SITUATION ANALYSIS REPORT no. 4

A pilot project
NATURAL SCIENCES AND MATHEMATICS CONTENTS IN THE DEVELOPMENT OF DIGITAL COMPETENCES

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GENERAL INFORMATION

The pilot project NATURAL SCIENCES AND MATHEMATICS CONTENTS IN THE DEVELOPMENT OF DIGITAL COMPETENCES as part of the "Plan for recovery and resilience, the project Reform of higher education for a green and resilient transition to Society 5.0" is being implemented at the Faculty of Sciences and Mathematics at the University of Maribor (FNM UM) and at the Faculty for Civil Engineering, Transport Engineering and Architecture at the University of Maribor (FGPA UM), in the period from 01/09/2022 to 31/08/2025.

The following activities are planned for the pilot project:

A1) Analysis of the situation.

A2) Comprehensive planning for the development of competences for the digital and green transition.

A3) Comprehensive implementation for the development of competences for the digital and green transition and lifelong learning.

A4) Evaluation.

The findings and results of the project work are collected in a status analysis report and two local reports. All reports are publicly available in Slovenian and English:

- KLEMENČIČ, Eva, CAJNKO, Petra, HANŽIČ, Katja, MACUH, Borut, REPNIK, Robert, MENCINGER, Matej. *Natural sciences and mathematical content in the development of digital competences: pilot project: report on the analysis of the situation* . Maribor: Faculty of Natural Sciences and Mathematics, 2024. 1 online source (1 PDF file ([78] pages)), tables. https://www.fnm.um.si/index.php/2024/02/16/porocilo-o-analizi-stanja-projekta-noo/ .
- KLEMENČIČ, Eva, ARCET, Barbara, GRUJIĆ, Jaša Veno, HANŽIČ, Katja, HRASTNIK LADINEK, Irena, HÖLBL, Arbresha, MENCINGER, Matej, REPNIK, Robert, REPOLUSK, Polona, SLAVINEC, Mitja, CAJNKO, Petra. Natural sciences and mathematical content in the development of digital competences: pilot project: study: interim report no. 2. Maribor: Faculty of Natural Sciences and Mathematics, 2024. 1 online source (1 PDF file ([214] pages)), illus., tables. https://www.fnm.um.si/index.php/2024/04/22/drugo-porocilo-o-analizi-stanja-projekta-noo/
- KLEMENČIČ, Eva (author, project leader), MENCINGER, Matej, REPNIK, Robert, CAJNKO, Petra. Natural sciences and mathematical content in the development of digital competences: pilot project: study: interim report no. 3. Maribor: Faculty of Natural Sciences and Mathematics, 2024. 1 online source (1 PDF file (61 pages)), illus., tables. https://www.fnm.um.si/wp-content/uploads/2024/09/NOO_V3_objava-sep-24.pdf .

The fourth interim report contains summaries and main results of project activities in the period from 1 July 2024 to 31 December 2024. The researchers listed in Table 1 participated in the project activities.

Table 1. Project team members.

Member of the project team		Member	Period of employment	Role
Barbara	**Arcet**	FNM	1.5.2023-31.8.2025	researcher
Petra	**Cajnko**	FNM	1.10.2022-31.8.2025	pilot project coordinator, member of the project council, researcher
Daša	**Donša**	FNM	1.1.2023-29.2.2024	researcher
Brigita	**Ferčec**	FNM	1.11.2022-31.8.2025	researcher
Katja	**Hanžič**	FGPA	1.1.2023-31.8.2025	researcher
Arbresha	**Hölbl**	FNM	1.11.2022-31.8.2025	researcher
Irena	**Hrastnik Ladinek**	FGPA	1.10.2022-31.8.2025	researcher
Veno Jaša	**Grujić**	FNM	1.10.2022-30.9.2024	researcher
Eve	**Klemenčič**	FNM	1.9.2022-31.8.2025	Project manager, project board member, researcher
Borut	**Macuh**	FGPA	1.1.2023-31.8.2025	researcher
Matej	**Mencinger**	FGPA	1.10.2022-31.8.2025	member of the project council, researcher
Robert	**Repnik**	FNM	1.9.2023 – 31.8.2025	member of the project council, coordinator of FNM-FGPA, researcher
Polona	**Repolusk**	FNM	1.1.2023-31.8.2025	researcher
Mitja	**Slavinec**	FNM	1.9.2022-31.8.2025	researcher
Leon	**Vratar**	FNM	12.6.2023-31.8.2025	professional associate
Jan	**Zmazek**	FNM	1.10.2022-30.9.2024	researcher

SHORT OVERVIEW OF THE WORKFLOW BY SUB-ACTIVITIES

In the reporting period, we continued working on activity *A2.2 Defining the level of competence development of graduates of selected study programs* and focused on activity *A3 Comprehensive implementation for the development of competences for the digital and green transition and lifelong learning.* Activity *A3* is divided into four sub-activities, which are listed in Table 2. The implementation of these sub-activities does not follow a linear pattern. We were also actively engaged in Activity *A4, Evaluation*, specifically in Sub-activity A4.2, Dissemination of Results.

Table 2. Sub-activities A 3

label	*activity*
A3	**Comprehensive implementation for developing competences for digital and green transitions and lifelong learning**
A3.1	Workshop preparation
A3.2	Promotion of workshops
A3.3	Conducting workshops
A3.4	Workshop evaluation

In July and August, researchers contributed to Sub-activity A4.2 by preparing abstracts for various international scientific conferences, where we presented the project's results to a broader audience. So far, participation in two conferences in 2025 has been confirmed: *The 10th IAFOR International Conference on Education (IICE2025)* and *MIPRO 2024 – 47th Convention*. Additionally, we continued preparing and promoting workshops. For 2025, we also plan to invite guest experts in digital competences, higher education, and energy literacy.

In September, we resumed workshop implementation and conducted six additional workshops by the end of 2024. Alongside the workshops, we carried out ongoing evaluations using evaluation forms. The findings are presented in the *Workshop Evaluation* chapter.

Parallel to activities A4 and A3, we also completed activity *A2.2 Defining the level of competence development of graduates of selected study programmes in this reporting period.* We examined the extent to which the fundamental goals and competences of selected study programmes align with digital competences, algorithmic, logical, and abstract thinking, natural science competences, and energy literacy. To assess students' competence levels, we designed closed-type questionnaires in which students provided self-assessments of their achievement in digital competences (based on the *DigComp 2.2* framework) and their proficiency in energy literacy, sustainability, and green transition. For this purpose, the project council developed a competency framework, detailed in the chapter *Competences of Energy Literacy, Sustainability, and Green Transition*. The analysis of the questionnaires will be presented in the next interim report.

We participated in the monitoring of the OECD pilot project, which took place on 25 September 2024. The questionnaires and results are included in the OECD Monitoring chapter. In October, we also took part in the University of Maribor Science Festival (15 October 2024). As part of the Pilot Projects section of NOO UM, we presented the project Natural Science and Mathematics Content in the Development

of Digital Competences Up Close (Figure 1). The presentation is attached to this interim report (Appendix 1).

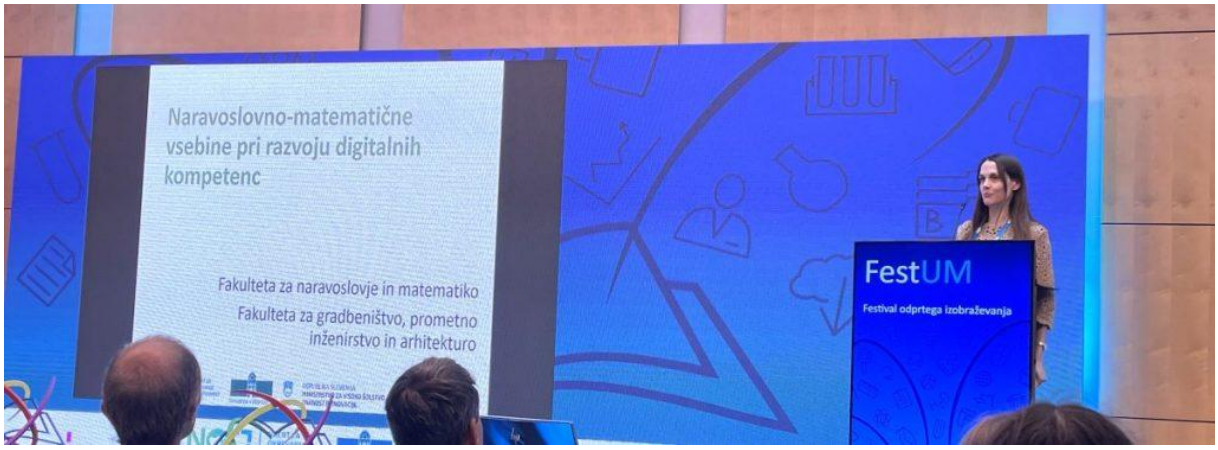

Figure 1. Presentation of the NOO project at FestUM on October 15, 2024.

With the start of the new academic year, computer equipment was introduced to modernize laboratory exercises in selected study programs. A brief report on this development is provided in the chapter Modernization of the Pedagogical Process to Support the Development of Digital Competences.

The status of the indicators as of 31 December 2024 is presented in Table 3.

Table 3. Set indicators and status.

no	*indicator*	*condition*	*note*
1	Situation analysis	completed	Interim report 1
2	Definition of the required level of digital competences and energy literacy	completed	Interim report 4
3	Comparative analysis	completed	Interim report 2
4	List of content and skills	completed	Interim report 2
5	Conducting at least 10 workshops/trainings	In progress / achieved (11/10)	Interim report 3 and 4
6	Number of participants	In progress / achieved 184 participants (82 participated in the evaluation)	Interim report 3 and 4
7	Micro-evidence *Certificates of attendance	In progress / achieved 123 certificates of attendance	Interim report 3 and 4
8	Recommendations for supplementing learning units and proposals for new learning units focused on labor market needs	In progress	
9	Evaluation report and dissemination of results	In progress	

COMPETENCES OF ENERGY LITERACY, SUSTAINABILITY AND GREEN TRANSITION OF GRADUATES

In the project activities to date, researchers have identified gaps in the comprehensive development of competences for a sustainable and green future. To address this, we have developed a competency framework for energy literacy, sustainability and green transition, intended primarily for students of science, mathematics and engineering study programs. In the development, we considered the UNESCO Sustainable Development Goals [1], the European Competence Framework for Sustainability [2]and the Energy Literacy Development Handbook [3]. We also considered the findings of a documentary analysis of curricula and accreditation documents of study programs, as well as graduate questionnaires, which provided insight into labor market requirements. The proposed competency framework highlights the knowledge and skills that graduates of science, physics, mathematics and civil engineering should acquire to promote energy literacy, sustainability and contribute to the green transition. It highlights the importance of key competences such as systems thinking, which enables students to understand the interconnectedness of environmental, economic and social systems; critical thinking, which enables graduates to analyze complex issues, challenge assumptions and make informed decisions; and problem solving, equipping them to design innovative solutions to real-world sustainability challenges. In addition, the framework highlights the importance of mathematical modeling as a tool for simulating and predicting system behavior, which aids decision-making processes for sustainable development. In addition, the framework fosters an attitude and awareness of the pressing issues of the "triple planetary crisis" - climate change, biodiversity loss, and pollution - encouraging graduates to be proactive and solution-oriented in their approach to these challenges.

The competency framework consists of 12 specific competences, grouped into five thematic areas (Figure 2): Systems Thinking of Energy Systems, Biodiversity, Resource Management, Technological Competence and Policies and Regulation Awareness.

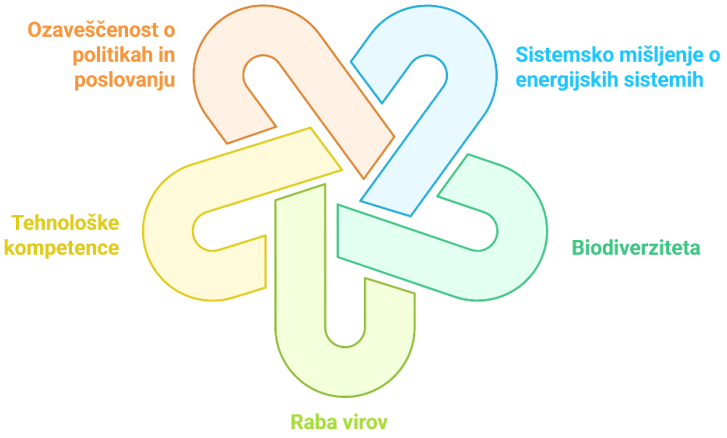

Figure 2. Infographic of the competency framework for energy literacy, sustainability and green transition.

[1] https://unis.unvienna.org/unis/sl/topics/sustainable_development_goals.html

[2] https://joint-research-centre.ec.europa.eu/greencomp-european-sustainability-competence-framework_en

[3] https://www.en-lite.si/enlite/gradiva

For each of the 12 competences, we have developed descriptors that describe students' progression in knowledge and skills, from fundamental understanding (basic level) to application and innovation (advanced level). The descriptors for each thematic area are listed in Tables 4-8.

Table 4. System thinking of energy systems competences with descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
1.1 Understanding systems	Recognize the basic relationships, cause-effect relationships, feedback loops, and energy flows within environmental systems	Analyze relationships, cause-and-effect links within and between systems and use models (e.g., stock-flow diagrams) to understand system dynamics.	Plan and take part in problem-solving (e.g., using mathematical modelling), seek proposals, and design solutions that consider long-term sustainability (interdisciplinarity).
1.2 Understanding the concept of energy	Understand the basic physics concepts of energy, list renewable energy sources, know that solar energy is stored in fossil fuels and biomass.	Explain energy conversions, energy losses and the importance of different energy sources, explain the ways of generating electricity and knows that energy can be stored for later use in diverse ways.	Understand that different energy sources and different forms of energy conversion, transport and storage have their advantages and disadvantages, analyze the efficiency of energy systems and the impact on the environment (carbon footprint).
1.3 Understanding physical processes on earth driven by energy flows	Understand that the sun is a key energy source, and that an internal or external energy source is needed for the flow of matter on Earth.	Understand that energy flows change our planet and knows the most important energy sources for processes on Earth (solar, radioactivity, rotation).	Explain and critically assess the impact of greenhouse gases on energy flows and understand that changes in energy flows at the system-wide level are not at once detected.
1.4 Understanding biological processes on earth driven by energy flows	Know that the sun is the primary energy source for organisms and ecosystems, and that food is biofuel for organisms.	Understand that energy in food chains flows one-way from producers to consumers, know the response of ecosystems to the availability of energy and nutrients.	Understand how ecosystems respond to the availability of energy and nutrients and is aware of the dependence and influence of humans on energy flows through these systems.

Table 5. Biodiversity competences with descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
2.1 Understanding biodiversity	Know the basic concepts of biodiversity and is aware of its importance.	Analyze the factors that affect biodiversity and link biodiversity with the energy efficiency of systems.	Formulate and implement strategies for the conservation of biodiversity.
2.2 Biodiversity management	Recognize the basic principles of biodiversity management (protected areas, etc.).	Apply biodiversity management practices in different contexts (species diversity in urban areas, etc.).	Plan and develop biodiversity management programs.

Table 6. Resource management skills competences with descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
3.1 Sustainability of resource management	Understand the importance of conserving resources (water, energy, etc.).	Identify and apply measures for the sustainable management of resources (e.g., rainwater harvesting, waste management, circular economy).	Analyze and optimize sustainable resource management measures (life cycle analysis, carbon footprint quantification).
3.2 Efficient use of energy	Recognize the day-to-day activities that consume energy, know the basics of saving energy consumption and is aware that the need for energy is growing, and energy resources are limited.	Know that social and technological innovations have an impact on the amount of energy consumed by society, identify and implement energy efficiency measures, is aware of how much energy is used to conduct activities and where energy is obtained from.	Know and use approaches for calculating, measuring, and monitoring the amount of energy consumed, plan and develop methods for efficient use of energy and optimization of energy processes (e.g., in the energy efficiency of buildings, life cycle of buildings)-

Table 7. Technological competences with descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
4.1 Understanding renewable energy technologies	Know the basic operation of renewable energy technologies.	Understand and analyze the operation of renewable energy technologies.	Plan and develop innovative solutions for the use of renewable energy sources.
4.2 Understanding green technology	Know the basic green technologies and their advantages (electric vehicles, sustainable materials, etc.). Know the concept of carbon footprint.	Understand basic green technologies and analyze their strengths and weaknesses (e.g., material life cycle analysis).	Plan, develop, and optimize green technologies.

Table 8. Policies and Regulations Awareness competences with descriptors

Competence	Basic	Intermediate	Advanced
5.1 Understanding policies	Understand basic environmental policies and regulations, is aware that decisions about the choice and use of energy sources affect the quality of life of individuals and society.	Explain the environmental policies that support the green transition and recognize that economic, political, environmental, and social factors influence decisions on the choice and use of energy sources.	Analyze and predict factors influencing decisions on the exploitation of energy resources, assesses risks, formulates the development of environmental policies at regional, national, or international level.
5.2 Green business	Understand the basics of green business and sustainable entrepreneurship.	Analyze examples of good practices in green business and sustainable entrepreneurship.	Plan and develop strategies for green business and sustainable entrepreneurship.

METHODOLOGY AND PREPARATION OF INSTRUMENTATION

To assess the digital competence levels of graduates upon completion of their studies, we conducted a document analysis using a prepared Excel spreadsheet (Appendix 2). This analysis considered the learning units identified in the situation analysis as well as the fundamental objectives and competences outlined in the accreditation applications for the *Physics*, *Mathematics*, and *Subject Teacher* study programs. Based on these findings, we evaluated the level of individual digital competences.

For graduates and final-year students in selected study programs, we developed a survey questionnaire in the 1KA application (Appendix 3), allowing respondents to provide a self-assessment of their proficiency in each digital competence. Additionally, we consulted the heads and coordinators of study programs regarding their assessment of graduates' digital competence levels, using a slightly adapted version of the questionnaire. The results of the survey will be presented in the 5th interim report.

All assessments were based on the DigComp 2.2 competence framework, which categorizes digital competences into five domains: 1. Information and data literacy, 2. Communication and collaboration, 3. Digital content creation, 4. Security and 5. Problem solving. According to DigComp 2.2, we have 8 levels of competence, which are divided into Basic levels (1 and 2), Intermediate levels (3 and 4), High levels (5 and 6), Master levels (7 and 8).

To assess the digital competence levels of graduates upon completion of their studies, we developed a survey questionnaire in the 1KA application (Appendix 4) for graduates and final-year students in selected study programs. Respondents provided a self-assessment for each competence.

DOCUMENTARY ANALYSIS OF DIGITAL COMPETENCES

The results of the document analysis on the study programs Physics (BSc), Mathematics (BSc) and Subject Teacher (Unified master study) – Educational Physics (Edu.phys) track and Educational Mathematics (Edu.Math) track, are given in Table 9.

Table 9. Achieved level of digital competences of FNM UM students.

1. INFORMATION AND DATA LITERACY	**PHYSICS**	**MATHS**	**EDU.PHYS**	**EDU. MATH**
1.1 BROWSING, SEARCHING AND FILTERING DATA, INFORMATION AND DIGITAL CONTENT	6	8	5	8
1.2 EVALUATION OF DATA, INFORMATION AND DIGITAL CONTENT	6	8	4	8
1.3 DATA, INFORMATION AND DIGITAL CONTENT MANAGEMENT	5	8	5	7
2. COMMUNICATION AND COOPERATION	**PHYSICS**	**MATHS**	**EDU.PHYS**	**EDU. MATH**
2.1 INTERACTION USING DIGITAL TECHNOLOGIES	6	8	4	8
2.2 SHARING USING DIGITAL TECHNOLOGIES	5	8	4	8
2.3 CITIZEN PARTICIPATION USING DIGITAL TECHNOLOGIES	3	5	3	5
2.4 COOPERATION USING DIGITAL TECHNOLOGIES	7	8	4	8
2.5 ONLINE ETIQUETTE	5	2	4	2
2.6 DIGITAL IDENTITY MANAGEMENT	5	5	5	5
3. DIGITAL CONTENT CREATION	**PHYSICS**	**MATHS**	**EDU.PHYS**	**EDU. MATH**
3.1 DIGITAL CONTENT DEVELOPMENT	5	6	4	6
3.2 PLACEMENT AND RE-CREATION OF DIGITAL CONTENT	5	5	4	4
3.3 COPYRIGHT AND LICENSES	4	5	3	5
3.4 PROGRAMMING	5	8	3	5
4. SAFETY	**PHYSICS**	**MATHS**	**EDU.PHYS**	**EDU. MATH**
4.1 DEVICE SAFETY CONSIDERATION	4	5	4	5
4.2 PROTECTION OF PERSONAL DATA AND PRIVACY	4	3	5	3
4.3 HEALTH AND WELL-BEING CARE	3	2	4	2
4.4 ENVIRONMENTAL PROTECTION	4	1	3	1
5. PROBLEM SOLVING	**PHYSICS UN**	**MATHS UN**	**EDU.PHYS**	**EDU. MATH**
5.1 SOLVING TECHNICAL PROBLEMS	4	2	4	2
5.2 IDENTIFYING NEEDS AND DEFINING TECHNOLOGICAL RESPONSES	6	6	4	6
5.3 CREATIVE USE OF DIGITAL TECHNOLOGY	5	5	5	5
5.4 IDENTIFYING DIGITAL SKILL GAPS	4	5	4	5

In the Bachelor's in Physics study program, document analysis indicates that graduates should attain a high level of digital competence upon completion of their studies, with a median of 5 and a standard

deviation of 1, suggesting a non-normal distribution. The lowest competence level is observed in Area 4 – Security.

Similarly, in the Bachelor's in Mathematics study program, the results show that graduates are expected to achieve a high level of digital competence, with a median of 5 and a standard deviation of 2. Again, the lowest competence level is found in Area 4 – Security.

For the Subject Teacher study program, document analysis reveals that graduates specializing in Educational Physics are expected to attain an average level of digital competence (median 4, standard deviation 0.7), while those specializing in Educational Mathematics should reach a high level (median 5, standard deviation 2). As with the Physics and Mathematics non-pedagogical study programs, the lowest competence level is observed in Area 4 – Security.

ANALYSIS OF THE 2024 GRADUATES SURVEY

Analysis of survey questionnaires of graduates of the Faculty of Natural Sciences and Mathematics at the University of Maribor (December 2024)

1. Basic information

Based on a survey conducted on FNM UM graduates for 2024, we collected the following basic data:

- Total number of respondents: 19
- Valid answers: The number of valid answers varies depending on the individual questions (e.g. 7 for the question "which level did you complete", 19 for the question "the subject is appropriate").

Breakdown by study programs:

- Pedagogical program: 8 (42%)
- Non-pedagogical program: 11 (58%)

Completed orientations in the Subject Teacher program:

- Educational Biology: 6 (32%)
- Educational Chemistry: 6 (32%)
- Educational Computing: 7 (37%)
- Educational Physics: 5 (26%)
- Educational Technology: 4 (21%)

Completed levels of study:

- Bachelors: 0 (0%)
- Masters: 3 (16%)
- PhD: 2 (11%)
- Other: 2 (11%)

Valid answers: 7 (37%)

2. Statistical analysis and results

Means and standard deviations for important variables are

Table 10: Statistical analysis

Category	Average	Standard deviation
Number of respondents	9.50	2.12
Average age	31.00	1.41
Completed level	2.85	0.07
Digital literacy	9.50	3.54
Energy literacy	8.50	4.95

1. Number of respondents by study program:
   Pedagogical program (8) represents 42%, and non-pedagogical program (11) represents 58%.
2. Average age of graduates (at the time of the survey):
   Pedagogical program: 30 years
   Non-pedagogical program: 32 years

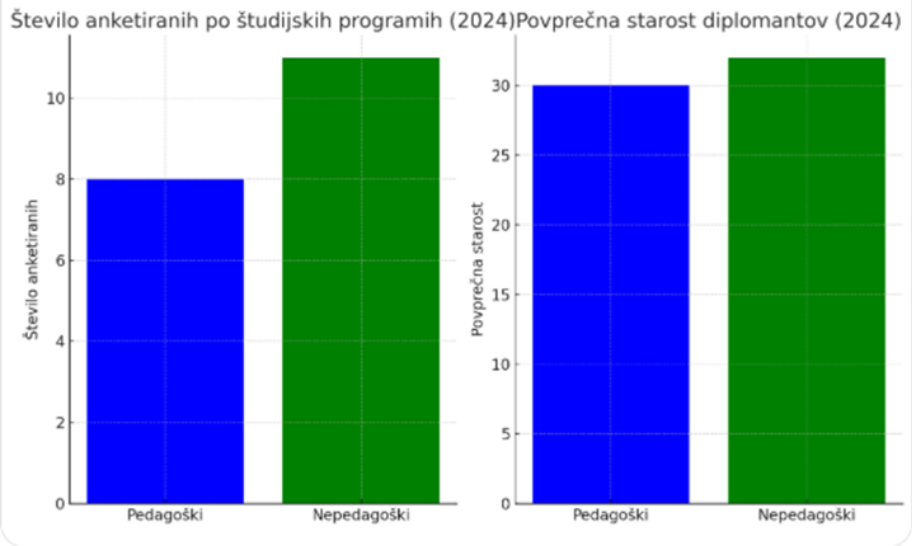

Figure 3: Number of respondents by study program (2024) and Average age of graduates (2024)

3. Differences between groups for each of the four competency areas

The graph above shows the differences between graduates of teaching and non-teaching programs in four key competency areas:

1. Algorithmic thinking competences: Graduates of non-pedagogical programs (12) recognize algorithmic thinking to a greater extent than graduates of pedagogical programs (7).

2. Natural science competences: Here the results are very similar for both groups, with the pedagogical program (10) being only slightly more recognizable than the non-pedagogical program (9).
3. Digital competences: Like algorithmic thinking, non-pedagogical graduates (11) identify digital competences better than pedagogical graduates (8).
4. Energy literacy: Here, the results are in favor of non-pedagogical programs, as 13 out of 19 graduates surveyed recognize it as part of their studies, while only 6 recognize it in pedagogical programs.

These differences reflect specific emphases in study programs, which means that it would be useful to consider increasing the inclusion of technological and digital competences in pedagogical programs and additional focus on sustainability and energy content in non-pedagogical programs.

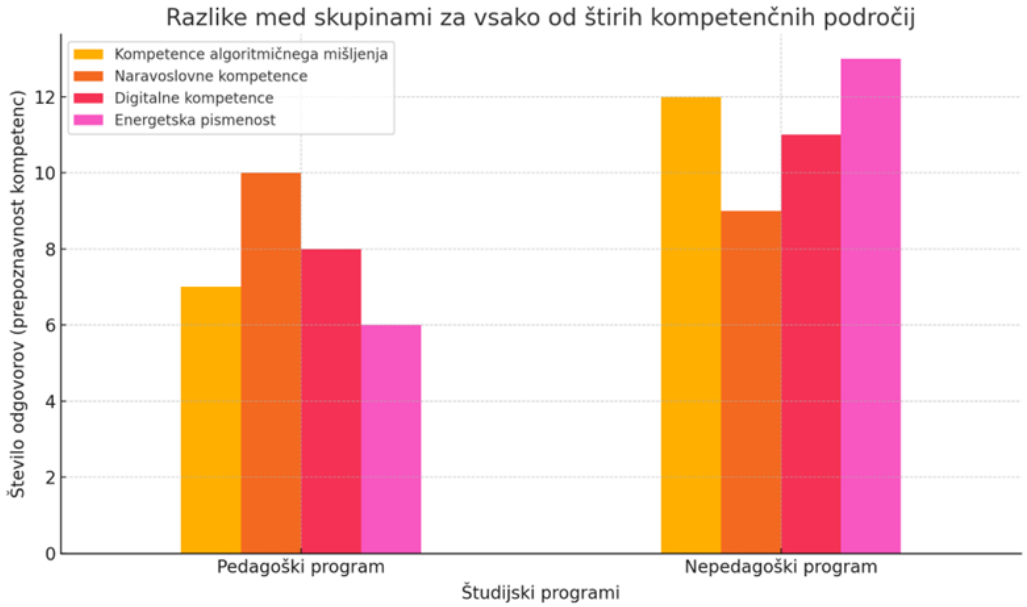

Figure 4: Difference between groups for each of the four competency areas

4. Statistical gaps and recommendations

Digital literacy:

- Results: Digital literacy competences were recognized by only 7 out of 19 respondents (37%).
- Statistical analysis: The chi-square test shows that the perceived proportion of digital competences is lower than expected.
- Interpretation: Digital competences are not sufficiently included or recognized in the pedagogical process.
- Recommendation: Strengthen content such as advanced use of computer tools, version control, and terminal work, and better integrate them into the study process.

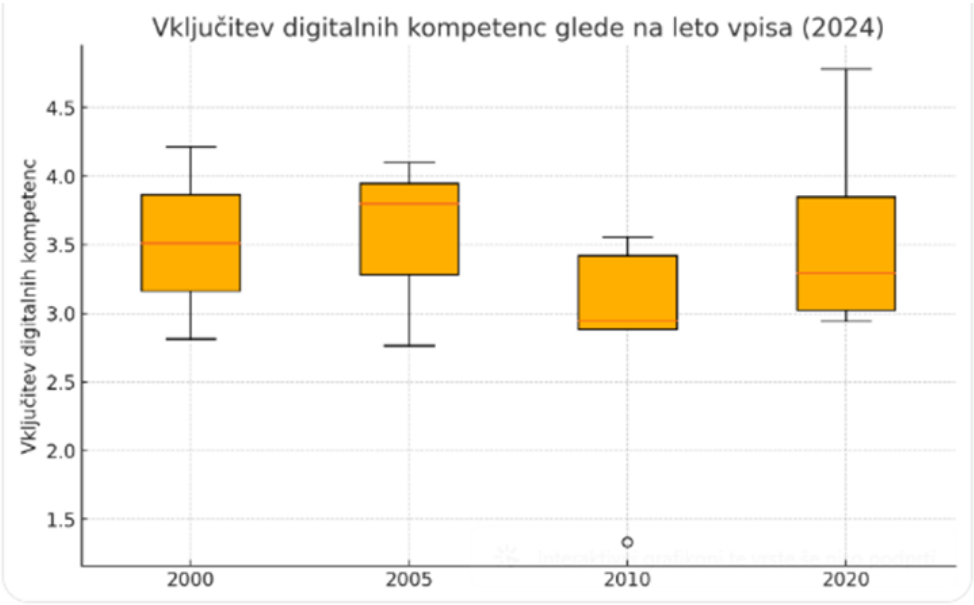

Figure 5: Inclusion of digital competences by year of enrollment.

Energy literacy:

- Results: Energy literacy competences were identified by 5 out of 19 respondents (26%).
- Statistical analysis: The share of energy literacy competences is significantly lower than expected.
- Interpretation: There is a need to increase the inclusion of energy literacy in the curriculum.
- Recommendation: Emphasize sustainability aspects and energy efficiency and include practical examples such as renewable energy sources and energy systems management.

Sustainability competences:

- Recommendation: Expand sustainable content to increase the visibility of these important areas in the economy and society.

4. Conclusion

The analysis showed that there are significant gaps in the integration of digital and energy competences into study programs. Emphasis on sustainable competences, energy literacy and digital literacy is crucial to improve the study process and prepare graduates for the challenges of the modern labor market.

Looking to the future:

- Suggestions for further research: Given the identified gaps in the integration of certain competences, it is recommended to continue monitoring the effects of the implementation of changes in the learning process. We recommend that in the future, we focus on analyzing the long-term effects of these changes, as well as on monitoring the performance of graduates who have acquired these additional competences.

ANALYSIS OF TWO SURVEYS OF GRADUATES 2023 AND 2024

Report on the comparison of research results between graduates of 2023 and 2024

Surveys conducted among graduates in 2023 and 2024 offer interesting insights into the development of competences and perceptions among graduates of various programs. In this report, we will analyze key findings in terms of sample size, demographic characteristics, competences, satisfaction with the curriculum, and suggestions for improvement.

1. Sample size and demographic characteristics

Research 2023:

- Total 166 respondents.
- 94 from pedagogical programs (57 %) and 72 (43 %) from non-pedagogical programs.

Research 2024:

- A total of 19 respondents.
- 8 from pedagogical programs (42 %) and 11 (58 %) from non-pedagogical programs.

2. Competences

2.1 Digital competences

Research 2023:

- Significant differences were observed between pedagogical and non-pedagogical groups regarding digital competences.
- Graduates of non-pedagogical programs were more satisfied with the development of digital competences within formal education.

Research 2024:

- Similar to 2023, graduates of non-pedagogical programs recognized digital competences more than those from pedagogical programs.
- Only 37% of respondents from pedagogical programs acknowledged the integration of digital competences.

2.2 Energy literacy

Research 2023:

- Statistically significant differences in energy literacy; higher satisfaction with its integration among graduates of non-pedagogical programs.

Research 2024:

- Similar to 2023, graduates of non-pedagogical programs reported satisfactory integration of energy literacy.

2.3 Algorithmic, logical and abstract thinking

Research 2023:

- Differences between graduates of pedagogical and non-pedagogical programs, particularly in the field of artificial intelligence.

Research 2024:

- Graduates of non-pedagogical programs reported greater integration of algorithmic and logical thinking competences.

2.4 Natural Science Competences

Research 2023:

- Graduates of non-pedagogical programs excelled in areas such as data processing, research, and synthesis.

Research 2024:

- Both groups showed similar results in recognizing the integration of natural sciences competences.

3. Satisfaction with the curriculum

Research 2023:

- Focusing on the inclusion of various competences, especially artificial intelligence and data management, with notable differences between pedagogical and non-pedagogical programs.

Research 2024:

- Many graduates from both groups expressed satisfaction with the curriculum, but it was clearly expressed that they would like more practical skills, especially in the use of computer programs, and better connections between theory and practice.

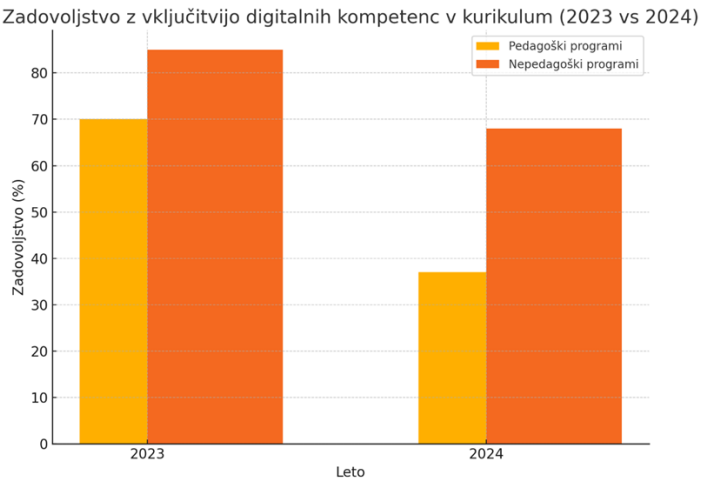

Figure 6: Satisfaction with the inclusion of digital competences in the curriculum (2023 vs 2024).

4. Suggestions for improvements

Research 2023:

- Participants highlighted the importance of incorporating artificial intelligence, data analytics, and energy literacy into the curricula of both programs.

Research 2024:

- Respondents highlighted the need to improve digital literacy, energy literacy, and include more sustainability topics and practical experiences in the curriculum.

Table 11: Suggestions for improvements (2023 vs 2024)

Suggestion for improvement	Research 2023	Research 2024
Improving digital literacy	Yes	Yes
Improving energy literacy	Yes	Yes
Incorporating more sustainability topics	No	Yes
Increasing practical experience	No	Yes

5. Conclusion

The main difference between the 2023 and 2024 surveys is the sample size, as the 2024 sample is significantly smaller. However, the key findings are similar in both years, as both surveys show a clear need for greater emphasis on digital and energy literacy. Graduates from non-pedagogical programs in most cases reported higher confidence in these areas in both years.

This highlights the need for improvements in pedagogical programs, especially in the integration of digital skills, energy literacy and other sustainability topics, which would contribute to a more comprehensive educational framework for the future.

MODERNIZATION OF THE PEDAGOGICAL PROCESS TO SUPPORT THE DEVELOPMENT OF DIGITAL COMPETENCES

During this period, we purchased computer equipment to modernize science laboratories and the pedagogical process.

Eight laptops are used in the pedagogical process to carry out experiments, thus promoting the development of digital competences in students (Figure 7). Table 12 lists some of the experiments, with measuring instruments and software used to carry out the experiment for the 3 analyzed learning units.

Table 12. Updating of practical courses.

learning unit	**Contents**	**meter**	**software**
Physics Didactics with Practicum 1 and 2	Accelerated movement of the cart	Vernier ultrasonic distance meter	Logger Pro
	Boyle's changes	Vernier pressure sensor	Logger Pro
	Trace of oscillation in tone, sound, noise and pop	Vernier microphone	Logger Pro, Audacity
	Sound Beats	Vernier microphone	Logger Pro
	Auditory area of the ear	Vernier microphone	Logger Pro
	Spectrometry	Vernier UV-VIS spectrophotometer	Logger Pro
	Doppler effect	Vernier microphone	Logger Pro
	Charging and discharging a capacitor	Vernier electric voltage and current meter	Logger Pro
Physics experiments 3	Coupled oscillation	Vernier ultrasonic distance meter	Logger Pro
	Oscillation with friction	Vernier ultrasonic distance meter	Logger Pro
	Resonance	Vernier ultrasonic distance meter	Logger Pro
	Spectrometer	TRISTAN spectrometer	TriWin3
Physics experiments 1	Measuring leg and arm muscle strength	Vernier force gauge	Logger Pro

It should be noted that students also use software for data processing and analysis, graphing, and report preparation as part of their experimental practicum. Microsoft Excel, Microsoft Word, and Origin are primarily used for these purposes.

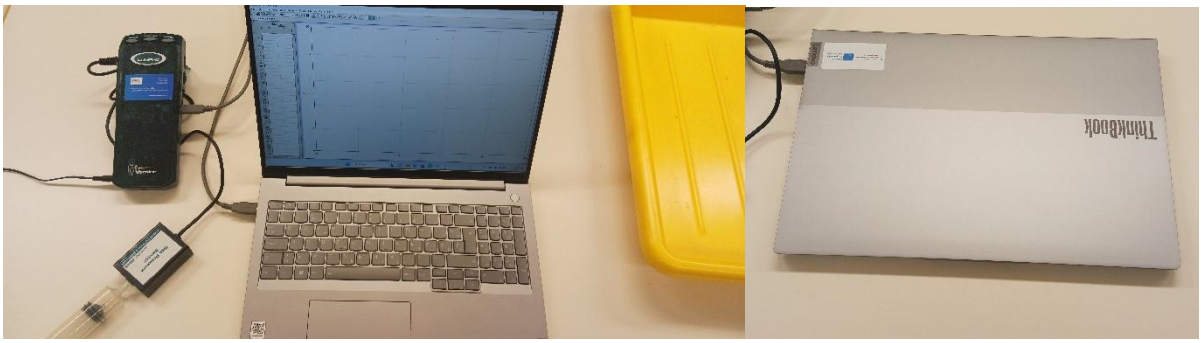

Figure 7. Use of computer equipment to update labs.

15 laptops are intended as a mobile classroom for conducting laboratory exercises in the following learning units: Computational Physics, Systems Thinking, System Dynamics Modeling, Complex Systems, Applied Physics, Numerical Methods. The following software is mainly used in the pedagogical process in the mentioned subjects: Visual Studio (C++ programming language), Python, MatLab, Berkeley Madonna and Wolfram Alpha and Wolfram Mathematica.

The decision to equip the mobile classroom was also made from the perspective of wider use. Laptops can also be used in other subjects where work with computer equipment is not in the foreground, and therefore they take place in classic lecture halls. They allow teachers to upgrade the treatment of the learning material by performing less time-consuming simulations, animations, etc. For example, laptops were used with students in conducting seminar exercises in the Mathematical Physics 1 course. Students used the Wolfram Alpha program to solve problems from the content of Taylor series expansion, and Matlab to solve problems from the content of Fourier analysis.

WORKSHOP CONDUCT

Digital tools for problem solving

The workshop was held on Tuesday, September 10, 2024, at 2 p.m. in lecture room 0/103 at the FNM UM and remotely.
Lecturer: Assist. Prof. Dr Eva Klemenčič

Workshop Summary: The workshop introduced participants to a problem-solving approach, with a focus on natural sciences and mathematics content. They learned about the use of various methods and digital tools for more efficient work.

Achievements of participants:

- Understanding fundamental approaches to solving problems in science and mathematics.
- Using digital tools for analysis, visualization and problem solving.
- Acquisition of practical skills for using specific software tools that support the problem-solving process.
- Improving digital competences with an emphasis on science and mathematics content.

Figure 8. Highlights from the workshop Digital Tools for Problem Solving, lecturer Assoc. Prof. Dr. Eva Klemenčič.

Civil Engineering, energy, environment

The workshop was held on Tuesday, September 24, 2024, at 2 p.m. in lecture room 0/103 at the FNM UM and remotely.
Lecturer: Assist. Prof. Dr. Borut Macuh

Workshop summary: The workshop explored fundamental aspects arising from the civil engineering study programs of the Faculty of Civil Engineering, Transport Engineering and Architecture, students' practice during their studies, and current professional subjects. We focused on important elements such as energy efficiency, the use of insulation materials, the importance of modern materials, the principles of the circular economy, and sustainability in construction. We also discussed the impact of construction on the environment and space and examined the practical experiences of students during their studies. The goal of the workshop was to stimulate discussion and exchange of ideas between students and colleagues on the topic of sustainable construction, emphasizing the importance of energy efficiency, the use of sustainable materials, and measures to reduce negative impacts on the environment and space.

Achievements of participants:

- In-depth understanding of energy efficiency.
- Knowledge of insulation and modern materials.
- Understanding the principles of the circular economy.
- Reducing negative environmental impacts and focusing on sustainable construction.

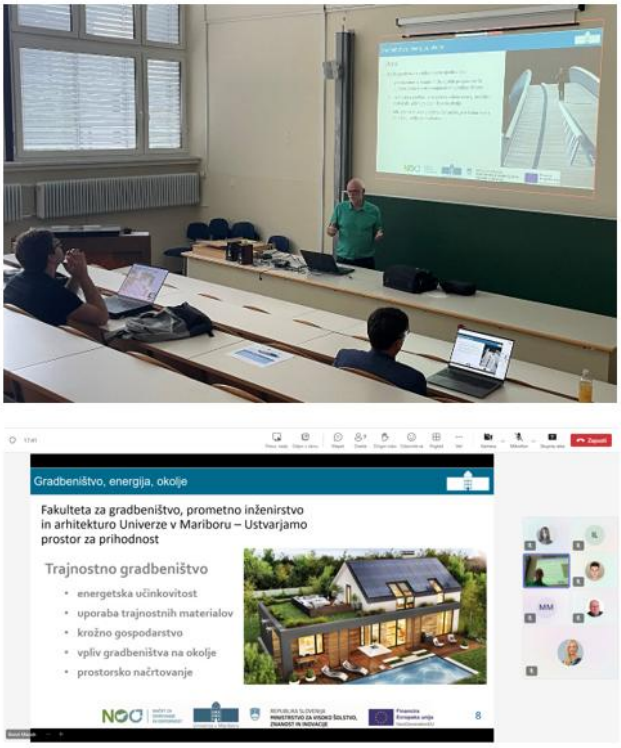

Figure 9. Snapshots from the workshop Construction, Energy, Environment, lecturer Assoc. Prof. Dr. Borut Macuh.

Flipped classroom to support the development of natural sciences and digital competences

The workshop was held on Tuesday, October 29, 2024, at 2 p.m. at the PEF UM and remotely.
Lecturer: Full Prof. Dr Robert Repnik

Workshop summary: Flipped learning and teaching enable more intensive individualization of learning. Unlike some traditional teaching methods, in which content is usually presented to students at the faculty frontally (mostly in larger groups) and where the provider of the pedagogical process focuses primarily on presenting the material and his/her explanation, and the students on writing down and memorizing, flipped teaching has a greater degree of focus on the student. Conventional learning approaches are based on forms and methods that take place in lecture halls and laboratories, with education being spatially and temporally determined and limited. In flipped teaching, students acquire only part of the knowledge while discussing the content at the faculty, and a larger part is acquired through independent work in other environments and at a time that suits them. This method requires a higher level of development of digital competences in both students and providers of the pedagogical process, but there are many useful information tools for this. In the training, we initially presented the development and purpose of this approach, its potential advantages and problems, and provided basic guidelines for its useful use. We discussed the role of higher education teachers and colleagues, as well as students, when using this approach in university education. As part of independent work, the participants looked for opportunities to include this approach in their own learning or teaching process. This was followed by an analysis and evaluation of the proposals given in light of the necessary level of development of digital competences for their implementation. Then, additional guidelines for the effective implementation of flipped teaching and conclusions were provided.

Achievements of participants:

- Understanding the concept of flipped learning.
- Development of digital competences.
- Improving didactic skills.
- Practical application of flipped learning.
- Analysis and evaluation of the approach.
- Creating a plan for flipped learning.

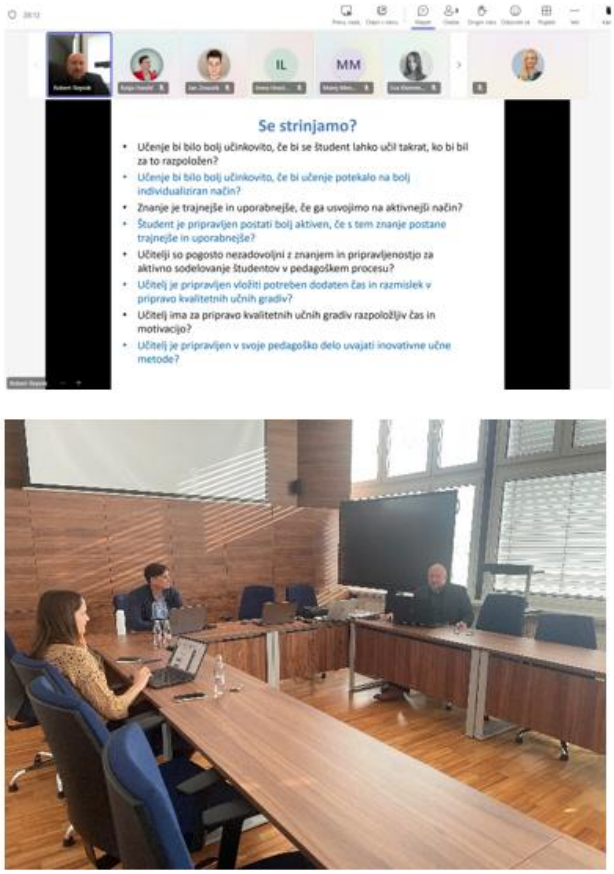

Figure 10. Snapshots from the workshop Flipped Classroom to Support the Development of Science and Digital Competences, lectured by Prof. Dr. Robert Repnik.

Digital competences

The workshop was held on Tuesday, November 12, 2024, at 2 p.m. PEF UM and remotely.
Lecturer: Full Prof. Dr. Robert Repnik

Workshop summary: The workshop introduced important documents in the field of digital competences and some examples of tools that can be helpful in learning or teaching. Educators and learners were introduced to various frameworks, such as the European Digital Competence Framework for Citizens DigComp, which offers a tool for improving citizens' digital competences. It was explained that this framework has been changing and upgrading since its first definition, with the current version DigComp 2.2, also translated into Slovenian, which includes examples of the use of digital competences in employment and education. Special emphasis was placed on the European Digital Competence Framework for Educators, DigCompEdu, which was presented as a fundamental scientifically supported document. This framework serves to prepare strategic guidelines in each country and to introduce appropriate tools and training programs at local and national levels. It was explained that the framework ensures uniform professional terminology and is intended for educators at all levels and fields of education – from pre-school to university and adult education, including compulsory, general and vocational education, education of students with special needs and non-formal education.

In addition, it serves as a fundamental framework for all developers of digital competence models, as well as educational institutions and training providers. In the second part of the workshop, participants carried out independent work with two alternative emphases. The first emphasis was intended to reflect on concrete examples of meaningful use of digital tools in the learning or teaching process, and the second was for individual self-assessment of the development of digital competences. The connection between digital and natural science competences was specifically addressed, which were presented in some more detail. A recommendation was presented that both groups of competences should be developed simultaneously, where this makes sense and is possible. The workshop included a discussion of the participants' experiences. The workshop concluded with a discussion on the results of the independent work, where participants shared their findings and experiences.

Achievements of participants:

- Understanding key digital competence frameworks and their importance.
- Gaining knowledge about various tools to improve digital skills.
- Developing the ability to independently assess one's own digital competences.
- Practical use of digital tools in the educational process.
- Exchange of experiences and best practices with other participants.

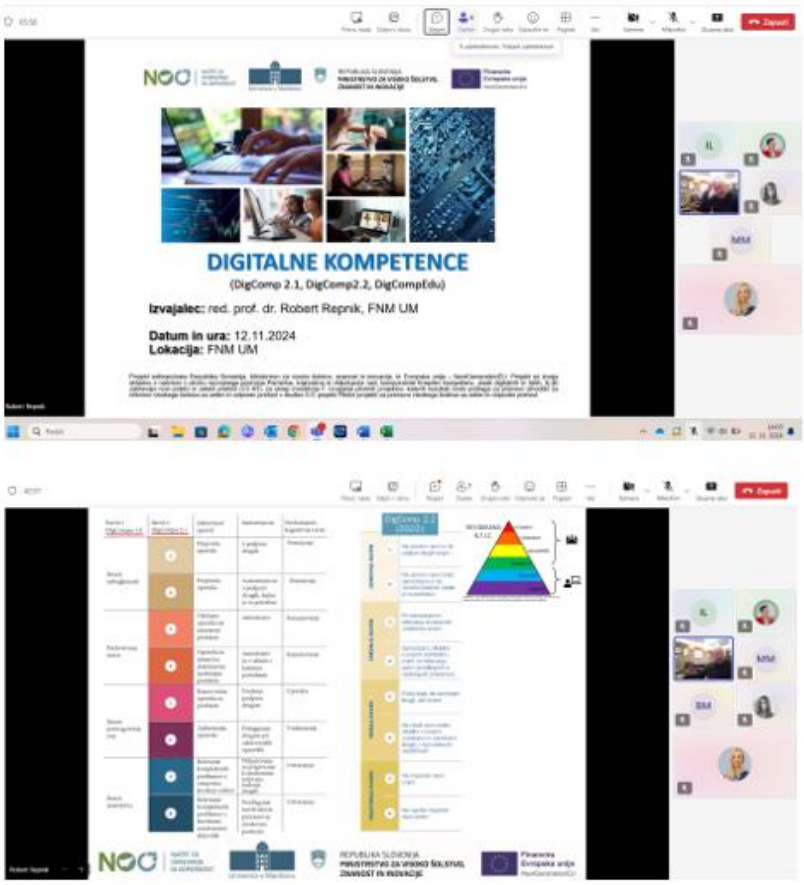

Figure 11. Snapshots from the Digital Competences workshop, lecturer Prof. Dr. Robert Repnik.

Development of systems thinking and modeling of system dynamics using artificial intelligence

The workshop was held on Tuesday, November 26, 2024, at 2 p.m. at the PEF UM and remotely.
Lecturer: Assist. Prof. Dr Vladimir Grubelnik

Workshop summary: Mathematical modeling has proven to be a successful scientific research method and, in most cases, together with experimental work, is the basis for physical theories. With the development of computer technology, especially artificial intelligence, solutions are also offered in the field of education that enable the treatment of more complex dynamic systems. The so-called systems thinking plays an important role in this, allowing us to learn to decompose a problem and meaningfully assemble individual elements into an appropriate whole, which we call a model. At the workshop, participants learned the basic concepts of systems thinking and modeling of system dynamics with examples in various fields of education. The emphasis was also on the use of artificial intelligence in education and the possibilities of including the content in the teaching process. Participants learned: Basic concepts of systems thinking and how to use them to solve complex problems; techniques for modeling system dynamics and their use in various educational scenarios; the roles and capabilities of artificial intelligence in modeling and simulation of dynamic systems and the possibilities for integrating artificial intelligence into the teaching process to increase learning effectiveness.

Achievements of participants:

- Understand the fundamental principles of systems thinking and be able to apply them to educational content.
- Gain practical experience with system dynamics modeling on basic examples.
- Learned about the use of artificial intelligence tools and methods to improve modeling and simulation.
- Acquired knowledge on how to transfer the aforementioned methods into the teaching process and educational activities, with an emphasis on the spread of critical and systemic thinking.
- The workshop contributed to upgrading the participants' teaching skills with the support of advanced methods of artificial intelligence and system dynamics modeling.

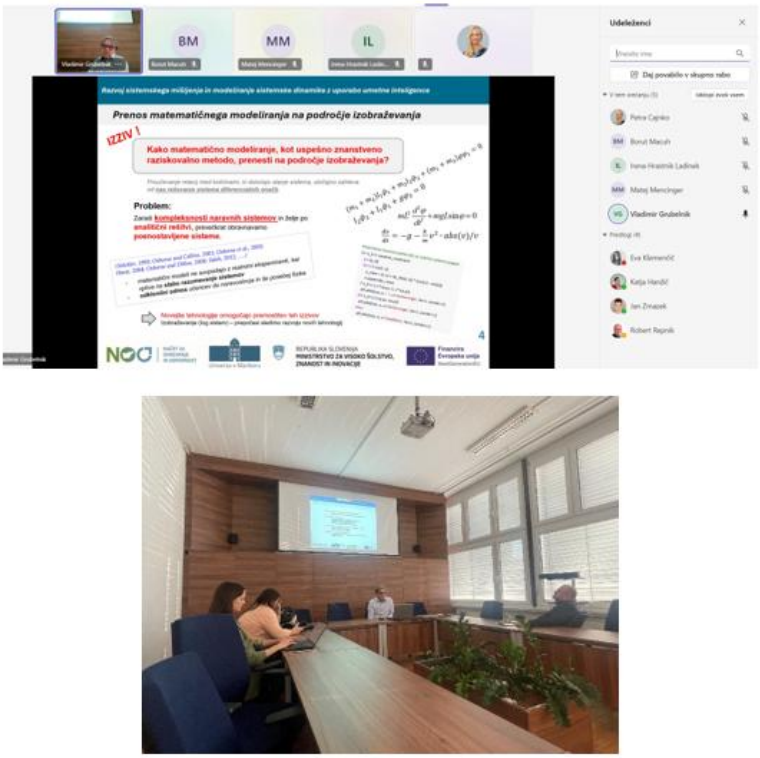

Figure 12. Highlights from the workshop Development of systems thinking and modeling of system dynamics using artificial intelligence, lecturer: Assist. Prof. Dr. Vladimir Grubelnik.

Challenges and opportunities of involving external stakeholders in the pedagogical process

The workshop was held on Tuesday, December 10, 2024, at 2 p.m. at the PEF UM and remotely.
Lecturer: Full Professor Dr. Robert Repnik

Workshop summary: The workshop provided participants with key competences and insights that enable them to successfully integrate external stakeholders into the pedagogical process of higher education. The workshop covered a wide range of topics that enabled participants to understand the challenges and opportunities associated with integrating experts from different fields (economy, public sector, etc.) into higher education learning processes. Participants were trained to identify problems that may arise when integrating external stakeholders, and to design and analyze possible solutions to eliminate these problems. The emphasis was on understanding the different perspectives of the involved actors: institutions (faculties, companies) and individuals (mentors, students). This allowed participants to develop the ability to evaluate the advantages and disadvantages of such cooperation, which allows them to better adapt the pedagogical process to specific needs and challenges. The workshop also addressed the potential benefits and limitations of integrating external stakeholders into higher education, highlighting key aspects such as the development of competences for the digital and green transitions. Participants learned how cooperation with external institutions

can contribute to preparing students for the challenges of the future, including sustainable development and digitalization. Practical activities, which included relevant case studies, discussions and analysis of concrete challenges, enabled participants to directly connect the acquired theoretical knowledge with real-world situations and experiences from practice. Based on this, participants developed strategies for effective involvement of external stakeholders and improvement of pedagogical practices within their institutions. The conclusion of the workshop focused on evaluation, where participants shared their experiences and acquired knowledge, and on finding concrete steps for further implementation of the acquired skills in their working environment.

Achievements of participants:

- Understanding the concept of involving external stakeholders in the pedagogical process.
- Ability to identify challenges when collaborating with external stakeholders.
- Developing competences for designing solutions.
- Evaluation of the advantages and disadvantages of cooperation with external stakeholders.
- Understanding the importance of the digital and green transition.
- Practical skills and approaches for effective implementation of the pedagogical process.
- Connecting theory with practice.

Figure 13. Highlights from the workshop Challenges and Opportunities of Involving External Stakeholders in the Pedagogical Process, lectured by Prof. Dr. Robert Repnik.

WORKSHOP EVALUATION

Findings

Feedback Analysis: Digital Tools for Problem Solving

Lecturer: Assist. Prof. Dr Eva Klemenčič

Event date: 10.9.2024

Event duration: 90 min

Event section: digital competences

n = 6

VU = 3, VS = 2, higher education worker = 1

The average scores for each statement are:

- Workshop date selection: 5.0
- Workshop length: 5.0
- The workshop description is consistent with the implementation: 4.83
- Self-evaluation after the workshop: 2.6
- The workshop would require separate basic and advanced levels: 2.2
- The content was presented clearly and understandably: 5.0
- Digital competences: 5.0
- Algorithmic, logical and abstract thinking competences: 4.83
- Natural science competences: 4.5
- Energy literacy: 3.0
- Impact on perceptions of the topic discussed: 4.5
- Motivation for further work in this field: 4.67
- Application of acquired knowledge in work or study: 4.67

Percentage of "strongly agree" for each statement:

- Workshop date selection: 100%
- Workshop length: 100%
- Workshop description is consistent with implementation: 83%
- Self-evaluation after the workshop: 50%
- The workshop would require separate basic and advanced levels: 33%
- The content was presented clearly and understandably: 100%
- Digital competences: 100%
- Algorithmic, logical and abstract thinking competences: 83%
- Natural science competences: 67%
- Energy literacy: 33%
- Impact on perceptions of the topic discussed: 83%
- Motivation for further work in this field: 83%
- Application of acquired knowledge in work or study: 83%
- Influence on perceptions of the topic: 100%

- Motivation for further learning: 100%
- Application of acquired knowledge in practice: 100%

Summary of analysis:

- The workshop was rated extremely high according to most criteria.

The general summary of the assessments includes the following points:

- The choice of workshop date, the length of the workshop, the clarity and comprehensibility of the content, and the development of digital competences received perfect scores (5.0) from all participants.
- Workshop description, algorithmic thinking competences, natural science competences, impact on concepts, motivation for further work , and application of knowledge were rated highly (between 4.5 and 4.83), indicating good participant satisfaction.
- The only difference between the participants was the idea of separating the basic and advanced levels of the workshop.
- Overall, the workshop received very positive feedback.

Feedback analysis: Construction, energy, environment

Lecturer: Assist. Prof. Dr. Borut Macuh

Event date: 24.9.2024

Event duration: 90 min

Event theme: green transition and energy literacy

n = 4

VU = 1, VS = 3

The average scores for each statement are:

- The choice of workshop date was appropriate: 5.0
- The length of the workshop was appropriate: 5.0
- The workshop description is consistent with the implementation: 5.0
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 2.75
- The workshop would require separate basic and advanced levels: 2.25
- The content was presented clearly and understandably: 5.0
- I developed my digital competences through the workshop: 2.0
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 4.0
- I developed natural sciences competences through the workshop: 4.67
- I developed energy literacy through the workshop: 5.0
- The workshop influenced my understanding of the topic: 5.0
- The workshop motivated me to continue working in this field: 4.75
- I will use the acquired knowledge or competences in my work or studies: 5.0

Percentage of "strongly agree" for each statement:

- Workshop date selection: 100%
- Workshop length: 100%
- Workshop description is consistent with implementation: 100%
- Self-evaluation after the workshop: 25%
- The workshop would require separate basic and advanced levels: 25%
- The content was presented clearly and understandably: 100%
- Digital competences: 0% (not relevant)
- Algorithmic, logical and abstract thinking competences: 25% (not relevant for most)
- Natural science competences: 50%
- Energy literacy: 100%
- Impact on perceptions of the topic discussed: 100%
- Motivation for further work in this field: 75%
- Application of acquired knowledge in work or study: 75%

Summary of analysis:

- Based on the analysis of the participants' responses, we can summarize that most of the statements received very positive ratings, indicating high satisfaction with the overall implementation of the workshop. Statements relating to the appropriateness of the choice of date and the length of the workshop received 100% agreement, meaning that all participants were completely satisfied with these aspects.
- Similarly, the scores for the consistency of the workshop description with the actual implementation and the clarity and comprehensibility of the content were also 100%, indicating that the expectations regarding the content and implementation of the workshop were fully met. When assessing the impact of the workshop on the participants' perceptions of the topic discussed and their motivation for further work in this area, there was also a very high level of agreement (100% and 75%), meaning that the workshop had a positive impact on the participants.
- We conclude that the workshop was very successful in terms of participant satisfaction, consistency of content with implementation, and motivation for further work, while additional adjustments could be considered, such as introducing different levels of difficulty and self-evaluation options.

Feedback Analysis: Flipped Classroom to Support the Development of Science and Digital Competences

Lecturer: Prof. Dr. Robert Repnik
Event date: 29.10.2024

Event duration: 90 min

Event section: digital competences

n = 5

VU = 1, VS = 3, MR=1

The average scores for each statement are:

- The choice of workshop date was appropriate: 4.6
- The length of the workshop was appropriate: 5.0
- The workshop description is consistent with the implementation: 4.8
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 3.0
- The workshop would require separate basic and advanced levels: 1.4
- The content was presented clearly and understandably: 5.0
- Through the workshop, I developed my digital competences: 4.4
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 4.2
- Through the workshop I developed natural sciences competences: 3.4
- Through the workshop I developed energy literacy: 3.0
- The workshop influenced my understanding of the topic: 4.6
- The workshop motivated me to continue working in this area: 4.4
- I will use the acquired knowledge or competences in my work or studies: 4.6

Percentage of "strongly agree" for each statement:

- The choice of workshop date was appropriate: 80%
- The length of the workshop was appropriate: 100%
- Workshop description is consistent with implementation: 80%
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 40%
- The workshop would require separate basic and advanced levels: 10%
- The content was presented clearly and understandably: 100%
- I developed my digital competences through the workshop: 60%
- Through the workshop, I developed algorithmic, logical and abstract thinking competences: 80%
- I developed natural sciences competences through the workshop: 60%
- I developed energy literacy through the workshop: 40%
- The workshop influenced my understanding of the topic: 80%
- The workshop motivated me to continue working in this field: 80%
- I will use the acquired knowledge or competences in my work or studies: 80%

Summary of analysis:

- The workshop received high marks for clarity of presentation (100% "strongly agree") and consistency between description and implementation (80%). Participants also assessed that the timeframe and length of the workshop were appropriate.
- A large proportion of participants stated that the workshop helped them develop important skills such as digital competence (60%) and algorithmic thinking (80%). The workshop also had a positive impact on their understanding of the topic and motivated them to continue their work (80%).
- The workshop was generally very positively received, especially in terms of structure, clarity and motivational impact.

Feedback analysis: Digital competences

Lecturer: Prof. Dr. Robert Repnik

Event date: 12.11.2024

Event duration: 90 min

Event section: digital competences

n = 4

VU = 3, VS = 1

The average scores for each statement are:

- The choice of workshop date was appropriate: 5.0
- The length of the workshop was appropriate: 5.0
- The workshop description is consistent with the implementation: 5.0
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 3.0
- The workshop would require separate basic and advanced levels: 3.0
- The content was presented clearly and understandably: 5.0
- I developed my digital competences through the workshop: 4.8
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 3.8
- Through the workshop I developed natural sciences competences: 4.2
- Through the workshop I developed energy literacy: 1.0
- The workshop influenced my understanding of the topic: 5.0
- The workshop motivated me to continue working in this field: 4.8
- I will use the acquired knowledge or competences in my work or studies: 4.8

Percentage of "strongly agree" for each statement:

- The choice of workshop date was appropriate: 100.0%
- The length of the workshop was appropriate: 100.0%
- Workshop description is consistent with implementation: 100.0%
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 25.0%
- The workshop would require separate basic and advanced levels: 25.0%

- The content was presented clearly and understandably: 100.0%
- I developed my digital competences through the workshop: 75.0%
- Through the workshop, I developed algorithmic, logical and abstract thinking competences: 50.0%
- I developed natural sciences competences through the workshop: 75.0%
- I developed energy literacy through the workshop: 0.0%
- The workshop influenced my understanding of the topic: 100.0%
- The workshop motivated me to continue working in this field: 75.0%
- I will use the acquired knowledge or competences in my work or studies: 75.0%

Summary of analysis:

- Most participants gave a very positive assessment of the workshop, with most of the statements being rated *"completely agree"*. This indicates a generally high level of satisfaction with the workshop and its course. Participants fully agreed that the choice of date and length of the workshop was appropriate, and they also 100% agreed that the workshop description was consistent with the implementation and that the content was presented clearly and understandably.
- A high percentage of *"completely agree"* (75% or more) was also achieved for the impact of the workshop on digital competences and motivation for further work and application of knowledge in practice. This shows that the workshop had a positive impact on the participants and encouraged them to continue working and applying the acquired knowledge.
- Based on these findings, it seems that the workshop effectively achieved its main objectives and satisfied the majority of participants, while it would be worthwhile considering adding self-evaluation options and differentiating the content for basic and advanced participants.

Feedback Analysis: Developing Systems Thinking and Modeling System Dynamics Using Artificial Intelligence

Lecturer: Assist. Prof. Dr. Vladimir Grubelnik

Event date: 26.11.2024

Event duration: 90 min

Event set: computational

n = 7

VU = 6, MR = 1

The average scores for each statement are:

- The choice of workshop time was appropriate: 5:00
- The workshop length was appropriate: 4.86
- The workshop description is consistent with the implementation: 5.00
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 3.14
- The workshop would require separate basic and advanced levels: 3.00
- The content was presented clearly and understandably: 5.00

- I developed my digital competences through the workshop: 4.43
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 5.00
- I developed natural sciences competences through the workshop: 4.29
- The workshop influenced my understanding of the topic: 4.86
- The workshop motivated me to continue working in this field: 4.57
- I will use the acquired knowledge or competences in my work or studies: 4.43

Percentage of "strongly agree" for each statement:

- The choice of workshop date was appropriate: 100%
- The length of the workshop was appropriate: 85.7%
- Workshop description is consistent with implementation: 100%
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 0%
- The workshop would require separate basic and advanced levels: 28.6%
- The content was presented clearly and understandably: 100%
- I developed my digital competences through the workshop: 57.1%
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 100%
- I developed natural sciences competences through the workshop: 57.1%
- The workshop influenced my understanding of the topic: 85.7%
- The workshop motivated me to continue working in this field: 71.4%
- I will use the acquired knowledge or competences in my work or studies: 71.4%

Summary of analysis:

- Participants expressed a high level of satisfaction with most of the key issues.
- Participants expressed strong motivation to continue working in the field (71.4%), and highly rated the likelihood of using the acquired knowledge in their work or studies (71.4%). This indicates the high practical value of the workshop and its long-term usefulness for participants.
- Overall, the workshop was evaluated very positively, with a strong emphasis on the clarity of the presentation of the content, the quality of the execution and its impact on understanding the topic. Praise such as "Thank you for the clear presentation of the issues" and "Excellent workshop«. Excellent facilitator. Excellent organization of the event," confirms the high level of satisfaction among the participants.

Feedback Analysis: Challenges and Opportunities of Involving External Stakeholders in the Pedagogical Process

Lecturer: Prof. Dr. Robert Repnik

Event date: 10.12.2024

Event duration: 90 min

Event section: pedagogical approaches & learning methods

n = 6

VU = 3, VS = 3

The average scores for each statement are:

- The choice of workshop date was appropriate: 4.83
- The length of the workshop was appropriate: 4.83
- The workshop description is consistent with the implementation: 5.00
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 2.67
- The workshop would require separate basic and advanced levels: 2.00
- The content was presented clearly and understandably: 5.00
- I developed my digital competences through the workshop: 3.33
- Through the workshop, I developed the competences of algorithmic, logical and abstract thinking: 3.33
- I developed natural sciences competences through the workshop: 3.33
- The workshop influenced my understanding of the topic: 4.50
- The workshop motivated me to continue working in this field: 3.67
- I will use the acquired knowledge or competences in my work or studies: 3.67

Percentage of "strongly agree" for each statement:

- The choice of workshop date was appropriate: 83.33%
- The length of the workshop was appropriate: 83.33%
- Workshop description is consistent with implementation: 100.00%
- After the workshop, I would like the opportunity to self-evaluate the knowledge gained: 0.00%
- The workshop would require separate basic and advanced levels: 0.00%
- The content was presented clearly and understandably: 100.00%
- I developed my digital competences through the workshop: 33.33%
- Through the workshop, I developed algorithmic, logical and abstract thinking competences: 33.33%
- I developed natural sciences competences through the workshop: 33.33%
- The workshop influenced my understanding of the topic: 50.00%
- The workshop motivated me to continue working in this field: 33.33%
- I will use the acquired knowledge or competences in my work or studies: 33.33%

Summary of analysis:

- Most of the key questions were rated very positively, indicating a high level of satisfaction among participants.
- Overall, the workshop was assessed as being of very high quality, with emphasis on the clarity of the content, the professionalism of the delivery, and the positive impact on the understanding of the topics discussed.

COOPERATION IN OECD MONITORING

Questionnaire with answers received before the monitoring, dated 25.9.2024.

Questionnaire for Pilot Projects of the University of Maribor

Objectives

1. How are your pilot projects contributing to the three main themes of the project:

- The digital and green transitions?
  The project addressed competences for the digital and green transition in three ways. Firstly, we conducted a document analysis of curricula that helped to identify opportunities to include some practices in formal education. Second, we conducted two questionnaires among undergraduate and first-year graduate students to identify areas that need more attention to equip students for their future careers. And finally, we offer free workshops for students, faculty and others, such as: *With artificial intelligence into a new era of teaching and research* , *How to Create an AI Model?, Digital tools for problem solving, A flipped classroom to support the development of digital competences, What and why is happening to biodiversity, A systemic approach to addressing energy literacy,* and *Construction, energy, environment.*
- The development of micro credentials?
  - We organized two roundtables (one at the Faculty of Natural Sciences and Mathematics and one at the Faculty of Civil Engineering, Transportation Engineering and Architecture) with representatives of the faculty management, teaching staff and students, where we discussed microcredentials, opportunities and shortcomings.
  - As part of our project, we organized 7 workshops that were open to the public. This year we are planning 6 more. Each workshop will be evaluated by the participants. After the evaluation, we will select the workshops to be held in 2025.
  - As the awarding of microcredentials has not yet been coordinated at the university level, participants will receive certificates of participation.
- The promotion of lifelong learning in higher education?
  Workshops are open to the public, with invitations available on faculty and university websites and social media platforms. Additionally, teaching staff and alumni receive direct invitations via email and social media. All workshops are conducted both online and in the

lecture hall at the faculty. We promote lifelong learning through these workshops, which focus on soft skills, competences, and pedagogical approaches to teaching and learning.

2. Have the objectives of any of your pilots been reoriented or changed compared to what was included in the original application? If yes, why?
   There have been some minor changes, as expected, but overall, the project adheres to the activities and monitoring indicators outlined in the original application.

Implementation

Institution level

- What are key milestones or activities achieved by autumn 2024, and what else is planned by the end of the project?

  Key milestones and their statuses are as follows:

  K1 Situation analysis report *(achieved),*

  K2 Definition of the required level of digital competence and energy literacy of the graduate in selected study programs (currently *under revision and upgrade)*,

  K3 Comparative analysis *(achieved)*,

  K4 List of contents and skills *(achieved),*

  K5 Number of conducted workshops (6/10; *in progress)*,

  K6 Number of participants (136; *in progress)*,

  K7 Microcredentials (75; *in progress)*.

  By the end of the project, we plan to address two additional indicators:

  K8 Learning units' guidelines to support competences for digital and green transitions, and K9 Final report and dissemination of results.

  Additionally, we have published two situation analysis reports in both Slovene and English, which are open to the public. In 2024, we plan to publish one more report, along with the final report at the end of the project.

  As part of the project, we also published the book Macroecology: Analyzing Biodiversity Data.

  The project research team is actively disseminating results with 6 conference contributions, 4 published papers, and 6 accepted conference abstracts to date.

- What are key factors that have been instrumental in helping the implementation of the different project activities? What has been more challenging to implement? And why?

  The key factor in the project's success has been the establishment of a project council, which coordinates project activities and oversees working teams. Researchers and administrators have online access to documents and a collaboration platform (Microsoft Teams). At the project's outset, it was crucial to conduct internal workshops for all researchers to ensure the comparability of findings. The situation analysis report involved document analysis and semi-structured interviews with teaching staff. The latter proved challenging due to the time demands and some resistance encountered.

- What evidence do you collect on the impact and/or benefits of the pilot(s), from whom (e.g. students, employers, teaching staff), and how (e.g. survey, interviews, others)?
  The impact and benefits of the pilot were discussed during roundtable discussions. Additionally, we prepared questionnaires for workshop attendees to evaluate each specific workshop, which allows us to indirectly assess the pilot's benefits. The project's impact also includes the acquisition of new computer equipment to enhance laboratory work in specific study programs.

- To what extent, and how, does collaboration across pilot projects take place?
  Members of our project council attended the conference of all pilots in Ljubljana, which facilitated valuable networking and knowledge exchange. Additionally, coordinators of pilot projects at the University of Maribor collaborate through the Microsoft Teams application, where they can easily exchange opinions, share resources, and discuss ongoing activities. This platform also provides access to dissemination materials from all pilot projects, ensuring that best practices and insights are shared across the board.

<u>System level</u>

- Beyond the financial support received from the Ministry, what other system-level incentives or supports have you received to ensure the successful implementation of your projects? In addition to the financial support from the Ministry, we have received several other system-level supports to facilitate the successful implementation of our projects:
  - Pedagogical Workload Reduction: We were granted permission for pedagogical workload reduction for certain faculty members who we wanted to involve more deeply in the project. This has allowed them to dedicate more time and focus on project activities, enhancing the quality and efficiency of the work being done.
  - Communication and Dissemination Support: The university has supported us by publishing news about our projects on their official websites and including notifications about workshops and mass email communications to faculty, students, and alumni. This has significantly increased the visibility and reach of our initiatives.
  - Monitoring by the Ministry: The Ministry has conducted regular monitoring of the project's progress. This oversight has been instrumental in ensuring that we adhere to the project's goals and deadlines. The feedback received from these monitoring activities has helped us make the necessary adjustments and improvements, ultimately contributing to the overall success of the project.
- Have you come across any system-level barriers to implement certain pilot project(s) or activities (e.g. regulatory barriers, quality assurance system)?
  None.

Looking to the future

- What do you see as the *immediate* and *long-term* impacts or benefits of the pilot project(s) for your institution? And for Slovenian higher education more broadly?
  Immediate impacts include the workshops conducted for students and faculty to support competences needed for digital and green transitions, as well as the acquisition of new computers for laboratory work, enabling new experiments using digital technology.

We anticipate the following long-term impacts:

1. Guidelines for teaching staff on how to modify curricula (content and/or teaching methods) to support digital and energy literacy, applicable to other higher education programs.
2. Competency Framework for energy literacy, sustainability, and green transition, applicable to other higher education programs.
3. Stronger collaboration between Faculty of Natural Sciences and Mathematics and Faculty of Civil Engineering, Transportation Engineering and Architecture.

- How do you plan to ensure the sustainability of these pilot(s) beyond their current project implementation period (i.e. beyond 2025)? What can the government do to support you?
  We plan to ensure the sustainability of project outcomes mostly by publishing guidelines and dissemination of project results (conferences). Additionally, our project study includes the "Subject Teachers" program, which trains future science and mathematics teachers for Slovenian elementary schools.
- What are the key elements you believe the Slovenian government should address in its future Blueprint for Slovenian higher education?
  The key element is to equip faculties with digital technology (both hardware and software) for the study process and for academic staff and researchers, as well as to provide support with experimental equipment. Additionally, there is a focus on enhancing digital competences among faculty staff and supporting digital business initiatives.

Questionnaire with answers received after the evaluation on September 25, 2025.

Mid-term evaluation of 38 pilot projects supported for the "Reform of Higher Education for Green and Resilient Transition" - Follow-up survey

Context and instructions for completing the survey

1. Focus of the pilot project/ specific activity

Q1: To what extent is your pilot project/activity related to the following thematic areas? (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Greening higher education 2
- Digital transformation of higher education 5
- Promoting lifelong learning 2

Q2: To what extent does your pilot project/activity focus on the following types of higher education offerings? (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Modernization of first cycle professional higher education study programs 5
- Development of micro-credentials 3

- Modernization of other types of programs (e.g. first cycle academic study programs, master's or doctoral programs) 5

Q2a: If 'Other types of program ' is selected with a rating of 2 or higher in Q2, then this optional long free-text question is displayed: Please specify what other types of higher education provision are a focus area of your pilot/activity (e.g. academic bachelor's, master's or doctoral programs)

Academic bachelor's study programs: Physics, Mathematics, Civil engineering

Unified master study program Subject teacher (educational Physics and educational Mathematics)

Q3: To what extent are the following operational areas a focus of your pilot project/activity?

Q3a: Competency identification and tracking (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Measuring and assessing competences of students 5
- Measuring and assessing competences of teaching staff 3
- Measuring and assessing competences of technical and support staff (this category can, for instance, include IT staff, administrative staff, and other support staff) 1
- Mapping competences currently taught in curricula 5
- Identification of competence needs in the labor market 4

Q3b: Curriculum development (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Updating curricula and existing modules and programs 5
- Creating new programs 1
- Creating new (optional) modules in existing programs 1

Q3c: Infrastructure (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Upgrading the institutions' digital equipment and/or purchasing educational technology 5
- Investments to make the campus more sustainable 1
- Adaptations to adapt campus equipment to students with disabilities 1
- Other types of equipment purchases, infrastructure investments or upgrades 1

Q3ci: If 'Other types' is selected with a rating of 2 or higher in Q3c, then this optional long free-text question is displayed: Please specify other types of equipment purchases, infrastructure investments or upgrades made:

(Optional long free-text question)

Q3d: Staff professional development (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Development of guidelines and materials for teaching staff 5
- Organization of professional development courses for teaching staff 4
- Creation and management of peer-learning communities for teaching staff 1
-
- Development of incentives for teaching staff to engage in updating their curricula and/or competences (e.g. prizes or rewards, amendments to staff appraisal systems, changes to academic career structures, etc.) 1
- Organization of professional development opportunities for technical and support staff to enhance their skills and knowledge related to digital technologies, sustainability, research

and/or educational innovations more generally (this category can, for instance, include IT staff, administrative staff, and other support staff). 2
- Encouraging collaboration between teaching staff and technical and support staff to facilitate the integration of new technologies and new educational practices in curricula (this latter category can, for instance, include IT staff, administrative staff, and other support staff). 2

Q3e: Learner engagement (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Promoting pedagogical innovation in teaching 5
- Adapting student assessment methods 3
- Developing targeted measures to reduce student dropout 3
- Involving students in curriculum design and review 3
- Involving employers in curriculum design and review 3
- Offering career guidance and support to students 1
- Expanding practical learning opportunities for students 2

Q3f: Collaboration (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

- Collaboration with business and industry 2
- Inter-disciplinary collaboration across faculties 5
- Collaboration with international partners 1
- Collaboration with other higher education institutions in Slovenia 1

Final section commentary box:

Please add any additional information or specific details that could further clarify your pilot project/activity's thematic and operational focus:

Developing guidelines to upgrade curricula that support digital, computational, and natural science competences, as well as energy literacy and the green transition. Additionally, we aim to provide opportunities for flexible curricula that can adapt to changes in the market. Focus is on natural science and mathematics contents and transfer of good practices between study programs.

2. Objectives

Q4: To what extent do you assess your pilot project/activity to be on track in meeting the guidelines included in the project proposal? If you're responding on behalf of an activity, please answer in relation to the objectives set within the scope of this activity. (1 = Not on track, 2 = Partially on track, 3 = Fully on track)

3

Q5: To what extent have the objectives of your pilot project/activity been reoriented or changed compared with the objectives included in the original application? (1 = Not at all, 2 = Little, 3 = Somewhat, 4 = To a large extent, 5 = To a great extent)

2

Final section commentary box:

Please add any specific insights or explanations regarding the project/activity's progress or changes in objectives in the text box below:

We have started conducting workshops for teaching staff, students, graduates, and external stakeholders. The only change regarding the initial project proposal is that we started issuing certificates of participation to the attendees, as we did not receive guidelines for micro-credential validation at the university level during the time of the workshops.

3. Implementation

Q6: Does your pilot project/activity have a system in place to systematically monitor the implementation and assess the effectiveness/impact of the pilot project/activity? (Yes, No question).

Q6a: If 'Yes' is selected with a rating of 2 or higher in Q6, then this mandatory question is displayed: Which of the following methods, if any, are employed to monitor the implementation and assess the effectiveness/impact of your pilot project / activity? (Select all that apply)

- Student feedback surveys Y
- Employer feedback surveys Y
- Tracking student progression (e.g. completion rates, labor market outcomes etc.)
- External reviewers are used
- Regular meetings with other pilots/activity leaders/leadership/coordinators to discuss progress Y
- Focus groups or interviews with project beneficiaries Y
- Other

Q7: Based on your assessment, which of the following statements, if any, best captures the impacts of your pilot project/activity so far? (Select up to 3)

- First cycle professional higher education study programs are better aligned with the needs of the labor market (especially the green and digital transitions)
- New first cycle professional higher education study programs that respond to evolving labor market demands have been created
- New micro-credential offerings have been developed to support the upskilling and reskilling of people already in employment and/or non-traditional students
- Teaching staff have been supported to improve their pedagogical competences
- Technical and support staff have been supported to develop competences required for the pilot projects (this category can, for instance, include IT staff, administrative staff, and other support staff)
- Interdisciplinary collaboration across faculties and teaching staff has increased
- Learning outcomes of assessed students are improving
- A culture of experimentation and innovation has been created in our institution
- Collaboration with external stakeholders, including industry partners, has increased

Q8: Based on your assessment, which of the following areas have been the most challenging in implementing your pilot project/activity? (Select up to 3)

- Hiring and retaining qualified teaching staff
- Motivating and training existing teaching staff to engage with the pilot project activities
- Hiring and retaining technical and support staff to work on pilot project activities (this category can, for instance, include IT staff, administrative staff, and other support staff)
- Training existing technical and support staff to develop competences required for the pilot project activities (this category can, for instance, include IT staff, administrative staff, and other support staff).
- Financial constraints
- Motivating and training students to participate in pilot project activities (eg choosing new optional modules that have been created)
- Collaboration with the labor market and wider society
- Encouraging interdisciplinary collaboration across faculties
- Designing curricula that meet the needs of an increasingly diverse student body
- Adapting provision to the needs of people already in employment and/or non-traditional students
- Creation of micro-credentials
- Updating existing curricula to the needs of the labor market (especially digital and green transitions)
- Gathering information on competence needs and identifying gaps in curricula
- Administrative burden or barriers (eg internal/external quality assurance procedures or regulatory requirements)
- Significant technological gaps and low digital competences among staff (teaching staff, researchers and support staff)
- Lack of understanding of what competences supporting the green transition are and/or how sustainability should be taught
- Other

Q8a: If 'Other' is selected in Q8, then this optional long free-text question is displayed: Please specify what other area has been most challenging in implementing the pilot project/activity:

(Optional long free-text question)

Final section commentary box:

Please add any specific insights or explanations regarding the relative successes or challenges faced by the pilot project/activity to date: (Optional long free-text question)

4. Looking ahead

Q9: To what extent do you agree with the following statements? (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree, 6 = Don't know):

- We have started to implement measures to ensure that the activities and outcomes of the current pilot project/activities can be sustained after the funding period concludes. 4

- We plan to streamline innovations generated by the pilot project/activity across other areas within the educational offerings of our institution. 6
- Adult learners are projected to become key target groups for our institution/faculty moving forward. 6
- We believe that microcredentials will become a key feature of Slovenian higher education in the future. 3
- Concepts related to green and digital transitions should continue to receive priority in curricula. 4
- Strengthening collaboration with the labor market is planned. 4

Q10: In your opinion, what are the most important system-level policy changes needed to support the ongoing reform of professional higher education and the development of a micro-credential ecosystem in Slovenia? (Select up to 3):

- Regulatory changes to support flexibility and innovation in program design
- Adapting external quality assurance procedures
- Creation of a national micro-credentials framework
- Creation of incentives and support for collaboration between higher education institutions and industry
- Continued support for curriculum review and pedagogical innovation
- Better access to forecasting skills and labor market intelligence
- Improving system-level information on programs and career guidance for students
- Further investment in sustainable campus infrastructure and/or digital equipment
- Improve interoperability between faculties, higher education institutions, industry and/or ministry bodies (interoperability is defined as: the ability of different types of computer systems or software products to communicate with each other, to use common data formats and/or to effectively interpret information passing from one system or product to another)
- Other

Q10a: If 'Other' is selected in Q10, then this optional long free-text question is displayed: Please specify what other system level policy changes are most needed to support the ongoing reform of professional higher education and the development of a micro-credential ecosystem:

(Optional long free-text question)

Final section commentary box:

Please add any specific insights or explanations regarding the future outlook beyond the funding period of the pilot projects, as well as any specific system-level challenges that you think should be addressed:

Information and communication activities

We inform about project activities on the FNM UM website and the FNM UM Facebook page. During this time, we made 19 announcements. The dates of the announcements, the type of media and the links are listed in Table 14.

Table 14: Summary of publications on various digital media

no	publication date	place of publication	connection
1	Thursday, 5.9.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/09/05/vabilo-na-8-javno-delavnico-v-sklopu-projekta-noo-naravoslovno-mathematicne-vsebine-pri-razvoju-digitalnih-kompetenc/
2	Wednesday, 11.9.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/09/11/izvedena-je-bila-8-javna-delavnica-v-sklopu-pilotnega-projekta-noo-10-9-2024/
3	Tuesday, 17.9.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/09/17/vabilo-na-9-javno-delavnico-v-sklopu-projekta-noo-naravoslovno-mathematicne-vsebine-pri-razvoju-digitalnih-kompetenc/
4	Tuesday, 17.9.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/09/17/tretje-porocilo-o-analizi-stanja-projekta-noo/
5	Wednesday, 25.9.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/09/25/izvedena-je-bila-9-javna-delavnica-v-sklopu-pilotnega-projekta-noo-24-9-2024/
6	Tuesday, 8.10.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/10/08/vabilo-na-10-javno-delavnico-v-sklopu-projekta-noo-naravoslovno-mathematicne-vsebine-pri-razvoju-digital-competences/
7	Wednesday, 16.10.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/10/16/fnm-um-z-noo-na-festum/
8	Wednesday, 30.10.2024	FB private Petra Cajnko	https://www.facebook.com/share/f1VUX3cLaqry4mqx/?mibextid=WC7FNe
9	Wednesday, 30.10.2024	FB FNM	https://www.facebook.com/share/p/HnQGHHXkCuyCwSp1/?mibextid=WC7FNe
10	Thursday, 7.11.2024	FB FNM	https://www.facebook.com/share/p/19c3k8DFpA/?mibextid=WC7FNe
11	Tuesday, 12.11.2024	FB FNM	https://www.facebook.com/share/p/12AG8rNh54z/?mibextid=WC7FNe
12	Tuesday, 19.11.2024	FB FNM	https://www.facebook.com/share/p/19RVpPozuc/?mibextid=WC7FNe
13	Tuesday, 19.11.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/11/19/vabilo-na-12-javno-delavnico-v-sklopu-projekta-noo-naravoslovno-mathematicne-vsebine-pri-razvoju-digital-competences/
14	Wednesday, 27.11.2024	FB FNM	https://www.facebook.com/share/p/19gH5WRCxU/?mibextid=WC7FNe

15	Wednesday, 27.11.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/11/27/izvedena-je-bila-12-javna-delavnica-v-sklopu-pilotnega-projekta-noo-26-11-2024/
16	Tuesday, 3.12.2024	FB FNM	https://www.facebook.com/share/p/15LUorr6B6/?
17	Wednesday, 4.12.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/12/04/vabilo-na-13-javno-delavnico-v-sklopu-projekta-noo-naravoslovno-mathematicne-vsebine-pri-razvoju-digital-competences/
18	Wednesday, 11.12.2024	FNM UM website	https://www.fnm.um.si/index.php/2024/12/11/izvedena-je-bila-13-javna-delavnica-v-sklopu-pilotnega-projekta-noo-10-12-2024/
19	Friday, 13.12.2024	FB FNM	https://www.facebook.com/share/19XFfrFkFZ/?mibextid=WC7FNe

POTENTIAL PROBLEMS

During this period of project implementation, we encountered difficulties due to a cyberattack on UM, which caused a malfunction in the 1KA application. As a result, some project tasks—such as the preparation and administration of survey questionnaires, data processing, analysis, and interpretation of results—were delayed. These tasks are now in the finalization phase, and the findings will be presented in the next interim report. No other major issues were identified.

CONCLUSIONS

The interim report covers the main results of the project activities from 1. 7. 2024 to 31. 12. 2024. During this period, we focused on completing activity A2. Researchers, members of the project council, designed a competency framework for energy literacy, sustainability and green transition. We designed survey questionnaires for students to determine the achievement of selected competences. Due to the prolonged inability to access the 1ka application, the analysis of the survey questionnaires will be carried out in January 2025.

We also continued with activity A3; promotion, implementation and evaluation of workshops. We conducted six of them during this period, thus exceeding the set indicator. In 2025, we will also invite experts from abroad.

Activity A4 - dissemination of results - took place both from the perspective of informing the public about the implementation of project activities, and from the perspective of active participation in international scientific conferences and publication of scientific papers.

APPENDICES

Appendix 1. Presentation at FESTUM

Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

01. 09. 2022 – 31. 8. 2025

Podati smernice za posodobitev učnih načrtov na način, da bodo:

- omogočali prilaganje izvedbe študijske procesa glede na pričakovanja potencialnih delodajalcev za obravnavo aktualnih, avtentičnih problemov,
- vključevali algoritmično in sistemsko mišljenje ter energetsko pismenost,
- spodbujali razvoj digitalnih kompetenc in naprednih digitalnih kompetenc.

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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Člani projektne skupine	Fakulteta	vloga
Eva Klemenčič	FNM UM	vodja projekta, članica projektnega sveta
Robert Repnik	FNM UM	član projektnega sveta, koordinator FNM-FGPA
Petra Cajnko	FNM UM	koordinatorica pilotnega projekta, članica projektnega sveta
Matej Mencinger	FGPA UM	član projektnega sveta, raziskovalec
Borut Macuh	FGPA UM	nadomestni član projektnega sveta, raziskovalec
Brigita Ferčec	FGPA UM	raziskovalka
Irena Hrastnik Ledinek	FGPA UM	raziskovalka
Katja Hanžič	FGPA UM	raziskovalka
Mitja Slavinec	FNM UM	raziskovalec
Arbresha Hölbl	FNM UM	raziskovalka
Veno Jaša Grujić	FNM UM	raziskovalec
Jan Zmazek	FNM UM	raziskovalec
Barbara Arcet	FNM UM	raziskovalka
Polona Repolusk	FNM UM	raziskovalka
Boštjan Brešar	FNM UM	raziskovalec
Leon Vratar	FNM UM	strokovni sodelavec

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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

Analiza stanja

Načrtovanje za razvoj kompetenc za digitalni in zeleni prehod

Implementacija za razvoj kompetenc za digitalni in zeleni prehod

Evalvacija projekta in diseminacija rezultatov

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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

Analiza stanja

Primerjalna analiza sorodnih učnih enot

Analiza vključenosti:
- digitalnih kompetenc,
- naravoslovnih kompetenc,
- kompetenc algoritmičnega, logičnega in abstraktnega mišljenja ter
- energetske pismenosti in zelenega prehoda.

Poročilo analize stanja

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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

Analiza stanja

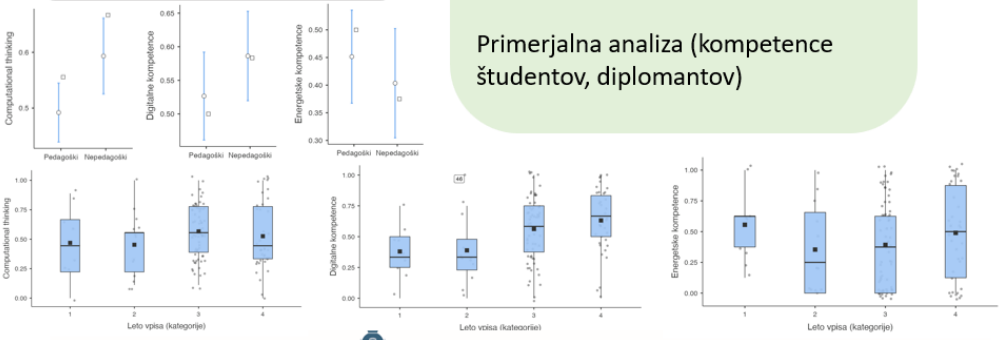
Načrtovanje za razvoj kompetenc za digitalni in zeleni prehod

Seznanitev z obstoječimi kompetenčnimi okvirji

Opredelitev zahtevanega nivoja kompetenc diplomanta (trg dela)

Opredelitev vsebin in veščin v podporo razvoja kompetenc

Primerjalna analiza (kompetence študentov, diplomantov)



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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

Analiza stanja

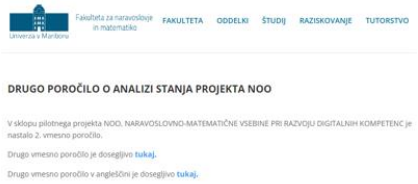
Načrtovanje za razvoj kompetenc za digitalni in zeleni prehod

Seznanitev z obstoječimi kompetenčnimi okvirji

Opredelitev zahtevanega nivoja kompetenc diplomanta (trg dela)

Opredelitev vsebin in veščin v podporo razvoja kompetenc

Primerjalna analiza (kompetence študentov, diplomantov)



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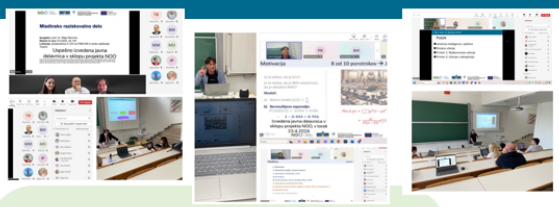
Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

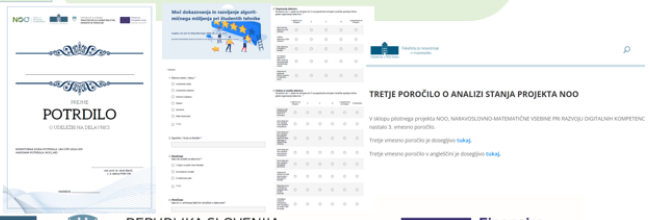


Analiza stanja

Načrtovanje za razvoj kompetenc za digitalni in zeleni prehod

Implementacija za razvoj kompetenc za digitalni in zeleni prehod

Načrtovanje, promocija, izvedba in evalvacija delavnic
do 1. 10. 2024
9 DELAVNIC,
150 UDELEŽENCEV,
85 POTRDIL O UDELEŽBI
Priprava smernic



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Naravoslovno-matematične vsebine pri razvoju digitalnih kompetenc

Aktivnosti

Analiza stanja

Načrtovanje za razvoj kompetenc za digitalni in zeleni prehod

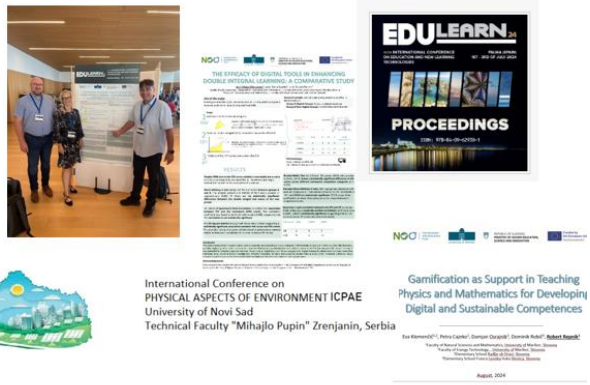
Implementacija za razvoj kompetenc za digitalni in zeleni prehod

Evalvacija projekta in diseminacija rezultatov

Promocija projektnih aktivnosti

Diseminacija rezultatov

Končno poročilo



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Appendix 2. Excel spreadsheet for document analysis

	A	B	C	D	E	F	G
3	https://www.zrss.si/digitalna_bralnica/digcomp-2-2-okvir-digitalnih-kompetenc-za-drzavljane-z-novimi-primeri-rabe-znanja-spretnosti-in-stalisc/	zaključen študijski program					
4		FIZ UN	MAT UN	PU IZO FI	PU IZO MAT	GRADB UN	GRADB VS
5	1. INFORMACIJSKA IN PODATKOVNA PISMENOST						
6	1.1 BRSKANJE, ISKANJE IN FILTRIRANJE PODATKOV, INFORMACIJ IN DIGITALNIH VSEBIN	št. od 1 do 8					
7	1.2 VREDNOTENJE PODATKOV, INFORMACIJ IN DIGITALNIH VSEBIN						
8	1.3 UPRAVLJANJE PODATKOV, INFORMACIJ IN DIGITALNIH VSEBIN						
9	2. KOMUNICIRANJE IN SODELOVANJE						
10	2.1 INTERAKCIJA Z UPORABO DIGITALNIH TEHNOLOGIJ						
11	2.2 DELJENJE Z UPORABO DIGITALNIH TEHNOLOGIJ						
12	2.3 DRŽAVLJANSKO UDEJSTVOVANJE Z UPORABO DIGITALNIH TEHNOLOGIJ						
13	2.4 SODELOVANJE Z UPORABO DIGITALNIH TEHNOLOGIJ						
14	2.5 SPLETNI BONTON						
15	2.6 UPRAVLJANJE DIGITALNE IDENTITETE						
16	3. USTVARJANJE DIGITALNIH VSEBIN						
17	3.1 RAZVOJ DIGITALNIH VSEBIN						
18	3.2 UMEŠČANJE IN POUSTVARJANJE DIGITALNIH VSEBIN						
19	3.3 AVTORSKE PRAVICE IN LICENCE						
20	3.4 PROGRAMIRANJE						
21	4. VARNOST						
22	4.1 SKRB ZA VARNOST NAPRAV						
23	4.2 VAROVANJE OSEBNIH PODATKOV IN ZASEBNOSTI						
24	4.3 SKRB ZA ZDRAVJE IN DOBROBIT						
25	4.4 VARSTVO OKOLJA						
26	5. REŠEVANJE PROBLEMOV						
27	5.1 REŠEVANJE TEHNIČNIH TEŽAV						
28	5.2 UGOTAVLJANJE POTREB IN OPREDELITEV TEHNOLOŠKIH ODZIVOV						
29	5.3 USTVARJALNA UPORABA DIGITALNE TEHNOLOGIJE						
30	5.4 PREPOZNAVANJE VRZELI V DIGITALNIH KOMPETENCAH						

Digital Competency Assessment Survey

Questionnaire

Dear students,

In the survey, we ask about your digital competences (confident and critical use of digital technologies to obtain and exchange information, communicate and collaborate, create digital content, use information society technologies safely and solve problems. Your answers will help us better understand the gaps in the study program in the field of digital content.

Please take a few minutes and click Next Page to start filling out the survey.

BLOCK (1) (General questions)

Q1 - I am a student

○ Physics, 2nd level, 1st year or 2nd year

○ Mathematics, 2nd level, 1st year or 2nd year

○ Physics, 1st level, 3rd year

○ Mathematics, 1st level, 3rd year

○ Subject teacher, 5th grade

IF (2) Q1 = [5] (Subject teacher, 5th grade)

Q2 - Directions (choose two answers):

Multiple answers are possible.

☐ Educational physics

☐ Educational mathematics

☐ Educational technique

☐ Educational biology

☐ Educational computing

☐ Educational chemistry

IF (3) Q1 = [1] or Q1 = [2]

Q3 - I graduated from the first level of education at

◯FNM UM

◯Other

IF (4) Q3 = [1]

Q4 - I have completed my studies

◯Physics, 1st level

◯Mathematics, 1st level

◯Other

IF (5) Q3 = [2]

Q5 - Please enter the program and institution where you completed your undergraduate studies:

_____

BLOCK (6) (Information and data literacy)

Q6 - How often do you browse, search or filter data, information and digital content?

Rate on a scale from 1 (never) to 8 (several times a day).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (several times a day)

BLOCK (6) (Information and data literacy)

Q7 - How do you rate your ability to evaluate the accuracy and reliability of information online?

Think about your ability to analyze, compare, and critically evaluate the credibility and reliability of sources of information and digital content. This includes identifying false or misleading information and verifying the credibility of authors or sources.

Rate on a scale from 1 (very poor) to 8 (excellent).

◯1 (very poor) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (excellent)

BLOCK (6) (Information and data literacy)

Q8 - How do you effectively manage data, information and digital content?

Storing, organizing, deleting, and processing for future use in digital environments along with structuring and categorizing information.

Rate on a scale from 1 (very ineffective) to 8 (very effective).

◯1 (very ineffective) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very effective)

BLOCK (7) (Communication and Collaboration)

Q9 - How often do you use digital technologies to communicate with others (e.g. email, social media)?

Rate on a scale from 1 (never) to 8 (several times a day).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (several times a day)

BLOCK (7) (Communication and Collaboration)

Q10 - How often do you share content via digital technologies (e.g. images, documents)?

Rate on a scale from 1 (never) to 8 (several times a day).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (several times a day)

BLOCK (7) (Communication and Collaboration)

Q11 - Do you engage in civic activities through digital platforms?

Participating in online petitions, commenting on political topics, participating in political debates, signing petitions for referendums, and similar activities that impact society.

Rate on a scale from 1 (never) to 8 (very often).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very often)

BLOCK (7) (Communication and Collaboration)

Q12 - How often do you collaborate with others through digital technologies (e.g. teamwork, collaborative platforms)?

Rate on a scale from 1 (never) to 8 (very often).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very often)

BLOCK (7) (Communication and Collaboration)

Q13 - How well do you know the rules of online etiquette when communicating online?

Rules for friendly, respectful and responsible communication in digital environments, aware of cultural and generational differences.

Rate on a scale from 1 (I don't know at all) to 8 (excellent).

○1 (I don't know at all) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (excellent)

BLOCK (7) (Communication and Collaboration)

Q14 - How often do you follow the rules of online etiquette when communicating online?

Friendly, respectful, and responsible communication in digital environments and consideration of cultural and generational differences.

Rate on a scale from 1 (never) to 8 (always).

○1 (never) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (always)

BLOCK (7) (Communication and Collaboration)

Q15 - How well do you manage your digital identity?

Control over digital identity, protection of personal data, care for public image and reputation online.

Rate on a scale from 1 (not interested) to 8 (excellent).

○1 (not interested) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (excellent)

BLOCK (8) (Digital Content Creation)

Q16 - How often do you create digital content (e.g. writing blogs, creating videos, taking photos)?

Rate on a scale from 1 (never) to 8 (very often).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very often)

BLOCK (8) (Digital Content Creation)

Q17 - How often do you adapt or recreate existing digital content?

Editing and processing photos, videos or texts.

Rate on a scale from 1 (never) to 8 (very often).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very often)

BLOCK (8) (Digital Content Creation)

Q18 - How well do you know copyright and licensing when using digital content?

Understanding copyright law, digital content licensing (e.g. Creative Commons), including understanding how to use content without violating the rights of others.

Rate on a scale from 1 (I don't know at all) to 8 (I know very well).

◯1 (I don't know at all) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (I know very well)

BLOCK (8) (Digital Content Creation)

Q19 - How often do you consider and take into account copyright and licensing when using digital content?

Copyright protection, licensing when using digital content without violating the rights of others (citing authors when using images, texts, videos from the web).

Rate on a scale from 1 (I don't care) to 8 (I always consider).

○1 (not interested) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (always consider)

BLOCK (8) (Digital Content Creation)

Q20 - How often do you use programming to create digital solutions?

Rate on a scale from 1 (never) to 8 (very often).

○1 (never) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (very often)

BLOCK (9) (Security)

Q21 - How do you ensure the security of your devices (e.g. software updates, antivirus protection)?

Rate on a scale from 1 (very bad) to 8 (very good).

○1 (very bad) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (very good)

BLOCK (9) (Security)

Q22 - Do you pay attention to the protection of personal data and privacy online?

Consider your habits for protecting personal information and ensuring privacy in the online environment, including the use of strong passwords and encryption.

Rate on a scale from 1 (never) to 8 (always).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (always)

BLOCK (9) (Security)

Q23 - How often do you consider health and well-being when using digital technologies?

Frequency of breaks, adequate lighting, correct placement of devices, posture when using devices.

Rate on a scale from 1 (never) to 8 (always).

◯1 (never) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (always)

BLOCK (9) (Security)

Q24 - How important do you think environmental protection is when using digital devices?

Energy efficiency of devices, recyclability of devices and their components.

Rate on a scale from 1 (unimportant) to 8 (very important).

◯1 (unimportant) ◯2 ◯3 ◯4 ◯5 ◯6 ◯7 ◯8 (very important)

BLOCK (10) (Problem Solving)

Q25 - Do you face technical difficulties when using digital devices?

Rate on a scale from 1 (I have insurmountable problems) to 8 (I have no problems at all).

○1 (I have insurmountable problems) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (I have no problems at all)

BLOCK (10) (Problem Solving)

Q26 - Can you solve technical problems when using digital devices yourself?

Rate on a scale from 1 (I always need help) to 8 (I always solve problems myself).

○1 (I always need help) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (I always solve problems myself)

BLOCK (10) (Problem Solving)

Q27 - How often do you analyze your technological needs and look for appropriate solutions?

Consider your own needs when choosing software for work, upgrading hardware for better efficiency, or deciding to purchase a new device to suit your needs.

Rate on a scale from 1 (never) to 8 (very often).

○1 (never) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (very often)

BLOCK (10) (Problem Solving)

Q28 - How often do you use digital technologies in creative ways?

Rate on a scale from 1 (never) to 8 (very often).

○1 (never) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (very often)

BLOCK (10) (Problem Solving)

Q29 - How well do you identify gaps in your digital competences and try to improve them?

Awareness of the lack of knowledge about online safety, knowledge about creating digital content, knowledge about protecting digital content and digital devices, knowledge about managing one's online image, and the like.

Rate on a scale from 1 (very bad) to 8 (very good).

○1 (very bad) ○2 ○3 ○4 ○5 ○6 ○7 ○8 (very good)

Q30 - Click and enter the question text

_____

Appendix 4. Questionnaire 1: Energy literacy, sustainability and green transition competences

Energy literacy and the green transition

Questionnaire

Dear students,

At the NOO project Natural Science and Mathematical Content in the Development of Digital Competences, we are also interested in the extent to which students become familiar with energy literacy, the green transition, and sustainability during their studies.

With the survey questionnaire, we want to gain insight into the achieved level of development of energy literacy, understanding of sustainability and the green transition, which will allow us to shape the content of the pedagogical process in the future.

Please take a few minutes and click Next Page to start filling out the survey.

BLOCK (1) (General questions)

Q1 - I am a student

○ Physics, 2nd level, 1st year or 2nd year

○ Mathematics, 2nd level, 1st year or 2nd year

○ Physics, 1st level, 3rd year

○ Mathematics, 1st level, 3rd year

○ Subject teacher, 5th grade

IF (2) Q1 = [5] (Subject teacher, 5th grade)

Q2 - Directions (choose two answers):

Multiple answers are possible.

☐ Educational physics

☐ Educational mathematics

☐ Educational technique

☐ Educational biology

☐ Educational computing

☐ Educational chemistry

IF (3) Q1 = [1] or Q1 = [2]

Q3 - I graduated from the first level of education at

◯FNM UM

◯Other

IF (4) Q3 = [1]

Q4 - I have completed my studies

◯Physics, 1st level

◯Mathematics, 1st level

◯Other

IF (5) Q3 = [2]

Q5 - Please enter the program and institution where you completed your undergraduate studies:

_____

BLOCK (6) (Systems thinking about energy systems)

Q6 - I am aware of cause-and-effect relationships and energy flows in environmental systems.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q7 - I am capable of independently analyzing connections within environmental systems. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q8 - I am capable of an independent approach to solving environmental challenges, taking into account long-term sustainability. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q9 - I know basic physical concepts about energy and renewable energy sources.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q10 - I can explain energy conversions, the importance of different energy sources and the different ways of producing and storing electricity. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q11 - I can explain that different energy sources and different forms of energy conversion, transport and storage have their own advantages and disadvantages. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q12 - I know that energy flows change our planet, and I know the most important energy sources for processes on Earth. Rate on a scale from 1 (disagree) to 5 (strongly agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q13 - I can explain that the sun is a key source of energy and that a source of energy is required for the flow of matter. Rate on a scale from 1 (disagree) to 5 (strongly agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q14 - I can explain the impact of greenhouse gases on energy flows.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q15 - I can explain that the Sun is the primary source of energy for organisms and ecosystems and that food is a biofuel for organisms.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q16 - I can explain that energy in food chains flows in one direction from producers to consumers, and I know the response of ecosystems to the availability of energy and nutrients.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (6) (Systems thinking about energy systems)

Q17 - I understand the impact of humans on the energy flows of ecosystems.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q18 - I know the basic concepts of biodiversity.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q19 - I am able to independently analyze factors that affect biodiversity and energy efficiency of systems.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q20 - I am capable of independently designing strategies for biodiversity conservation. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q21 - I know the basic principles of biodiversity management (for example, protected areas).

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q22 - I am able to independently apply biodiversity management practices in different contexts (for example, species diversity in urban areas). Rate on a scale from 1 (disagree) to 5 (strongly agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (7) (Biodiversity)

Q23 - I am capable of independently planning biodiversity management programs. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q24 - I understand the importance of conserving resources (water, energy...)

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q25 - I recognize and apply measures for sustainable resource management (materials, water, energy...).

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q26 - I am capable of independently analyzing and optimizing measures for sustainable resource management. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q27 - I recognize everyday activities that use energy and the basics of saving energy consumption.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q28 - I know that social and technological innovations affect the amount of energy used by society and I recognize energy efficiency measures.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (8) (Resource management)

Q29 - I am capable of independent planning and developing methods for efficient energy use and optimization of energy processes. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q30 - I know the basic operation of renewable energy technologies.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q31 - I understand how renewable energy technologies work and am able to analyze them.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q32 - I am capable of planning and developing innovative solutions for the use of renewable energy sources. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q33 - I know basic green technologies (electric vehicles, etc.).

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q34 - I understand basic green technologies and analyze their advantages and disadvantages.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (9) (Technological competences)

Q35 - I am capable of independently planning, developing and optimizing green technologies. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q36 - I know basic environmental policies and regulations and am aware that decisions about the choice and use of energy sources affect the quality of life of individuals and society.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q37 - I can explain environmental policies that support the green transition and I am aware that decisions about the choice and exploitation of energy sources are influenced by economic, political, environmental and social factors.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q38 - I am able to independently analyze and predict factors that influence decisions on the exploitation of energy resources, and to shape the development of environmental policies at regional, national or international level. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q39 - I understand the basics of green business and sustainable entrepreneurship.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q40 - I am capable of independently analyzing examples of good practices in green business and sustainable entrepreneurship.

Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)

BLOCK (10) (Policies and Regulations)

Q41 - I am capable of independently planning and developing strategies for green business and sustainable entrepreneurship. Rate on a scale from 1 (disagree) to 5 (completely agree).

◯1 (disagree) ◯2 ◯3 (undecided) ◯4 ◯5 (strongly agree)