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Systematic Development of Generic Skills to Enhance Innovation Capacity of Eastern and Southeastern European Universities †

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Abstract: The level of innovativeness within the higher education systems of east and southeast Europe and their graduates is still assessed as modest or moderate. Besides the general socio–economic context and the inherited institutional management types, this deficiency stems from a lack of generic skills crucial for increasing the innovation capacity of the universities. TrainE-SEE v.2 project suggests that significant changes should be already put in place within the applied teaching methodology, but also highlights the importance of developing project development and management skills, innovation, entrepreneurial skills, and finally competences needed to strengthen science to business cooperation.

Keywords: raw materials education; ESEE region; generic skills implementation; transferable methodology

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1. Introduction

The Communication from the European Commission on a renewed EU agenda for higher education from 2017 clearly states the need for the modernization of higher education systems of the Member States. Some of the key strategic directions set include the strengthening of capacity and outputs of higher education institutions, especially by supporting investment in skills and innovation projects, being crucial to achieve a successful collaboration between higher education, research, and business [1]. Today, several challenges seem to be in common to most of the higher education systems in the EU, including an insufficient range of transversal skills needed by the graduates for positioning on the labor market and secondly a lack of contribution of the higher education institutions to the wider economy, thus creating an innovation gap. As recognized by the European Commission, well-designed higher education programs and curricula are the crucial tools to address these challenges.

Following the conclusions of the European Commission (EC) and understanding the issues that need to be tackled, in 2018 the University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering started with the implementation of the EIT funded ESEE S project, with an aim to build a set of generic skills in the staff members of six selected faculties. The project was based on the results of the institutional self-analyses, which showed that the observed academic staff lacked skills in the application of new educational techniques/methods, management and organization, writing (data organization), communication, evaluation, PR, marketing, and English language proficiency skills. These results were in line with the wider studies conducted on the EU level and have impacted the project's structure. ESEE S consisted of seven courses related to a set of specific generic skills, as a part of a structured training plan aimed mostly at unexperienced to moderately experienced academic staff. During 2018, a total of 96 professionals were educated, resulting in extremely positive feedbacks from the workshops.

ESEE S project led to the development of TrainESEE v.2 project (to be implemented from 1 January of 2020 to 31 December of 2021), with 12 consortium members building on the previously conducted research and lessons learned (https://trainesee2.eu/ (accessed on 31 July 2021)). The Action plan of EIT RawMaterials Learning and Education identifies three key facts describing the wider context in which the activities of the TrainESEE project have been defined and implemented. The crucial one is a shortage of people and skills gap in the raw materials sector, addressed by the EIT RawMaterials Academy and the TrainESEE itself. The EIT RM Academy program supports the growth of competences both in the relevant technical fields and in the application of generic skills such as entrepreneurship, pedagogy, business modelling, etc. [2]. This is especially important for the RIS countries, where the east and southeast European (ESEE) region has a unique set of baseline characteristics, requiring a specific educational strategy [2,3]. The first step in implementing this strategy is the capacity building of vital skills and competences of academic staff.

The generic skills chosen as topics of the TrainESEE training modules include improved teaching methodology, project development and management skills, innovation and entrepreneurship related skills and science to business competencies. The improved and generation-adjusted teaching methodology supports knowledge transfer regardless of the field, while project-related skills bring multifaceted benefits for the universities and the students entering the labor market [4] Innovation potential of an economy is closely related to the capacities and growth of the entrepreneurial sector. Research has shown that entrepreneurship education in universities may impact the decision of students to become entrepreneurs or self-employed, highlighting that positive effect of the entrepreneurship education can be felt after graduation and five years of paid employment, thus improving the allocation of resources and increasing social welfare [5]. Technology transfer as a consequence of strong science to business connection can "potentially generate revenues for universities, create research connections between academia and industry, and enhance regional economic growth and development" [6], making it a crucial aspect of ESEE universities' modernization.

The aims of TrainESEE are:

1. to carry out an integrated SWOT analysis of the education needs in the ESEE region;
2. to design and implement four tailor-made educational modules for the academic staff of the six RIS ESEE universities;
3. to develop and implement six acceleration "train-the-trainer" programs.

2. Methodology

During the design of the methodological approach, one of the requirements was to develop and apply a methodology that could later be used in any other high education institution and its units, making the methodology more easily replicated or transferred to some other educational sector.

2.1. SWOT Analysis Methodology

Data collection and analysis were carried out as the first step in the preparation of the tailor-made training modules. The objects of the analysis were the six ESEE universities and their individual units, with the primary objective to understand their strengths and weaknesses in terms of the current level of the generic skills but also to grasp the wider context in which they are operating.

The main purpose of the SWOT analyses was to:

1. describe the current state of the system being analyzed (university/faculty/unit);
2. classify the baseline conclusions as positive or negative impacts to further development of the educational systems (positive impacts—Strengths (internal impacts) and Opportunities (external impacts) and negative impacts—Weaknesses (internal impacts) and Threats (external impacts));
3. define the objective status of the system.

Input data collection and assessment were carried out in two steps. The first step was implemented on a more general level and included a thorough study of the following:

1. relevant education and research related university/faculty strategic documents;
2. relevant education and research related national strategic documents;
3. Strategic agenda 2018–2022 of the EIT Raw Materials and KIC EIT Raw materials RIS strategy (2018–2020);
4. strategic documents related to the higher education systems at the EU level.

The second group of input data was generated through the questionnaires developed by the "trainer" institutions, directed at the staff of the analyzed units within the six universities ("Trainees"). The key purpose of the questionnaires was to collect additional data in order to develop a viable and comprehensive set of SWOT matrices.

2.2. Modules' Content Development

The process of developing the content of the four modules was carried out through two main steps: activity drafting and final content development.

The purpose of the activity drafting was to identify educational elements to be included in the modules (learning outcomes), thus designing them in line with the previously identified needs of the universities.

Basic requirements initially set for the process of the activity drafting were as follows:

1. the learning outcomes should be realistic;
2. achievement of the objectives should be under the control of the universities (not third parties);
3. elements should be directly traceable to the conclusions listed in the SWOT matrices;
4. initially conducted activity drafting should be reflected later in the content of modules developed.

Within these limits, the first step of the activity drafting process was to inspect the statements presented in the six SWOT matrices and establish a connection between the individual statements and the topics of the module, i.e., to classify statements as relevant for at least one module, if applicable.

In the next methodological step, SWOT matrices were to be used for the estimation of relevance of the preliminary elements/learning outcomes of each module. Except for the pre-defined learning outcomes of the modules, the engaged universities ("trainees") were also given the opportunity to add their desired learning outcomes, stemming from the specific needs of the respective institution. Relevance assessment was calculated on two levels. First, three basic types of inputs were required from the six universities:

1. confirmation of the relevance of the particular pre-defined learning outcome for their institution (by stating yes (relevant) or no (not relevant));
2. expressing the relative relevance of the individual pre-defined learning outcome for their institution (as percentage), assigned according to the share of module-related facts from the respective SWOT matrix;
3. additional notes and comments more closely specifying the most relevant sub-objectives of the learning units.

Second, the learning outcomes were again rated by the six universities, but this time on a scale from 2 to 5. The purpose of this step was to re-assess elements already identified as 100% relevant, thus establishing a refined hierarchy of relevance for all elements listed.

After the activity drafting, content of each module was developed in two subsequent phases, in which the reviewers from the industry have been actively included. An industry review was carried out twice during the modules' content development: once after the first development phase was completed, and the second time just before the completion of the modules.

2.3. Acceleration Programs Development Methodology

The basis for the development of the acceleration programs for each of the six participating universities included:

1. the content of four developed modules;
2. experience of the academic staff related to the four implementation workshops;
3. SWOT analysis of each ESEE university;
4. results achieved through the acceleration LinkedIn network.

The core of each acceleration program is the implementation plan developed by the respective university (Figure 1).

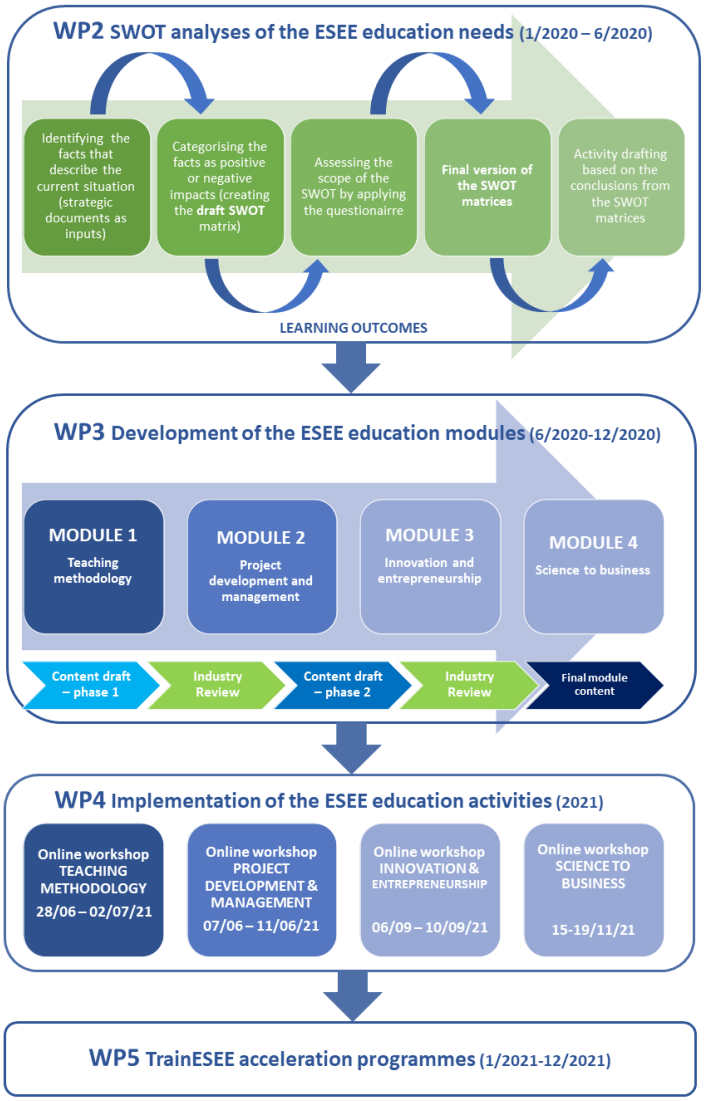

Figure 1. Overview of the methodological steps in project implementation.

3. Results and Discussion

3.1. SWOT Matrices

The analyses resulted in a complete set of SWOT matrices, finalized in April 2020, one for each of the six universities. In accordance with the applied methodology, the final result enabled a clear understanding of challenges and opportunities related to the modernization of the six analyzed universities, but also of the entire high education systems in the ESEE region [7]. Such input was needed to adjust the content of modules to the needs of universities, thus increasing their acceptance and impact. Although there were differences

between the baseline circumstances described by the universities, there were also several commonly present key weaknesses:

1. lack of digital education tools;
2. insufficient project management competences of the academic staff;
3. lack of entrepreneurial skills (of the staff and in the curricula);
4. insufficient communication and integration with the business sector.

3.2. Four Training Modules

The phased process of the modules' development resulted in a fully developed content of four generic skills modules: Teaching Methodology, Project Development and Management, Innovation and Entrepreneurial Skills, and Science to Business Cooperation. These are to be implemented as four online workshops during 2021, testing the quality of the taken approach and serving as a foundation for the acceleration programs of the six universities.

3.2.1. Results of the Activity Drafting Process

Sets of learning outcomes were clearly defined, impacting the modules' content and the selection of learning tools.

The basic criterium for the final selection of the learning outcomes per module was their moderate to extreme level of relevance for all training universities. The learning outcomes that were assessed to be of extreme importance by all universities are as follows:

1. Teaching methodology: new teaching techniques (problem/case-based learning).
2. Project development and management: (a) specific trainings for successful application of national, regional, and EU grants, (b) development of the project idea, (c) building of a project team (consortium), (d) proposal planning, development, and writing, (e) communication plan, (f) risk management, and (g) financial reporting and control.
3. Innovation and Entrepreneurial Skills: (a) building and leading teams and projects and (b) generating ideas and creating innovations to solve customers' needs.
4. Science to Business Cooperation: transferring scientific research innovation into business cases.

3.2.2. Results of the Modules' Content Development Process

Both the process of content development and the industry review have been standardized for all four modules: in the initial phase, key elements that needed to be defined for a specific module, have been set. These included the duration of the module, requirements for the enrolment in the module, theoretical vs. practical work ratio, ECTS credits, learning outcomes, competences gained, type of teaching activities applied, methods of knowledge testing, teaching quality assessment, etc.

There were eight industry advisors included in the review process. They were invited to provide feedback by filling in the predefined assessment forms, aligned with the structure of the module content. The comments and guidelines of the reviewers were given in relation to the suitable selection of the prerequisites for enrollment, proper definition of learning outcomes and gained competences, selection of appropriate teaching activities and testing methods, possible shortcomings, deficiencies, and suggestions for improvement of the module. The assessment of the modules' draft was used to improve the content before finalization. The final review confirmed that the previously given guidelines were successfully implemented.

3.2.3. Results of the Training Modules' Implementation

Training modules are to be implemented as four online five-day trainings for a total of 80 participants chosen from the academic staff of the six universities by applying the criteria developed for the recruitment purposes. The aim of the recruitment process based on evaluation and selection of applicants was to ensure that proper target groups are trained, thus maximizing the benefits of the training for the respective institution.

Two modules have already been conducted in the first half of 2021; those remaining are planned for September and November 2021. Two completed trainings were held with a high level of participants' engagement before, during, and after the training itself. The technical possibilities of the digital communication tools were used to enable teamwork and interactive exercises. The Moodle platform was used to exchange training materials and the LinkedIn social network was utilized as a tool for more permanent engagement of the participants, facilitating further discussion among trainers and trainees.

3.3. Six Follow Up Programmes

Following the completion of the six implementation plans, a sound plan for the integration of the acceleration programs into the existing structures of the ESEE universities is developed.

The mobility of the incoming professors—external lecturers at in-house acceleration programs and the involvement of domestic industry representatives are a significant part of implementing the acceleration programs. All six of them are to be run for a minimum of three years after the project finalization.

The structure of the acceleration programs is as follows:

1. Purpose: section describes the scope of the acceleration program, lists persons responsible for the organization of the defined activities and the expected change generated by the program implementation in a period of three to four years.
2. Starting point and strategy development: section describes the current university strategy and the SWOT matrix in relation to the topic addressed by the four training modules. Based on that, the prioritized items to be included in the acceleration program are listed.
3. Implementation plan: section defines a list of activities to be implemented in a four-year period for each module, including a definition of target groups, implementation time frame, purpose, outcomes, responsibilities, and resources needed.
4. Follow up: section provides an elaboration how the trainings received impacted the acceleration program of the respective university.

The following additional activities to ensure the quality of the acceleration programs have been launched: (1) online workshops for the academic staff involved in the acceleration program preparation, (2) activization of the LinkedIn groups gathering trained academic staff and trainers for the purpose of exchanging ideas for the acceleration plans, and (3) naming the acceleration program leaders, one at each of the six universities, to act as motivators and coordinators of internal activities on acceleration programs development, thus ensuring their sustainability.

The results related to the acceleration programs of the six universities will be made publicly available on the project website. However, crucial results will be generated within three years after the programs have been completed, through their implementation at the six universities, the impact of which will be measured in quantitative terms.

4. Conclusions

The outputs and deliverables of the TrainESEE v.2 project have the potential to pave the way for the integration of the generic skills to the curricula of the technical universities' study programs in the ESEE region. The development of generic skills in the higher education institutions has been a subject of many projects and research papers during the last two decades, especially when it comes to entrepreneurial skills and innovation generation abilities. However, there are no examples found by the authors specifically addressing the technical universities implementing raw-materials-related study programs or the context of east and southeast Europe, which makes the TrainESEE v.2 project even more relevant.

The developed and tested methodology could be used for the creation of future trainings focusing on other generic skills lacking in the current high education systems. The need to conduct the trainings online could also be interpreted as an added value,

as the significance and application of teaching in a digital environment is continuously growing. The experience of the six universities and the trainers gained by the TrainESEE v.2 implementation will surely prove useful for the implementation of positive changes, not only in the participating universities, but also for similar endeavors of other educational institutions in the region.

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