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ENHANCING COMPETENCES OF SUSTAINABLE WASTE MANAGEMENT IN RUSSIAN AND KAZAKH HEIS / EDUENVI

Final project external evaluation report (learning material)

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Project webpage: https://eduenvi.tamk.fi/

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Executive summary

The ENDUENVI project (https://eduenvi.tamk.fi/) has been the joint collaboration of nine universities (Russia, Kazakhstan, Finland, Spain), and other agencies, funded by the European Erasmus+ program to develop a curriculum for online "Sustainable Waste Management" implemented in Russia and Kazakhstan. The consortium operates from spring 2018 to date through co-development of the deliverables and other supporting outlets (guides, seminars and workshops) following educational quality assurance processes.

The project initially identified learning needs through close collaborations with various stakeholders (students, university teachers and administrative staff, local authorities, companies and others) conforming with the university-industry collaboration policies. Then it received feedback from all sides and afterwards it developed the online curriculum followed a pilot implementation phase in both Russia and Kazakhstan. As its main output, the consortium developed twenty courses organized in eight teaching modules, at the mater's level, covering all aspects of waste management, including entrepreneurship and quality management. The purpose of the present report is the summative evaluation of the project's learning material by an independent external reviewer.

To this end, a theoretical background for the assessment was adopted by incorporating European and worldwide recommendations for contemporary Higher Education. In this way, five dimensions for the assessment of learning material were identified and four concrete assessment criteria were adopted. Then, the shared content was studied by the examiner and the four criteria were implemented on it. The emergent evaluation showed that EDUENVI's learning material complies with the European and worldwide requirements for Higher Education exhibiting top quality learning material in the majority of courses.

Further to evaluation, feedback on how the output could be enhanced in further implementations is provided by the examiner. The feedback mostly pertains to very recent developments of educational technology depicted in the latest guidelines of HE agencies. Then, a final conclusion on project's output and its potential for the future is presented.

Brief description of the EDUENVI project

The EDUENVI project has developed an online curriculum in the area of "Sustainable Waste Management", implemented in Russia and Kazakhstan, comprised of twenty courses organized in eight teaching modules. The output has been a collaboration among nine universities through the European Erasmus+ funding. Beyond pilot implementation in existent Russian and Kazakh university programs, in all participating institutes, it is also publicly available in open education platforms (e.g. open.edu.ru, mooc.kz, edx.org). For the development of the curriculum, the consortium investigated underlying learning needs[1] following educational quality assurance processes[2]. In these endeavors, educators, students, administrative staff from universities and environmental authorities, as well as other internal and external stakeholders were involved. As a starting point, the conceptions of university teachers about ICT-based learning were surveyed[3]. Beyond typical learning needs, requirements from local companies, regional administration and the industry were considered. Each learning module was formatively evaluated through webinars and workshops toward pedagogy and industry-university collaboration policies. Peer and expert feedback were received before the pilot implementation phase[4]. By receiving feedback from all stakeholders, the consortium clearly aimed to provide state of the art education in waste management, providing the learners with certain capacities in the field capable of making them more employable and successful in the contemporary job market. The consortium has operated from spring 2018 to date undergoing the last phase of the external evaluation toward completion of the project. Supplementary to the main curriculum, the consortium developed a series of publications, webinars, seminars and workshops supportive to the adoption of the online program and to the timely monitoring of its progress.

[1] https://eduenvi.tamk.fi/files/2019/09/Needs-Analysis-Report_0919.pdf
[2] https://eduenvi.tamk.fi/files/2021/02/EduEnvi-QA-project-deliverables_links.pdf
[3] https://eduenvi.tamk.fi/activities/elearning-pedagogies-and-tools/
[4] https://eduenvi.tamk.fi/files/2020/04/Webinar_310320_Zhanar-Shortanbayeva.pdf

Organization of modules and courses

As mentioned, the EDUENVI project provided online learning on "Sustainable Waste Management" at the master's level. The curriculum consists of 8 modules and 20 relevant courses shown in Table 1. The whole online program offers 60 ECTS overall (3 ECTS per course).

Table 1 Modules and courses of EDUENVI project (60 ECTS altogether)

Module 1	**Comprehensive risk assessment in waste management**
Course 1	Introduction to environmental risks
Course 2	Environmental, social and economic risks
Course 3	Solid wastes and environmental risks
Module 2	**Biotechnologies for waste utilization**
Course 1	Basics of ecological biotechnologies
Course 2	The Applied Aspects of Using Biotechnological Methods for Waste Utilization
Module 3	**Non-energy technologies for waste utilization**
Course 1	Basics of waste utilization
Course 2	Reuse of side products and outputs
Course 3	Physico-chemical treatment methods in waste management
Module 4	**Energy technologies for waste utilization**
Course 1	Waste-to-energy plants and technologies
Course 2	Energy efficient technologies in waste treatment
Module 5	**Development of business and entrepreneurship for sustainable waste management**
Course 1	Modeling of business processes in the field of waste management
Course 2	Business planning for sustainable waste management projects
Module 6	**Public administration and municipal governance in Sustainable Waste Management**
Course 1	Institutional approach to SWM decision-making
Course 2	Public and municipal governance in SWM
Course 3	Budget and financial base of SWM
Module 7	**Environmental management and waste prevention**
Course 1	Waste prevention: sustainable business models, tools and good practices
Course 2	Application of ISO 14001 for waste prevention
Course 3	Theory and practice of waste management in companies
Module 8	**Life cycle assessment and life cycle costing**
Course 1	Introduction to LCA based on ISO 14040 series
Course 2	Application of LCA for waste prevention

The courses' subjects cover a full range of waste management topics, such as: risk assessment, biotechnologies, non-energy/energy technologies, entrepreneurship, public administration, environmental and sustainability management and quality assurance standards as well as life-

cycle costing. The relevant expected competences and learning outcomes, the required prior knowledge along with the teaching and assessment methods per course have been articulated in the "Handbook of curriculum" booklet developed by the project members (Figure 1).

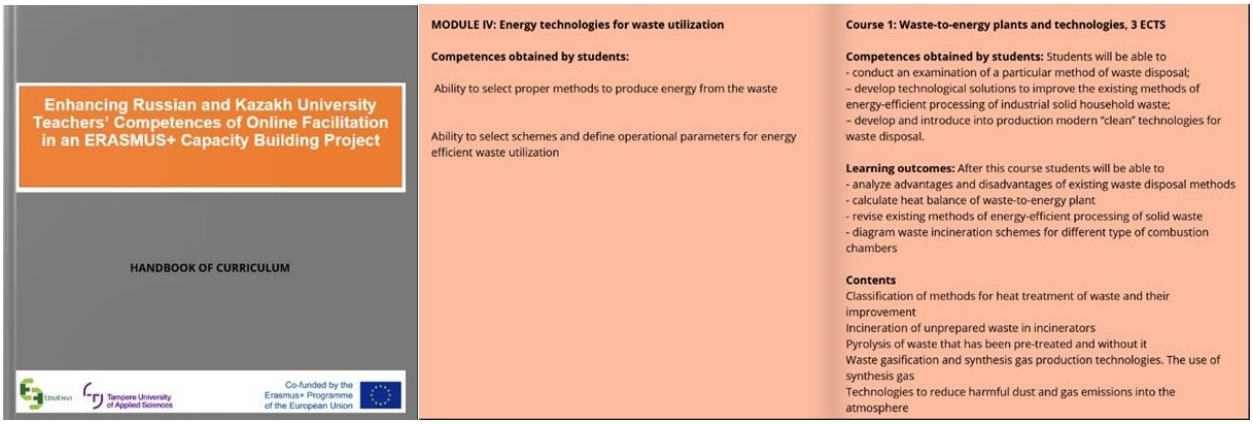

Figure 1 Project's "Handbook of curriculum" booklet (part)

Evaluation objectives

The present evaluation aimed at examining the learning material, of all kinds, developed for the needs of the EDUENVI project. Among others, documents, presentations (ppts), articles, exercises and interim tests, case studies, videos, datasheets, legal and quality forms as well as course outlines were considered (Table 2). The main goal of the learning material is to accommodate the learners' needs and to facilitate them toward acquiring the expected capacities. Thus, the present findings not only reveal the learning potential of the extant material but also derive suggestions for material improvements in future implementations of the EDUENVI online education in "Sustainable Waste Management".

The evaluation focused on the following issues:

- quantity and quality of the learning material;
- appropriability of the material and diversification in methods and tools;

- effectiveness of learning material in engaging the learners;
- effectiveness of learning material in conducting assessments;
- adaptivity and extensivity of the material in other contexts.

The previous five dimensions render the material assessment multi-perspective and holistic, providing insights for educators, managerial staff of universities and bodies as well as various stakeholders.

Methodology

The methodology for the evaluation is based on the study and assiduous examination of the shared project's learning material by the external evaluator. Translations from Russian to English language were used where needed. The specific theoretical framework for evaluation of learning resources relies on the Framework for Qualifications of the European Higher Education Area[5], the European Recommendations on Key Competences for Lifelong Learning[6] and relevant European Commission's guidelines for evaluations of learning material and quality principles (e.g. MINERVA[7]), OECD[8][9] plans and recommendations, international checklists for tertiary education resources and e-learning (e.g. EADTU, 2016[10]; Ontario Ministry of Training[11], 2011) as well as relevant educational research (e.g. Bundsgaard and Hansen, 2011[12]; Reinders and Lewis, 2006[13]; Tomlinson, 2003[14]). The previous theoretical background on educational assessment has been

[5] http://www.ecahe.eu/w/index.php/Framework_for_Qualifications_of_the_European_Higher_Education_Area
[6] https://ec.europa.eu/education/education-in-the-eu/council-recommendation-on-key-competences-for-lifelong-learning_en
[7] https://www.minervaeurope.org/qau/qualityprinciples.htm
[8] https://espas.secure.europarl.europa.eu/orbis/sites/default/files/generated/document/en/9617031e.pdf
[9] https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/
[10] https://e-xcellencelabel.eadtu.eu/images/E-xcellence_manual_2016_third_edition.pdf
[11] http://tcu.gov.on.ca/eng/eopg/publications/OALCF_How_to_Evaluate_Learning_Materials_Mar_11.pdf
[12] Bundsgaard, J., & Hansen, T. I. (2011). Evaluation of Learning Materials: A Holistic Framework. Journal of learning design, 4(4), 31-44.
[13] Reinders, H., & Lewis, M. (2006). An evaluative checklist for self-access materials. ELT Journal, 60(3), 272-278.
[14] Tomlinson, B. (2003) Developing Materials for Language Teaching. London: Continuum.

used for the adoption of specific criteria toward the evaluation of the online learning material presented in the next section.

Evaluation criteria for learning material

Regarding assessment of learning material, of several kinds, the following four criteria were adopted:

- **Criterion 1**. Content adequateness
- **Criterion 2**. Content appropriateness and quality
- **Criterion 3**. Content effectiveness and adaptability
- **Criterion 4**. Content usability

Furthermore, **specific comments** are provided for the improvement of the learning material in future implementations consistent with each specific criterion.

More precisely, each criterion is described as follows:

- Criterion 1. The quantity of the content is examined along with its orientation in respect to the subject taught, the teaching methods and the curriculum timetable. The workload per ECTS is also considered.
- Criterion 2. The appropriateness of the content is examined, namely, the extent and accuracy of contemporary knowledge in the topic, the coverage of the subject, the language skills it adopts, the links to bibliography and further reading. The quality of the content can be identified through its general appearance (layout and design), its objectives' clarity, its coverage of cognitive learning needs of the targeted group, its methodological consistency and fidelity, inclusion of activities and facilitation of authentic assessments.
- Criterion 3. The effectiveness of the content examines whether it facilitates the teaching-learning process in the individual level. Ideally, the content has to motivate the learners,

accommodate different learning preferences through encompassing text, images and videos, exercises, activities and case studies in well organized tasks. The adaptability of the content concerns the extent to which the learning material can be adapted to individual, task-specific needs. In many cases, the content is tested toward satisfying specific groups of learners (e.g. disability groups).

- Criterion 4. The usability of the content pertains to its attractiveness, ability to procure task-specific competencies, problem solving and metacognitive skills, flexibility and autonomy. Possibilities for collective or self-reflection, modular structure, guidance to further learning resources and experiences, connection with real life examples and the vocational interests of students, inclusion of Web 2.0 tools, gamification, self-assessment exercises and tools, among others, lead to better student engagement with the course and in general assist self-directed learning. The usability of the content could also refer to its possible extensivity (transferability) in other contexts and learning programs.

The simultaneous adoption of the previous four criteria, with specific comments for improvements, provide a methodological tool for the assessment of the EDUENVI project's learning material, implemented in the following sections.

Learning material per module and course

Shared learning materials per EDUENVI module (Mod) and course (Co) are shown in Table 2. Columns refer to the language of the content (either Russian or English with one course providing translation between the two languages), the type and the quantity of the learning material, the inclusion of videos (with their total duration), the inclusion of exercises, the type of assessments as well as some other comments and remarks on specific attributes found in the content of some courses. The learning material was disseminated through internet cloud services occupying more than 8 Gb.

Table 2 Teaching material per modules (Mod) and courses (Co) of Table 1.

Mod	Co	Lang.	Learning material	Videos	Exercises	Assessment	Other
M1	C1 - C3	Russian	many (36) detailed documents/ppts /articles /teacher CVs	9 – total duration 50.15 minutes	case studies; exercises, data for problem formulation	peer assessment; assignment (mini-project)	introduction of teachers / Glossary & Index
M2	C1	Russian & English	ppts/articles (46 files)	9 – total duration 71 min	case studies / tests / exercises	weekly test; mini-project	material is translated in English
	C2	English	ppts/articles (69 files)		many questions / groupwork	weekly test; final exam; mini-project	
M3	C1	Russian	ppts/lectures/docs (18 files)		tests	tests; mini-project	
	C2	Russian	ppts/lectures (9 files)		tests	tests; team-project	
	C3	Russian	ppts/lectures (9 files)		tests	tests; group-project; peer-assessment	
M4	C1	Russian	ppts/lectures (27 files)				
	C2	Russian	ppts/lectures (9 files)				
M5	C1	Russian	ppts/lectures (15 files)			team project	
	C2	Russian	ppts/lectures (18 files)			mini-project; student presentations	
M6	C1	English	many (37 files) documents/ppts/articles	7 – total duration 150.68 minutes	case studies / discussions / project	team-project assessment / final exam	introductions / written learning objectives
	C2	English	ppts/lectures (5 files)		tests /exercises	interim tests / team-project	written learning obj.
	C3	English	many documents/ppts (46 files)		case studies / discussions / exercises	team-project	written learning objectives
M7	C1	Russian	ppts/documents/lectures (29 files)		interim tests / practical work	team-work / final test	
	C2	English	ppts/lectures (44 files)		many interim tests		
	C3	Russian	ppts/lectures (36 files)	6 – total duration 11.16 min	interim tests / practical work		
M8	C1 - C2	Russian	ppts/lectures/documents (27 files)		case studies / exercises	peer to peer / discussions	

Evaluation of the learning material

Implementing the four assessment criteria to the EDUENVI learning material of Table 2, the emergent evaluation adopts three levels: (1) need for improvement, (2) possibility for improvement and (3) no need for improvement. These three levels are represented by colors: (1) blue, (2) orange and (3) red, so as the emergent summative assessment colormap for the material of modules and courses of Table 2 is shown in Table 3. No level (1) cells were found throughout the courses, 39 cells need no improvements and for 29 cells there are suggestions for possible improvements.

Table 3 Colormap for further material improvements of modules and courses

Color specification					
Needs improvement		Permits improvement		No improvements	
Mod.	**Course**	**Criterion 1**	**Criterion 2**	**Criterion 3**	**Criterion 4**
M1	C1 - C3				
M2	C1				
	C2				
M3	C1				
	C2				
	C3				
M4	C1				
	C2				
M5	C1				
	C2				
M6	C1				
	C2				
	C3				
M7	C1				
	C2				
	C3				
M8	C1 - C2				

Toward criterion 1, the majority of courses include plenty of content consisting of documents, presentations and articles. Given that each course lasts for approximately 8 weeks, the workload per ECTS is reasonable and the material can be followed within the program timetable. A few courses may need to enrich the existent learning material in future implementations.

Toward criterion 2, the majority of courses encompasses high-end learning material with state-of-the-art knowledge on sustainable waste management, well-organized thematically, clear leaning objectives, comprehensive language, attractive design, equipped with exercises, case studies and activities. The learners' assessment methodology and procedure are clear and authentic (i.e. associated with the learning needs) in most cases. In a few cases, improvements refer to the enrichment of exercises and case studies, clarification of assessment processes and inclusion of teacher resumes and specific learning objectives per lecture.

Toward criterion 3, half of the courses utilize very effective and motivational learning material with plenty of case studies, activities, problems, additional learning resources and real-life examples. They also include videos, lots of tests and team-work accommodating task-specific needs of different type individuals. It is recommended for the rest of courses to enrich the alternative teaching material, especially with videos and interactive learning tools which facilitate active learning, in order to motivate different type learners and to enhance the engagement of them with the course.

Toward criterion 4, there are courses which incorporate learning material that supports autonomy and self-directed learning. Different type of cases and problems connected with real-life experiences in well-organized tasks exhibit high usability of the content. Although the rest courses follow the same perspective, in accordance with the handbook of curriculum, there are possibilities for improvements. The content is thematically organized in separate lectures that can be enriched with interactive learning tools to improve autonomy and self-assessments. Overall, the organization of themes and their authenticity permits integration in other educational programs and contexts.

In sum, the learning material of the EDUENVI project is of high quality, meets the European requirement of HE, but also allows of suggestions for future improvements presented next.

Feedback for future improvements

Although the learning material of EDUENVI project already exhibits the required quality, some improvements are possible for future implementations. The next comments aim at providing the examiner's comments and feedback to the consortium on how to enhance the use and potential of the material produced in the present learning program.

1. The inclusion of stakeholders' and local authorities' views as well as job market demands in some courses' content enhances the engagement with the course as it confronts vocational needs of the learners and motivates them. Close monitoring of real-life examples and cases offers authentic and unique insights on the utility of what is learnt. The "know-why" dimension of learning is very crucial once the learning aims to affect the attitudes of learners. The inclusion of teachers' resumes, professional skills and contact info is also important toward this direction as online learning can easily become impersonal with poor communication between the peers and the instructor.

2. The guidance throughout the learning material in some courses can be enriched. The inclusion of specific comments on how to read the content, how to perform the exercises and the provision with exact or indicative answers per exercise or activity, greatly advances the autonomy of learning. Additionally, glossaries and indexes are very helpful. In this way, the "flipped classroom"[15] model in blended learning can be pursued.

3. Written learning objectives per lecture are very important in providing authentic evaluation at the end of each course. Beyond the general learning objectives of the module or course, written objectives in the beginning of each lecture, or even task, render the provided knowledge and skills identifiable and measurable. Thus, the inclusion of comments and step-by-step guidance, where needed, autonomizes the content as a standalone teaching-learning tool capable of supporting self-directed learning once the program is offered online or under blended learning models.

[15] https://en.wikipedia.org/wiki/Flipped_classroom

4. The diversification of the learning material with incorporation of videos and alternative ICT content (with possible use of social media) is also helpful in engaging the students in the tasks. In some courses, videos could be included along with gamification techniques in exercises and activities, or the inclusion of learning badges, in order to increase the interaction with the course and peers.

5. Many courses utilize team-projects on real case studies that accommodate active learning techniques (collaborative learning, interaction with the material, co-development of outputs, peer review, etc.). This practice could be equally transferred to all courses and their learning material without increasing the workload significantly.

6. Another important aspect for self-directed learning is the empowerment of meta-cognitive skills. Reflective exercises or discussions, with possibilities for self-reflection, are extremely useful on "learning to learn" that is a key-competence in modern policies for education. Therefore, metacognition and creative thinking could be strengthened in some cases of the learning material.

7. The transferability of the project's learning material to other educational programs and contexts is also important for the sustainability of the present outcome. The learning material already exhibits a sound and easy to follow thematic classification that could be reexamined, where needed, in order to become fully modular and extendable. It is suggested part of the project's content might be integrated to other educational curricula, and VET, through the micro-credentialling[16] system.

8. Lastly, entrepreneurship could be encouraged in all courses and modules as it is one of the eight key-competencies in European Lifelong learning.

The previous eight remarks are the examiner's feedback for future amendment and exploitation.

[16] https://ec.europa.eu/education/education-in-the-eu/european-education-area/a-european-approach-to-micro-credentials_en

Final conclusion

The present evaluation was based on four criteria consistent with European Commission's requirements for Higher Education. According to its result, the learning material of the EDUENVI project is a rich, knowledge-intensive source for active online learning in "Sustainable Waste Management". Its main advantage emerges from the multi-stakeholders' collaboration to develop an educational program that meets the substantive demands of the economy (industry-university collaboration) and the contemporary job market, especially for Russia and Kazakhstan. The learning material complies with the European Commission's requirements for Higher Education as expressed in several directives[17] and wider perspectives for education[18]. The output of the EDUENVI Erasmus+ project, a joint effort of nine universities, can be disseminated throughout educational curricula in both countries, Europe and abroad. The inclusion of entrepreneurship and sustainability topics strengthens the utility of the curriculum for students as entrepreneurship is included among the eight key-competencies for the European Lifelong Learning, associated with the recent European life competencies framework[19]. The present educational output can be also used as a base for future projects focusing on online education not only in waste management but in other relevant fields too.

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[17] http://www.ecahe.eu/w/index.php/Framework_for_Qualifications_of_the_European_Higher_Education_Area, https://ec.europa.eu/education/education-in-the-eu/council-recommendation-on-key-competences-for-lifelong-learning_en

[18] https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/

[19] https://ec.europa.eu/jrc/en/lifecomp