need of introducing it to their students.

Regarding learning methodologies, active lerarning, problem-based learning and project-based learning are already integrated, specially in practical subjects, in combination with methods like group work, also very common. However, gamification is used less often, mainly due to the lack of games that are well aligned with the educational goals. Better games are needed and will be welcomed in their teaching.

HERA learning framework

The proposed learning framework is the basis for the design and implementation of the HERA serious game that encourages students to address non-trivial challenges of today by integrating knowledge from diverse thematic areas, thinking critically, and collaborating in multidisciplinary teams in a manner that simulates real-world industry practices.

A serious game is being designed and developed with the objective of exposing HE students to active and problem-based learning scenarios that simulate real world industry practices. The scenarios give the students a mission and describe an open-ended, non-trivial objective in the context of a city building simulation, observing time and budget constraints. All in-game tasks require collaboration and interdisciplinary knowledge, including project management skills, to be completed successfully. Stay tuned for further information about this in the next newsletter.

ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ ΙΚΥ

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