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University of Maribor
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SITUATION ANALYSIS REPORT no. 2

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

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GENERAL DATA

The pilot project *SCIENCE AND MATHEMATICS CONTENT IN THE DEVELOPMENT OF DIGITAL COMPETENCES* part of the *Plan for recovery and resilience: Reform of higher education for a green and resilient transition to Society 5.0* is being implemented at the Faculty of Natural Sciences and Mathematics of the University of Maribor (FNM UM) and at the Faculty for Civil Engineering, Traffic Engineering and Architecture of the University of Maribor (FGPA UM), in the period from 1st of September 2022 to 31st of August 2025.

The project encompasses the following activities:

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 analysis of the situation was concluded in 2023, and the report of the analysis of the situation is publicly available in Slovenian and in English languages at the provided link. It entails a comparison of related teaching units across pairs of study programs: i) Civil Engineering VS (professional) and Civil Engineering UN (academic), ii) Physics UN (academic) and Subject Teacher, orientation Educational Physics EMAG (uniform master study), iii) Mathematics UN (academic) and Subject Teacher, orientation Educational Mathematics EMAG (uniform master study). The comparison encompasses learning content, teaching methods, study results, assessment methods, as well as the integration of digital and natural science competences, algorithmic, logical, and abstract thinking competences, and energy literacy. This fulfills Indicator K1: Analysis of the situation.

This report details the project's progress from 15th of February, 2023, to 31st of December, 2023, (activity A2). It includes indicators K3: Comparative analysis and K4: List of contents and skills. The researchers involved in the project activities are listed in Table 1.

Table 1. Members of the project team.

Member of the project team		Faculty	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
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- 31. 8. 2025	researcher
Eve	**Klemenčič**	FNM	1. 9. 2022- 31. 8. 2025	project manager, member of the project council
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
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	expert
Jan	**Zmazek**	FNM	1.10.2022- 31. 8. 2025	researcher

DESCRIPTION OF THE WORKFLOW BY SUBACTIVITIES

Activity *A2 Comprehensive planning for the development of competences for the digital and green transition* is divided into five sub-activities, which are listed in Table 2.

Table 2. Sub-activities A2

mark	*activity*
A2	**Comprehensive planning for the development of competences for the digital and green transition**
A2.1	Acquaintance with existing competence frameworks
A2.2	Definition of the level of competence development of graduates of selected study programs
A2.3	Definition of skills and content for competence development
A2.4	Preparation of methodology and instrumentation for comparative analysis
A2.5	Comparative analysis

We initiated activity A2 ahead of schedule, prompted by the necessity to establish a unified understanding of individual competencies among researchers. Subsequently, under sub-activity *A2.1 Acquaintance with Existing Competence Frameworks*, we conducted five internal workshops as follows:

1) *Systems thinking*, on 15th of February 2023, asst. prof. Vladimir Grubelnik;
2) *Natural science competences*, on 14th of March 2023, Prof. Robert Repnik;
3) *Energy literacy and the educational system*, on 16th of May 2023, Prof. Marko Marhl;
4) *Biodiversity quantification*, on 20th of June 2023, Prof. Franc Janžeković;
5) *Digital competences (DigComp 2.1, DigComp 2.2, DigCompEdu),* on 28th of November 2023, prof. Robert Repnik.

On the 29th of August 2023, asst. prof. Borut Macuh conducted a working meeting on *Practical Training and Alumni at FGPA UM*. Following the lecture, there was a discussion during which the researchers on the project shared examples of good practice and experiences.

In June 2023, we commenced sub-activity *A2.2, Definition of the Level of Competence Development of Graduates of Selected Study Programs*. We established the methodology, incorporating document analysis, semi-structured interviews, surveys, conversations with alumni, and prepared instruments for comparative analysis under sub-activity *A2.4, Preparation of Methodology and Instrumentation for Comparative Analysis.* Within sub-activity A2.3, *Definition of Skills and Content for Competence Development*, we utilized the results of the situation analysis and comparative analysis (sub-activity A2.5, as presented in this report) to formulate a set of skills and content to support the development of selected competencies. Based on this selection, we devised a plan for workshops to be conducted within the framework of activity A3, *Comprehensive Implementation for the Development of Competences for the Digital and Green Transition and Lifelong Learning*.

ACQUAINTANCE WITH EXISTING COMPETENCE FRAMEWORKS

At the onset of activity A1, *Analysis of the Situation*, we recognized the imperative to establish a common understanding of the identified competencies and literacy among the project researchers. This step was deemed essential to ensure comparability during document analysis and semi-structured interviews. Thus, we initiated activity A2.1, *Acquaintance with Existing Competence Frameworks*, in February 2023 and organized five internal workshops for this purpose. These workshops were conducted in a hybrid format, accommodating both in-person and virtual participation.

Brief description of workshops

First, a workshop was held on the topic *of systems thinking*, which was conducted by assoc. dr. Vladimir Grubelnik on 15th of February 2023. The workshop was attended by 15 researchers (Figure 1). We realized that systems thinking is part of the competences of algorithmic, logical and abstract thinking as well as one of the competences of sustainability (according to the European Competence Framework for Sustainability available at the link). In systems thinking, it is important to understand the relationships and cause-and-effect connections between system quantities, and, in order to solve dynamic systems analytically or numerically, it is important to understand differential equations. The workshop was followed by a discussion, where we formulated proposals for the inclusion of systems thinking in the pedagogical process, such as the inclusion of block diagrams and graphically oriented programs.

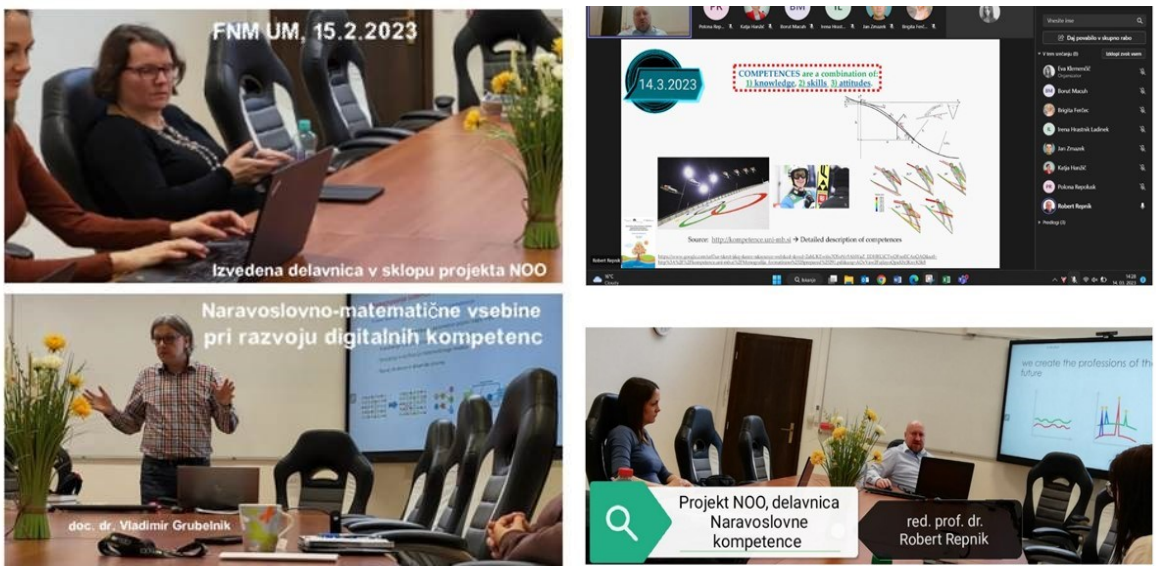


Figure 1. System Thinking workshop, lecturer asst. prof. Vladimir Grubelnik (left), and Natural Science Competences workshop, lecturer Prof. Robert Repnik (right).

At the workshop on 14th of March 2023, Prof. Robert Repnik presented in more detail *natural science competences* and the importance of competence development in the context of formal education. Natural science competences include abilities: to collect information, to analyze, organize, and interpret information, to synthesize conclusions, to learn and solve problems, to the transfer theoretical knowledge into practice, to use mathematical ideas and techniques, to adapt to new situations, to work independently as well as to work in a team, to organize and plan work, to communicate, and to integrate safety regimes at work. We also familiarized ourselves with the materials that were created as part of the Development of Natural Science Competences project and are available at the link. 16 researchers participated in the workshop.

On 16th of May 2023, Prof. Marko Marhl conducted *the Energy Literacy and Education System workshop*, which was attended by 11 researchers. During the workshop, we learned about different approaches to promote the development of energy literacy among students. We also familiarized ourselves with existing manuals on energy literacy and guidelines for education in support of energy literacy (material available at the link).

On 20th of June 2023, a workshop on the topic of the green transition *Quantification of biodiversity*, was conducted by Prof. Franc Janžekovič. At the workshop, we learned about the importance of the green transition and discussed the possibility of including content, also from the field of biodiversity, in the pedagogical process. The workshop was attended by 15 researchers on the project (Figure 2).

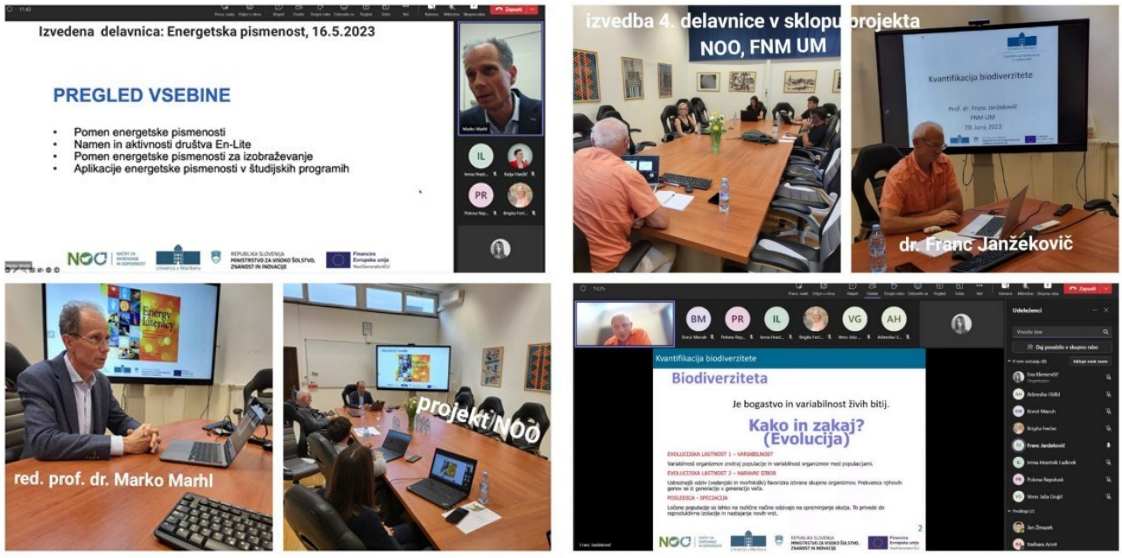


Figure 2. Energy Literacy and Education System workshops, Prof. Marko Marhl (left), and Quantification of Biodiversity, Prof. Franc Janžekovič (right).

At the last internal workshop on 28th of November 2023, Prof. Robert Repnik held *a Digital Competences workshop (DigComp 2.1, DigComp 2.2 , DigCompEdu)*, where we learned more about the European competence framework for digital competences, different levels of competence achievement, and applications that can be used to self-assess the level of competences. The workshop was attended by 11 researchers (Figure 3).

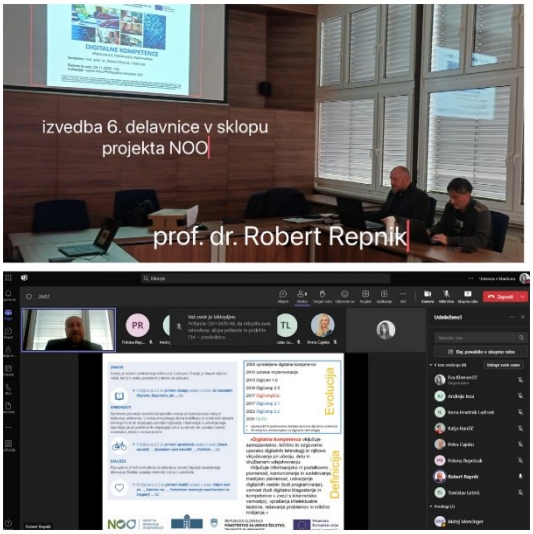


Figure 3. Digital Competence workshop (DigComp 2.1, DigComp 2.2, DigCompEdu), Prof. Robert Repnik.

PREPARATION OF METHODOLOGY AND INSTRUMENTARY

The methodology of the work of sub-activities in the framework of *A2 Comprehensive planning for the development of competencies for the digital and green transition* included document analysis, analysis of semi-structured interviews, surveying and interviewing.

Document analysis is a method that enables objectivity, but can lead to problems in the interpretation of what is written. It was conducted following the next steps:

1) selection of document sources,
2) collection and organization of documents,
3) review and interpretation of documents,
4) summary of relevant information.

Using document analysis, we reviewed the parts of the self-evaluation reports of FNM UM and FGPA UM related to the opinion and involvement of external stakeholders and employers on the labor market. The review of the findings of external stakeholders' satisfaction with graduates is mainly based on three mechanisms. The first mechanism includes formal and informal contacts of program councils of faculties, whose members are recognized authorities from the business and academic environment, as well as graduates' employers. Two program councils have been established at the FNM UM, namely the FNM Program Council and the Program Council for Pedagogical Study Programs. Another mechanism for monitoring the competences and placement of graduates is contact with Alumni within the framework of the FNM Alumni Club and the FGPA Alumni Club. The third mechanism for monitoring the adequacy of graduates' competences is the study satisfaction survey. These mechanisms enable an overview of the placement of study programs in the environment and the qualifications of graduates to work in various fields.

The preparation of semi-structured interviews was carried out within the framework of activity A1. The form for the semi-structured interview, which we conducted with the professors of the selected subjects, is included in the appendix of the State Analysis report (available at link). Although semi-structured interviews are time-consuming, and subjectivity and bias can appear in the interpretation of questions and answers, they enable a deeper understanding of attitudes, opinions and experiences. The analysis of the semi-structured interviews took place in the following steps:

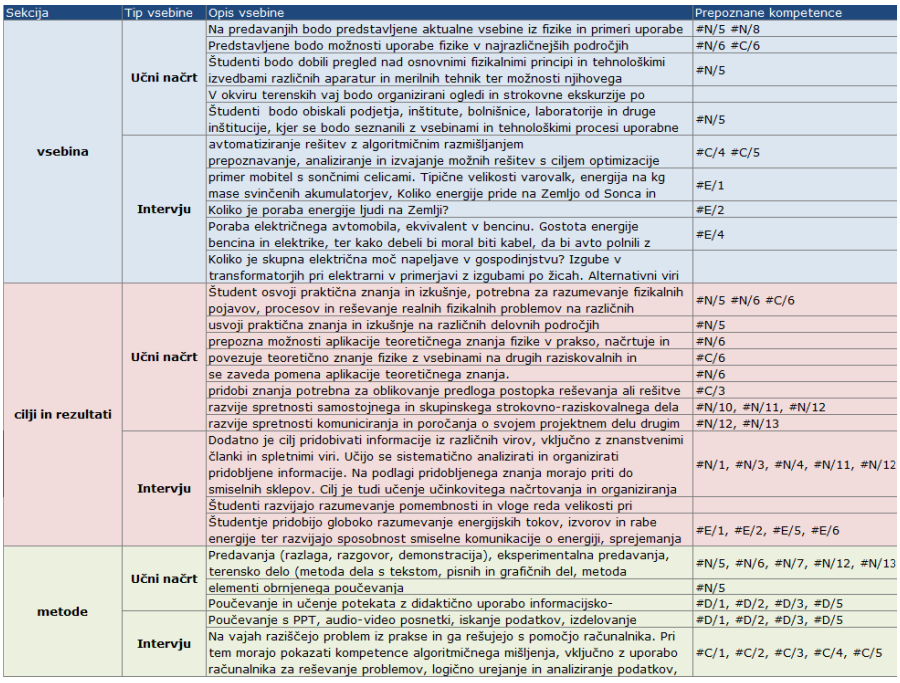
1) transcription and coding,
2) data analysis for pattern identification,
3) interpretation of results,
4) summary of key findings.

We have developed instrumentation for data transcription and coding, which is prepared as an Excel spreadsheet. The instrument makes it possible to compare the findings of the document analysis and the semi-structured interview and record the recognized competencies (Figure 4). For this purpose, the coding of the selected competencies was prepared as presented in Table 3. In doing so, we relied on the conclusions of the discussions held in the internal workshops and on the existing competency frameworks.

Table 3. Coding of individual competencies.

area	code	competence
Digital competences	**D1**	Information and data literacy - browsing, searching and selecting data, information and digital content - evaluation of data, information and digital content - management of data, information and digital content
	D2	Communication and cooperation - communication using digital technologies - sharing using digital technologies - active citizenship using digital technologies - collaboration using digital technologies - online etiquette - digital identity management
	D3	Creating digital content - development of digital content - placing and recreating digital content - copyrights and licenses - programming
	D4	Safety - device protection - protection of personal data and privacy - protecting health and well-being - environment protection
	D5	Problem solving - solving technical problems - identifying needs and technology bottlenecks - creative use of digital technologies - identifying digital divides
Natural science competences	**N1**	The ability to gather information
	N2	Ability to analyze and organize information
	N3	Ability to interpret
	N4	The ability to synthesize conclusions
	N5	Ability to learn and solve problems
	N6	Transferring theory into practice
	N7	Application of mathematical ideas and techniques
	N8	Adapting to new conditions
	N9	Concern for quality
	N10	Ability to work independently and in a team
	N11	Organizing and planning work
	N12	Verbal and written communication
	N13	Interpersonal interaction
	N14	Safety at Work

area	code	competence
Algorithmic, logical and abstract thinking skills	C1	Framing problems in a way that allows us to use the computer and other tools to solve them
	C2	Logical arrangement and analysis of data
	C3	Data presentation with models and simulations
	C4	Automating solutions with algorithmic thinking (set of ordered steps)
	C5	Identifying, analyzing and implementing possible solutions with the goal of optimization
	C6	Generalization and transfer of procedures for solving problems to other problems
Energy literacy	E1	Understanding energy flows and energy systems
	E2	Awareness of energy consumption and production
	E3	Evaluating the credibility of energy information
	E4	Meaningful communication about energy and its use
	E5	Making informed decisions about energy and energy use, based on an understanding of impacts and consequences
	E6	Lifelong learning about energy



Sekcija	Tip vsebine	Opis vsebine	Prepoznane kompetence
vsebina	Učni načrt	Na predavanjih bodo predstavljene aktualne vsebine iz fizike in primeri uporabe	#N/5 #N/8
		Predstavljene bodo možnosti uporabe fizike v najrazličnejših področjih	#N/6 #C/6
		Študenti bodo dobili pregled nad osnovnimi fizikalnimi principi in tehnološkimi izvedbami različnih aparatur in merilnih tehnik ter možnosti njihovega	#N/5
		V okviru terenskih vaj bodo organizirani ogledi in strokovne ekskurzije po	
		Študenti bodo obiskali podjetja, inštitute, bolnišnice, laboratorije in druge inštitucije, kjer se bodo seznanili z vsebinami in tehnološkimi procesi uporabne	#N/5
	Intervju	avtomatiziranje rešitev z algoritmičnim razmišljanjem prepoznavanje, analiziranje in izvajanje možnih rešitev s ciljem optimizacije	#C/4 #C/5
		primer mobitel s sončnimi celicami. Tipične velikosti varovalk, energija na kg mase svinčenih akumulatorjev, Koliko energije pride na Zemljo od Sonca in	#E/1
		Koliko je poraba energije ljudi na Zemlji?	#E/2
		Poraba električnega avtomobila, ekvivalent v bencinu. Gostota energije bencina in elektrike, ter kako debeli bi moral biti kabel, da bi avto polnili z	#E/4
		Koliko je skupna električna moč napeljave v gospodinjstvu? Izgube v transformatorjih pri elektrarni v primerjavi z izgubami po žicah. Alternativni viri	
cilji in rezultati	Učni načrt	Študent osvoji praktična znanja in izkušnje, potrebna za razumevanje fizikalnih pojavov, procesov in reševanje realnih fizikalnih problemov na različnih	#N/5 #N/6 #C/6
		usvoji praktična znanja in izkušnje na različnih delovnih področjih	#N/5
		prepozna možnosti aplikacije teoretičnega znanja fizike v prakso, načrtuje in	#N/6
		povezuje teoretično znanje fizike z vsebinami na drugih raziskovalnih in	#C/6
		se zaveda pomena aplikacije teoretičnega znanja.	#N/6
		pridobi znanja potrebna za oblikovanje predloga postopka reševanja ali rešitve	#C/3
		razvije spretnosti samostojnega in skupinskega strokovno-raziskovalnega dela	#N/10, #N/11, #N/12
		razvije spretnosti komuniciranja in poročanja o svojem projektnem delu drugim	#N/12, #N/13
	Intervju	Dodatno je cilj pridobivati informacije iz različnih virov, vključno z znanstvenimi članki in spletnimi viri. Učijo se sistematično analizirati in organizirati pridobljene informacije. Na podlagi pridobljenega znanja morajo priti do smiselnih sklepov. Cilj je tudi učenje učinkovitega načrtovanja in organiziranja	#N/1, #N/3, #N/4, #N/11, #N/12
		Študenti razvijajo razumevanje pomembnosti in vloge reda velikosti pri	
		Študentje pridobijo globoko razumevanje energijskih tokov, izvorov in rabe energije ter razvijajo sposobnost smiselne komunikacije o energiji, sprejemanja	#E/1, #E/2, #E/5, #E/6
metode	Učni načrt	Predavanja (razlaga, razgovor, demonstracija), eksperimentalna predavanja, terensko delo (metoda dela s tekstom, pisnih in grafičnih del, metoda	#N/5, #N/6, #N/7, #N/12, #N/13
		elementi obrnjenega poučevanja	#N/5
		Poučevanje in učenje potekata z didaktično uporabo informacijsko-	#D/1, #D/2, #D/3, #D/5
	Intervju	Poučevanje s PPT, audio-video posnetki, iskanje podatkov, izdelovanje	#D/1, #D/2, #D/3, #D/5
		Na vajah raziščejo problem iz prakse in ga rešujejo s pomočjo računalnika. Pri tem morajo pokazati kompetence algoritmičnega mišljenja, vključno z uporabo računalnika za reševanje problemov, logično urejanje in analiziranje podatkov,	#C/1, #C/2, #C/3, #C/4, #C/5

Figure 4. Screen image of the prepared instrumentation for comparing the findings of document analysis and semi-structured interviews and the record of recognized competencies.

A fundamental aspect of activity A2 was assessing the proficiency levels of freshmen and graduates in digital competences, natural science competences, algorithmic, logical, and abstract thinking competences, as well as energy literacy. To achieve this, we employed the survey method. Surveys offer an effective means of gathering data from a large participant pool, while standardized questions facilitate comparison, and anonymity fosters honesty in responses. However, challenges such as potential low response rates and the risk of question misunderstanding or misinterpretation were anticipated. The implementation proceeded as follows:

1) designing two survey questionnaires, separately for freshmen and for graduates of selected study programs (appendix 1 and appendix 2),
2) preparation of two survey questionnaires in the 1ka software,
3) distribution of the questionnaire among freshmen and graduates,
4) data collection and analysis,
5) statistical processing of data to identify trends,
6) interpretation of results and presentation of conclusions.

This structured approach allowed us to systematically evaluate the stated competencies and draw meaningful insights from the survey data.

FINDINGS OF SEMI-STRUCTURED INTERVIEWS

Findings of the interview for the comparison of learning content in study programs Physics UN and Subject teacher, orientation Educational Physics

The document analysis comparing the learning contents of the UN Physics and Subject Teacher study programs revealed minor discrepancies across most study units. These variances encompassed the content of the study units, goals and competencies, expected study outcomes, teaching and learning methodologies, and assessment methods. To delineate these disparities more precisely and to uncover any potentially overlooked information within the curricula, we opted for semi-structured interviews with professors responsible for teaching units common to both majors. Fortunately, the majority of professors were willing to participate in this process.

Semi-structured interviews were conducted for subjects such as *Applied Physics, Mechanics, Oscillations and Waves, Thermodynamics, Environmental Physics, Physics Experiments 1 through 4, Electromagnetism, Modern Physics, and Complex Systems*. The detailed results of these interviews are documented in Appendix 3, while the primary findings are summarized below.

In the course Applied Physics (3 ECTS), which is taught in the 3rd year of the academic Physics program (UN) and in the 5th year of the Subject Teacher study program, the professor does not indicate any differences in the implementation of the course, which is in accordance with the curriculum. In addition, the professor is of the opinion that the implementation of adjustments for both groups of students would not significantly benefit any of the elements of the course implementation.

In the course Mechanics (7 ECTS), which is taught in the 1st year of the Physics and Subject Teacher study programs, certain differences between the two programs were already revealed by document analysis. The professor confirms that the primary discrepancy in content lies in the fact that students enrolled in the UN Physics study program undergo an additional 15 hours of lectures compared to their counterparts in the Subject Teacher study program. In the additional 15 lecture hours allocated to UN Physics students, the mathematical level is elevated, and the professor integrates "live" simulations of specific physical phenomena for these students. Conversely, students enrolled in the Subject Teacher study program dedicate these 15 additional hours to laboratory exercises. Within this framework, students are tasked with mastering the fundamentals of data measurement and processing, conducting experiments related to mechanical physical quantities, graphically representing measurements, linearizing graphs, and adjusting linear functions. Moreover, as part of these laboratory exercises, students are required to familiarize themselves with and utilize software for data processing.

The course Oscillations and Waves (7 ECTS) is taught in the 2nd year of the Physics and Subject Teacher study programs. Document analysis revealed some variation in implementation for this learning unit; the difference is mainly in the goals and results, as students on the UN Physics study program use

modern computer software as an aid in quantitative calculations, to draw dependencies between variables depending on parameter values, and to predict trends.

The subject Thermodynamics is taught in the 1st year of the Physics study program (5 ECTS) and in the 2nd year of the Subject Teacher study program (3 ECTS). The document analysis uncovered disparities in content and expected study outcomes, a finding corroborated during the interview with the professor. Notably, students enrolled in the Subject Teacher program have fewer lectures, leading to certain content becoming optional. However, this optional content is not assessed, although its knowledge is encouraged. Regarding teaching and learning methods, while the document analysis initially indicated no differences, the professor revealed that additional experiments are conducted for Subject Teacher study program students to deepen their understanding and prepare them for teaching in schools. Conversely, students in the Physics study program focus more on mastering mathematical modeling. In terms of expected study outcomes, the professor noted that distinctions between the two programs primarily center on the importance of a comprehensive understanding of the material. Minor errors in derivation are overlooked for Subject Teacher students, whereas for Physics students, emphasis is placed on setting up models, including full mathematical derivations. Furthermore, differences in assessment methods were highlighted, with UN Physics program students receiving four questions compared to three for Subject Teacher program students. Additionally, questions for the Subject Teacher program are tailored towards material relevant to primary/secondary school contexts and include engaging tricks to maintain student interest.

The Document analysis for the subject Environmental Physics, which is implemented in the 3rd year of the Physics study program (6 credits) and in the 5th year of the Subject Teacher study program (5 credits), did not identify any differences in implementation. However, during the interview, the professor highlighted variances in teaching and learning methods. Specifically, Physics students engage in additional activities such as measurement, modeling, and calculation, whereas Subject Teacher students concentrate on how to effectively teach this material in a school setting. Additionally, there are discrepancies in the assessment method, with differentiated project tasks for each group. The professor suggests potential advantages to separate implementations, particularly in catering to Subject Teacher students with slightly weaker mathematical backgrounds. This approach could allow for more tailored instruction, ensuring a deeper understanding of the material and better preparation for teaching in schools.

In the subject Physics Experiments 1, which is carried out in the 1st year of the Physics program (UN) (4 ECTS) and in the 1st year of the Subject Teacher program (3 ECTS), the professor states the difference in the contact hours of the laboratory exercises, which is in accordance with the curriculum. The volume of exercises for students of the Subject Teacher is smaller, the content of the exercises is the same. All students have 5 hours of lectures from exercises, the review of exercises is the same. The difference is that the students of the Subject Teacher can adopt additional didactic approaches when dealing with natural phenomena and the ability to transfer knowledge to others. The professor is of the opinion that the implementation of adjustments for both groups of students would not significantly benefit any of the elements of the course implementation.

In the subject Physics experiments 2, which is carried out in the 2nd year of the academic Physics program (4 ECTS) and in the 2nd year of the Subject Teacher study program (3 ECTS), the professor states the difference in the contact hours of the laboratory exercises, which is in accordance with the curriculum. The volume of exercises for students of the Subject Teacher is smaller, the content of the exercises is the same. All students have 5 hours of lectures from exercises, the review of exercises is the same. The difference is that the students of the Subject Teacher can adopt additional didactic approaches when dealing with natural phenomena and the ability to transfer knowledge to the layman. The professor is of the opinion that the implementation of adjustments for both groups of students would not significantly benefit any of the elements of the course implementation.

In the subject Physics experiments 3, which is carried out in the 2nd year of the academic Physics program (4 ECTS) and in the 2nd year of the Subject Teacher study program (3 ECTS), the professor states the difference in the contact hours of the laboratory exercises, which is in accordance with the curriculum. The volume of exercises for students of the Subject Teacher is smaller, the content of the exercises is the same. All students have 5 hours of lectures from exercises, the review of exercises is the same. The difference is that the students of the Subject Teacher can adopt additional didactic approaches when dealing with natural phenomena and the ability to transfer knowledge to others. The professor is of the opinion that the implementation of adjustments for both groups of students would not significantly benefit any of the elements of the course implementation.

In the subject Physics Experiments 4, which is conducted in the 3rd year of the academic Physics program (4 ECTS) and in the 3rd year of the Subject Teacher (3 ECTS) study program, the professor does not indicate any differences in the implementation of the subject, which is in accordance with the curriculum. The scope and content of the exercises are the same. All students have 15 hours of lectures from exercises, the review of exercises is the same. The difference is that the students of the Subject Teacher can adopt additional didactic approaches when dealing with natural phenomena and the ability to transfer knowledge to others. For students of the Subject Teacher, the goals and results are more in the direction of teaching. For students of the Physics program, it is more related to the use of meters, where we meet them and the use of radioactive materials. The professor is of the opinion that the implementation of adjustments for both groups of students would not significantly benefit any of the elements of the course implementation.

In the subject Electromagnetism, which is taught in the 1st year of the academic Physics program (7 ECTS) and in the 1st year of the Subject Teacher study program (7 ECTS), the professor states the differences. In addition to the understanding and qualitative and quantitative description of phenomena, Physics students must also demonstrate more in-depth knowledge, such as solving Maxwell's equations, electric and magnetic fields, and solving problems using symmetry. They know how to use basic theoretical knowledge in solving relevant problems using mathematical tools. Students of the Subject Teacher study program focus on solving problems, while Physics students also focus on understanding basic processes in nature. The professor is of the opinion that making adjustments for both groups of students would be beneficial in the implementation of the course, as it would emphasize different contents.

In the subject of Modern physics, taught in the 2nd year of the Physics undergraduate program (8KT) and in the 2nd year of the Subject Teacher undergraduate program (7KT), the instructor points out differences. Students in the Physics undergraduate program achieve a deeper understanding of the fundamental processes in nature and a comprehensive approach to problem-solving. In addition to describing basic phenomena of modern physics, they also acquire the use of specific equations, description of the properties of atoms/molecules/crystals, and prediction of system properties based on their constituents. Students in the Subject Teacher undergraduate program gain an understanding of the basic processes in nature. They can qualitatively and quantitatively describe basic phenomena in modern physics and learn to solve individual problems using mathematical tools. The instructor believes that making adjustments for both groups of students would benefit the course delivery by emphasizing different content areas.

In the subject Complex systems, which is taught in the 3rd year of the academic Physics program (4 ECTS) and in the 3rd year of the Subject Teacher study program (4 ECTS), the professor states the differences. Physics students acquire fundamental theoretical knowledge and solve problems with the help of mathematical tools of the subject teacher study program only basic knowledge. In addition to a basic understanding of basic processes in nature, Physics students must also use simple nonlinear differential equations, describe the basic properties of fractal and chaotic systems, and predict solutions based on symmetry. The professor is of the opinion that making adjustments for both groups of students would be beneficial in the implementation of the course, as it would emphasize different contents.

Findings of the interview for the comparison of learning content in the study programs Mathematics UN and Subject teacher, orientation Educational mathematics

The document analysis indicates significant differences in learning contents between the UN Mathematics and Subject Teacher programs, making comparisons through interviews often impractical or meaningless. Consequently, interviews were conducted for teaching units shared by both majors, where discrepancies in the curricula were identified from the document analysis. These subjects include Plane and Spatial Geometry, Number Theory, Introduction to Differential Equations and Differential Equations in Context, Mathematical Modeling, and Geometry.

Fortunately, professors were willing to collaborate, providing valuable observations for four out of five comparisons. This approach allowed for a more meaningful examination of curriculum differences and facilitated a clearer understanding of areas where adjustments may be necessary.

In Plane and Solid geometry, the variance in ECTS between the two study programs stems from the disparity in student's independent work requirements. Lectures and exercises are conducted jointly for both groups, with identical course material. However, the professor differentiates the knowledge test between the two cohorts. For students of the study program Mathematics, the curriculum demands a comprehensive understanding, synthesis abilities, and often requires proofs. Conversely, Subject Teacher students are assessed through an oral exam, focusing on a fundamental grasp of the material.

The document analysis in the course Number Theory does not show any differences between the fields of study. The implementation is completely the same for both courses, the exam is also the same. The professor believes that separate implementation is not necessary. If it were possible, given the resources, they would implement this subject for Subject teacher students in exactly the same way as now. The differences would be for Mathematics students regarding some topic that they may already hear in some other subject and replacing them with new topics from number theory. In addition, the course could be more in-depth and suitable for students of this field of study.

The subject Geometry is not taught together in its entirety - the difference is in the number of hours of exercises and in the independent work, although the final number of ECTS is the same for both study courses. The difference in execution is therefore made so that students of the Subject Teacher program only listen to the exercises for part of the material and write the written exam only from that part of the material.

In Mathematical Modelling, the implementation is joint, and the difference between the study programs is in the hours of individual student work. Mathematics students develop research content, connect with companies and tackle a real problem, solve/model/simulate it in a seminar assignment, which is part of the course's obligations. Subject Teacher Students prepare the basis for mentoring in the research project, prepare an introduction or motivation for the students, who would process it and then take up further research.

To summarize the professors of teaching units do not see any problems in the joint delivery of courses for both majors, although in some cases a separate delivery would lead to a more in-depth treatment of topics in one of the study programs. If the written part of the exam for a certain course is the same for both study courses, then in the oral part of the exam students have the opportunity to make a difference between the students of the two courses in terms of assessment, where in one course more in-depth knowledge is required for the same assessment. In this way, the difference in the hours of individual student work for both majors are also justified. The professors noted interesting observation: despite Subject Teacher students receiving less than half the hours of mathematical instruction compared to the mathematics students, it's common for Subject Teacher program students to exhibit superior knowledge in their respective year.

Findings of the interview for the comparison of learning contents in the study programs Construction UN and Construction VS

UN and VS program: Physics

Based on the syllabuses for the subject Physics in the academic (UN) and professional (VS) programs and based on an interview with the professor, we can see some differences between the programs in terms of competences, content, teaching and learning methods, and assessment methods. The subject is taught in the 1st year at VS and UN, which means an earlier familiarization with the topic and also a basis for other professional subjects.

Contents: The contents are partly similar. At the academic program there are additional contents (eg torsion). For similar contents, students of professional program don't need to prove and derive. There are also several calculation examples on professional program, while the academic program includes more theory and covers the content in more depth.

Digital competences: ICT is used in both programs for presentation, animations, simulations, and otherwise the digital competences in the two study programs do not differ. All digital competencies are present except online safety, media literacy and cyber security. Also, the use of software tools for processing and analyzing data, drawing graphs and searching, editing information in databases, which are planned according to NOO to be connected with computer science, are also not yet present. ICT is expressed in both programs in the form of Moodle and PHET simulations in physics.

Competences of algorithmic, logical and abstract thinking: These competencies do not differ significantly between both programs. Both programs feature problem solving, modeling, systems thinking, programming, coding, algorithms, logical operators, and data analysis. Optimization in the form of determining states in thermodynamics - calorimetry is also present in both educational programs. Artificial intelligence and machine learning are not present. In computational thinking, both programs have in common that fundamentals are essential and that the course prepares students in the theoretical foundations that they use in other subjects. When solving tasks, they must divide the problem into smaller solvable units (decomposition and algorithms). There is also pattern recognition to step up one task and identify novelties and differences. Abstraction is also present.

Natural science competences: They are present in both programs, with the exception of environmental sustainability and safety at work, which are not emphasized in either program.

Energy literacy: Both programs partially cover energy literacy content or do not cover it at all. For example in energy policy, environmental impacts and energy efficiency, it is established that they are covered later in the Building Physics course. Other topics are not directly covered, with the exception of energy conservation, which is partially covered in thermodynamics. In both programs, it is emphasized that the foundations for Building Physics are prepared, where the contents of energy literacy are discussed on a larger scale.

Teaching and learning methods: The teaching and learning methods do not differ between the programs and include a combination of classic lectures and solving tasks, and the Moodle platform is used.

Assessment methods: In both programs, there are two tests with calculation tasks, which, if they are positive on average, replace the written exam with calculation tasks, which represents a 50% share. Both programs also have an oral exam with theoretical questions, which also accounts for 50%.

Assessment partly differs between the two programs in the way that the assignments are different - more demanding on the UN, and the UN includes content that is not on the VS (e.g. torsion).
Objectives and competences: They are the same in both study programs.
Study results: Varies between UN and VS. Difficulty also varies at the same level of Bloom's taxonomy.
Basic literature and resources: The basic literature and resources are recommended to be the same for both study programs. However, different literature within the same program is recommended depending on the level of prior knowledge (refreshing high school physics is recommended for certain students).

UN and VS program: Building Physics

Regarding digital competences, both professors report that students do not program (at the first level) within this course. DEZMOS is used to prepare seminar/project assignments. In both programs, the student uses software tools for data processing/analysis. Sorting and searching data in databases is not applied to any program. Digital literacy, online safety, internet use, information literacy, media literacy and cyber security are not part of this course. Students acquire these competencies in other subjects or already have them. The professor mentioned that the student acquires some competences related to digital communication.
Competencies of algorithmic thinking are mostly present in the academic (UN) program (with the exception of programming and machine learning and artificial intelligence). They don't use algorithms on the professional program. Optimization is present for glass walls in both programs. The two subjects are very different in terms of computational thinking. Decomposition, pattern recognition, abstraction and algorithms are present at the academic (UN) program.
Apart from safety at work, natural science competences are present in both programs. At professional study program, they also plan experiments (which they want to introduce to the UN program as well). In terms of science literacy, both programs acquire all the discussed competencies.
When it comes to energy literacy, none of the programs deal with the content of the circular economy, but climate change is also touched on at the academic study program. Regarding energy literacy, both professors believe that students acquire all competencies, except (they cannot confirm this with certainty) the constant upgrading of knowledge about energy and its supply.
The difference in terms of content is about 5% of different content, and in VS there is a greater emphasis on practical problems. The professor would not make any additional differences between VS and UN regarding the content. However, minimal sensible differences already exist. Differences between subjects (on different programs) exist in teaching methods (simplifications in the VS program) and in knowledge testing/assessment (adapted exam for VS) and in goals and competencies. There are no differences in the literature. Among the goals and competencies, this course envisages the development of digital competencies. Based on the course materials for construction physics in both programs and based on an interview with both professors, we can observe several key differences between the programs in terms of competencies, content, teaching and learning methods, and assessment methods.
Digital competences: In both programs, students do not program, but the preparation of seminar/project assignments is carried out using software tools for data processing/analysis such as DEZMOS. Algorithmic thinking is more present in the academic (UN) program, where it covers

everything except programming, machine learning and artificial intelligence, while in the VS program they do not use algorithms at all. Online safety and similar digital competencies are not part of the course.

Natural science competences: They are present in both programs, whereby the VS program also includes the design of experiments. Science literacy is treated equally at both levels.

Energy Literacy: Both programs cover topics related to energy, but do not include circular economy content. On the UN program, they additionally touch on climate change.

The content of the subjects is similar, with about 5% differences in the content, where VS puts more emphasis on practical problems. Teaching methods include a combination of classic lectures and solving tasks using the Moodle platform. In the VS program, teaching methods are simplified compared to the UN program.

The evaluation includes two tests for solving tasks, a written part of the exam and an oral part of the exam with theoretical questions on both programs. Differences in grading are adjustments for the VS program that allow for a customized exam.

The subject is taught in the 1st year at VS, which means an earlier familiarization with the topic, and in the 2nd year at the UN program, which can enable a more in-depth understanding based on previously acquired knowledge from other subjects. The differences between the two programs reflect different approaches to education, with the UN program being more theoretical and research-oriented, while the VS program emphasizes the practical application of knowledge. Both approaches are aimed at developing key competencies in the field of construction physics, but with different emphases depending on the level and goals of the educational program.

UN program: Civil engineering materials
VS program: Introduction to materials, Materials for civil engineers

Content: The content of the subjects is similar, there is a difference in emphasizing certain content. At the academic UN the program has a greater emphasis on theoretical content, which is more conceptually oriented understanding and formulating general laws, while of course breaking down and they also investigate specific problems. On the professional VS program, all content is much more practical oriented, these students are usually employed after graduation.

Digital competences: In both programmes, students use ICT to support their studies. They use software tools to process and analyze data and search and edit information in databases. In the academic (UN) program, they are information and digitally literate, in VS to a lesser extent. Online safety and cyber security are not part of the course.

Competencies of algorithmic, logical and abstract thinking: In both programs, they solve problems and analyze data and results, but logical and abstract thinking is more present in the academic (UN) program. Of course, it is necessary to think systematically.

Natural science competences: They are present in both programs and are included to an approximately equal extent. They are planning experiments at VS.

Energy literacy: Both programs include the topic of energy. The goal here is not only that they understand it, but that they know how to integrate this knowledge and understanding to meet our needs in all areas.

Teaching methods: Professors do not differentiate between teaching and learning methods. The differences are in the content. They strive for student-oriented teaching and problem-based learning. About two-thirds of the literature in the studied units is shared. The rest is more on the VS program practically oriented, the use of English literature is also mandatory on the UN program.
Objectives and learning outcomes: The objectives of the two programs are different. In the academic (UN) program, students need to know more of the theoretical basis. Within the scope of elective courses, they are involved in research and creativity thinking, among other things, so that they can graduate on time and continue their studies at second stage.
Assessment methods: When it comes to the method of evaluation, the professors do not make any distinctions.

UN program: Geometric modeling with descriptive geometry
VS program: Geometric modeling and CAD

The content of the subjects varies significantly between the programs. For instance, in the topic of cross-sections of bodies with planes, the UN program covers this using arbitrary planes, whereas the VS program focuses solely on perpendicular planes. Additionally, the UN program includes calculations with homogeneous coordinates, a component that is absent from the VS program. In terms of problem-solving approaches, the UN program tackles more challenging cases with multiple derivations, whereas the VS program emphasizes practical applications. Furthermore, the VS program allocates an additional 10 hours of lectures, primarily dedicated to revisiting high school geometry lessons. Additionally, students in the VS program engage in more hours of laboratory exercises, resulting in fewer independent work assignments compared to their counterparts in the UN program.
Digital competences: On both programmes, students use ICT, online classrooms and the internet to help with their studies. They use computer graphics methods and software CAD tools. They are digitally and informationally literate. Students of the UN program have an upgrade of this subject in the subject Digital programming. They don't talk about online safety and cyber security.
Algorithmic, logical and abstract thinking skills: In both subjects, they use algorithms and logical operators, solve problems and analyze data. They know how to think computationally.
Natural science competences: Except for research and planning experiments, all other natural science competences are represented in both programs.
Energy literacy: Energy literacy is not talked about.
Teaching methods: In the VS program, the teaching methods are quite simplified compared to the UN program. On the VS program, the exercises include more practical examples, on the UN more theoretical and more demanding. Both approaches are aimed at the development of key competences, but in different ways approaches depending on the complexity of the program.
Objectives and study results: The objectives and competences and study results are the same for both study units, except that the students of the VS program complete more practical exercises. They also have more of these at their disposal. Educational literature is the same for both programs, but differs in presentation.
Methods of evaluation: When it comes to the method of evaluation, the professors do not make any distinctions. Assessment includes a written and oral exam and a seminar assignment. The adaptation

for the VS program is, for example, in the fact that students defend the products made during the exercises, while students of the UN program defend independently solved assignments.

UN program: Mathematics A, B
VS program: Mathematics I

Students of the UN program listen to Mathematics A and Mathematics B in the first year, Mathematics C in the second year. Students of the VS program listen to mathematics only in the first year, they are called Mathematics I and Mathematics II. In terms of content, Mathematics I is best matched by Mathematics A and B.

Content: Mathematics A and B differ from Mathematics I in terms of scope and difficulty of the learning material - only the basic content is the same. In addition to the fact that more math is processed in the academic (UN) program contents, these are given at a more in-depth level. This also means the involvement of the greater number of competencies, only these are at a higher level.

Digital competences: On both programmes, students use ICT, online classrooms and the internet to help with their studies. They use software tools for data processing and analysis, use digital communication and are digitally literate.

Algorithmic, logical and abstract thinking competences: All these competencies are included in both programs except programming, artificial intelligence and machine learning.

Natural science competences: All natural science competencies are included except research and experimental design, environmental sustainability and occupational safety.

Energy literacy: Students do not encounter energy literacy in these subjects.

Teaching methods: In the VS program, the teaching methods are simplified compared to the UN program. In the academic (UN) program, the abstraction is greater, the cases are more difficult and are dealt with more quickly. In the VS program, the material is case-based and more structured.

Goals and study results: There are differences in the learning material and, consequently, also in the goals and competencies and study results. With the same content, students on the UN program learn more because of the more difficult cases. Competences are also at a higher level. The core teaching literature varies. In most cases material, it is considered that the basic literature on the UN program is additional literature for the VS program.

Assessment methods: In the academic (UN) program, the questions are in-depth and the problems are more difficult, the theory is tested orally, students must also complete individual homework. In the VS program, the theory is tested in writing and only exceptionally orally. The ratio of written part: oral part is 70:30.

UN program: Foundation engineering
VS program: Foundation engineering 1

Content: The content of the subjects is similar, there is a difference in emphasizing certain content. In the academic (UN) program, there is a greater emphasis on theoretical content, which is more oriented towards the conceptual understanding and formulation of general laws, while, of course, specific problems are also analyzed and researched. In the VS program, all the content is much more practically oriented, these students usually get a job after graduation.

Digital competences: In both study programs, students use ICT to help with their studies. They use software tools to process and analyze data, program and search and edit information in databases. In the academic (UN) program, they are information and digitally literate, competences are achieved more in-depth and at a higher level, in VS to a lesser extent. An interactive whiteboard is not used in the teaching unit.
Competences of algorithmic, logical and abstract thinking: In both programs, they solve problems and analyze data and results, but logical and abstract thinking is more present in the academic (UN) program, the competencies are achieved in greater depth and at a higher level. In this, of course, systemic thinking is exposed. They don't stress about artificial intelligence and machine learning.
Natural science competences: They are present in both programs and are also included to approximately the same extent, in the academic (UN) program the competences are achieved in more depth and at a higher level. They are planning a program of experiments at the VS.
Energy literacy: Both programs include topics about energy, without energy policy. The goal here is not only for them to understand it, but for them to be able to include this knowledge and understanding in the planning of geotechnical constructions and to meet our needs in all areas.
Teaching methods: VS professors use simpler teaching and learning methods compared to UN. There are also differences in content. They strive for student-oriented teaching and problem-based learning. The rest of the VS program is more practically oriented. About two-thirds of the literature in the studied units is shared.
Objectives and learning outcomes: The objectives of the two programs are different. In the academic (UN) program, students need to know more of the theoretical basis. As part of elective courses, they are involved in research and creative thinking, among other things, so that they can graduate on time and continue their studies at the second level. The differences are in the calculation methods used and in solving various cases from geotechnical practice.
Assessment methods:
UN: Programs 10%, Seminar assignment: 10%, Written exam: 40%, Oral exam: 40%.
VS: Seminar assignment: 10%, Written exam: 45%, Oral exam: 45%.

UN and VS program: Concrete structures

Content: The content of the subjects is similar, there is a difference in emphasizing certain content. In the academic (UN) program, there is a greater emphasis on the theoretical deepening of the contents, which are more oriented towards the conceptual understanding and formulation of general laws, whereby, of course, specific problems are also analyzed and researched. On the VS program, all content is much more practically oriented, e.g. armature drawings, these students are usually employed after graduation.
Digital competences: In both study programs, students use ICT to help with their studies. They use software tools to process and analyze data, program and search and edit information in databases. In the academic (UN) program, they are informationally and digitally literate, competences are achieved more in-depth and at a higher level, in VS to a lesser extent. The learning unit does not use an interactive whiteboard, does not program, and does not emphasize online safety, media literacy, and cyber security.

Competences of algorithmic, logical and abstract thinking: In both programs, they solve problems and analyze data and results, but logical and abstract thinking is more present in the academic (UN) program, the competencies are achieved in greater depth and at a higher level. In this, of course, systemic thinking is exposed. They don't stress about programming, optimization and machine learning.

Natural science competences: They are present in both programs and are also included to approximately the same extent, in the academic (UN) program the competences are achieved in more depth and at a higher level. In the VS study program, there are many theoretical derivations and more basic knowledge. They do not plan experiments and emphasize safety at work.

Energy literacy: Both programs include topics on energy with an emphasis on the importance of economic planning, without energy sources and a circular economy. The goal here is not just for them to understand it, but for them to be able to include this knowledge and understanding in the planning of concrete structures and to meet our needs in all areas.

Teaching methods: At the professional study program professors use simpler teaching and learning methods compared to the academic. There are also differences in content. At academic study program, flipped learning is partially implemented with handouts that are given in advance. At the professional study program, they note that repetition of previously acquired knowledge is required, more contact hours would be needed. Competences are included with the demonstration and use of software for static analysis and dimensioning of AB cross-sections, whereby the scope of the given content on the VS program is significantly smaller.

Objectives and learning outcomes: The objectives of both programs are the same. In the academic (UN) program, students need to know more of the theoretical basis. The differences are in the calculation methods used and in solving various cases from practice. The goals and competencies of the VS program should be reduced because the learning unit is in the 2nd year and the students have less prior knowledge.

Assessment methods: Written exam at VS less theoretical work. UN - calculation part / theoretical part (50% / 50%). VS - calculation part / theoretical part (70% / 30%).

UN and VS program: Steel structures

The subject is taught in the 2nd year at VS, in the 3rd year at UN, the scope of implementation is also different - at VS 45 hours (30 hours of lectures, 15 hours of exercises) and at UN 60 hours (35 hours of lectures, 25 hours exercise). The essential difference between the two programs is the in-depth treatment of content at UN, where students must independently master derivations and calculations, while at VS, only understanding without derivations is required. The content on VS is also more practically oriented.

Digital competences: there are no differences between the two programs in terms of digital competences, both include programming and the use of software tools for processing and analyzing data, drawing graphs.

Competences of algorithmic, logical and abstract thinking: They are included in both programs (simple data analysis, classical engineering optimization, simple decisions). Modeling is encouraged in both

programs (it is not mandatory), it is very rarely undertaken by VS students while about half of UN students undertake it.

Natural science competences: both programs include natural science competences (synthesis of conclusions, problem solving, critical thinking, environmental sustainability), the UN program also includes the use of mathematical tools.

Energy literacy: energy literacy is not part of the course (awareness of energy literacy is included in the initial lectures), because the course optimizes materials and not energy.

In both programs, an understanding of the basics is important in the course. Students of the UN program master the content in depth, understand derivations and more difficult matters, or must be able to understand the causes (WHY). In the VS program, students also learn the basics, learn the content more and do not delve as much as UN students, because understanding the WHY is not necessary.

UN and VS program: Timber constructions

The subject is taught in the 2nd year at VS, in the 3rd year at UN, the scope of implementation is also different - at VS 45 hours (30 hours of lectures, 15 hours of exercises) and at UN 55 hours (30 hours of lectures, 25 hours exercise). The difference between the two programs is mainly in the details of the explanations - on the UN program the contents are explained in more detail, and on the UN there is also additional content - torsion, which is not present on the VS, giving tasks is more demanding on the UN than on the VS program. The students of the UN program mainly acquire more in-depth knowledge, which gives them a better basis for studying at the 2nd level of study, while the students of the VS program get knowledge that they can use in practice.

Digital competences: covers only basic competences (use of ICT, digital literacy), as students must understand the content before starting to work with software tools.

Competencies of algorithmic, logical and abstract thinking: in order to succeed in the course, students must already have the basic competencies of problem solving, systems thinking and data analysis. The course contains essential basics - the course prepares students in the theoretical basics that they use in other courses.

Natural science competences: the subject includes basic problem-solving competences, critical thinking and environmental sustainability, natural science literacy in the fields of mechanics, physics and mathematics basics.

Energy literacy: competences of energy literacy are mainly missing in the VS program, in the academic (UN) program it is included in other subj ECTS.

The essential difference between the two programs in terms of the way and scope of content treatment is that the UN has more theory and covers the content in more depth, while at the VS they understand certain content (e.g. the critical section), but they cannot calculate it (which is required at the UN).

COMMON FINDINGS

Based on the analyzes of the interviews and the summaries contained in the uploaded documents, it is possible to summarize the main findings regarding the differences and similarities between the academic (UN) and professional (VS) study programs in different categories, such as subject content, digital competences, algorithmic, logical and abstract thinking competences, natural science competences, energy literacy, teaching and learning methods, goals and competences, study results, and assessment methods.

Contents of subjects

Steel and Timber Structures, Physics, Mathematics, Foundation engineering, Building Physics, Civil engineering materials, Geometric Modeling and descriptive geometry: UN programs focus on theoretical content, a greater range of derivations and theory, while VS programs are more practically oriented, with less emphasis on theory and more on practical examples.

Digital competences

The use of ICT, software tools for data analysis, and an online classroom are present in both programs. However, in UN programs, students achieve a higher level of digital literacy.

Algorithmic, logical and abstract thinking skills

Competencies of problem solving, modeling and systems thinking are present in both programs. The differences are mainly in the level of complexity and in-depth treatment of the topics.

Natural science competences

Natural science competencies, including collecting, analyzing and interpreting data, critical thinking, and the use of mathematical tools, are present in both programs. In UN programs, there is usually a greater depth of theory.

Energy literacy

Energy literacy is in principle covered in both programmes, but is often limited to specific subjects and may not be covered comprehensively.

Teaching and learning methods

Teaching and learning methods do not differ significantly between the programs; the key difference is in the approach, where UN programs use more theoretical and complex approaches, while VS programs emphasize practical exercises and applied knowledge.

Objectives and competences and study results

Objectives and study results are adapted to the level and nature of the programs; UN programs focus on theoretical knowledge and research, while VS programs emphasize practical skills and the direct applicability of knowledge.

Assessment methods

The methods of assessment do not differ significantly between the two programs, and in VS programs the tasks can be adapted to the complexity and nature of the program.

Summary of analysis findings

In general, we can summarize that academic (UN) program place more emphasis on theoretical content, in-depth understanding and research work, while professional (VS) programs emphasize practical orientation, applicability of knowledge and direct preparation for the labor market. UN program require from students a higher level of independent work, research and critical thinking, while VS program are more oriented towards acquiring concrete skills and knowledge that are directly applicable in practice. Digital competences are key in both programs, but the emphasis in UN program is mostly on a higher level of literacy and the use of more sophisticated tools and analytical methods. In terms of algorithmic, logical and abstract thinking competencies, both programs cover the basic needs, with the UN programs offering more demanding applications of these skills. In terms of science competencies and energy literacy, both programs are designed to provide students with the foundation they need for further education or to enter the labor market. Differences in teaching and learning methods between programs reflect different target groups and educational goals, with difficulty and emphasis adjusted to the specific needs of students. The goals and competences and study results in the academic (UN) programs are aimed at a broader and deeper understanding of the material, while in the VS programs they are more focused on the practical application of knowledge and skills. Assessment methods are tailored to these goals, with minimal differences in approach between programs to ensure a fair and appropriate assessment of student knowledge and skills.

We can conclude that both types of programs serve their purpose and target groups, with different emphases on theory and practice, reflecting the different needs and expectations of students and employers in the engineering and technical industries.

COMPARATIVE ANALYSIS

In order to determine the state of competence of graduates and the satisfaction of potential employers with graduates, we conducted a survey of freshmen and graduates of FNM UM and FGPA UM. We also reviewed the self-evaluation reports of both faculties, focusing on the conclusions of surveys on satisfaction with studies, the conclusions of conversations with external stakeholders - future employers, and findings on the employability of graduates. In the following, the analyzes of the survey questionnaires of freshmen and graduates and common findings are presented.

Analysis of survey questionnaires of FNM UM freshmen

Two generations of freshmen at FNM participated in the survey, namely first-year students in the academic years 2022/2023 and 2023/2024. A total of 55 participants responded. The questionnaire (appendix 1) consists of 26 questions, most of which relate to studies and the decision to do so, while the rest relate to the use of social networks, digital competence and the completion of secondary school. The results of the survey questionnaire, including the graphs, are given in Appendix 4.

In the analysis, we focused on the differences between the answers of students of the unified master's pedagogic study program and students of non-pedagogical study programs.

When asked about the use of digital technologies, the participants indicated to what extent they agreed with each of the five statements (strongly disagree, disagree, neither agree/neither agree, agree, strongly agree). The claims were as follows:

- I independently use digital technology to search and retrieve information.
- I independently use digital technologies for communication (e-mail, cloud, online classrooms, social networks).
- I use the Microsoft software environment independently (Word, PowerPoint, Excel...).
- I independently use at least one programming language or graphical interface for programming.
- I know how to protect information, personal data and content in digital technologies.

In the questions regarding daily hours of use of digital technology (mobile phone, TV, laptop) and daily time spent on social networks, the number of hours was recorded.

We found that the two groups were not statistically different from each other (Table 4).

Table 4. *Comparison of answers of students of pedagogical and non-pedagogical study programs regarding the use of digital technologies.*

	Test	**Statistics**	**df**	**p**
Use of digital technologies	Mann- Whitney U	126.5	31.7	1,000
Hours of use of digital technology	Mann- Whitney U	109.0	24.5	0.657
Hours on social networks	Welch's t	0.903	22.6	0.376

to both groups (test: chi-square; p=0.810) if the lecturer included new teaching methods and techniques in the pedagogical process (Figure , left), but it is interesting that, despite this, both students of pedagogical and non-pedagogical programs (test: chi-square; p=0.593) prefer the study materials in printed form to the e-textbook (Figure 5, right).

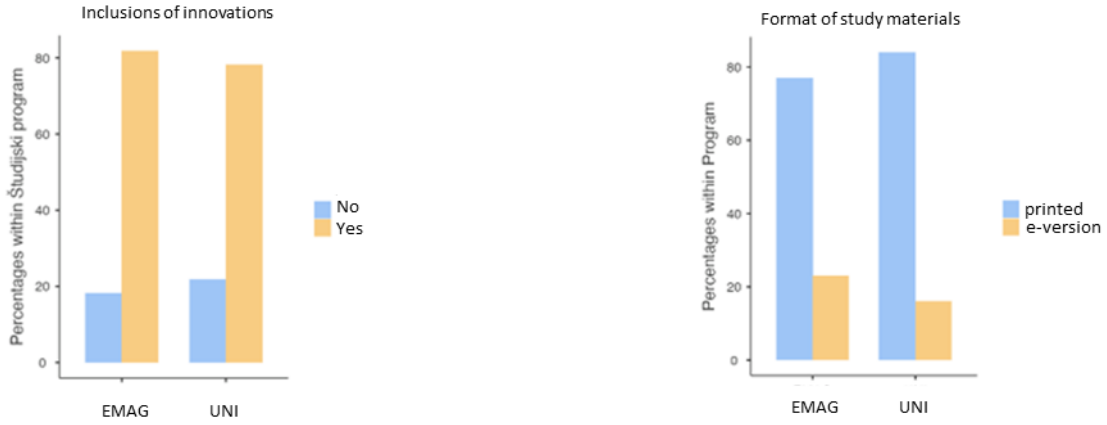


Figure 5: Comparison of the answers of students of pedagogical (also: EMAG) and non-pedagogical (also: UNI) study programs regarding the inclusion of innovations in the study process (left) and study materials selection (right).

It is also more important for both groups (test: chi-square, p=0.825) to acquire enough competences (knowledge) during their studies to be ready for the labor market than to fulfill obligations as soon as possible during their studies to be ready for the labor market as soon as possible (Figure 6).

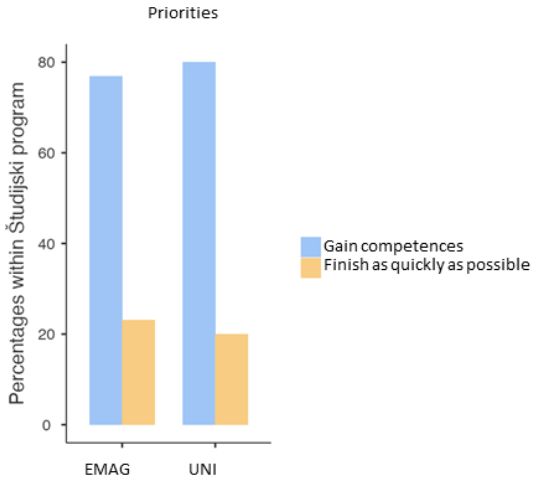


Figure 6: Priorities during studies.

Therefore, there were no statistically significant differences in answers between the groups for any question. Most likely, the reason for this is the fact that the students of both programs come from approximately the same high school programs, and they have not spent enough time in college to make a difference due to the study program.

Analysis of survey questionnaires of FGPA UM freshmen

Q1 Mark the study program in which you are enrolled:

The survey was answered by 104 freshmen who were divided between several different study programs: The most represented program is UN Architecture (38%), much less VS Construction (23%) and UN Construction (18%). Construction programs (UN Construction and VS Construction) together account for more than 40% of all responses, which shows the significant presence of students in this field of study. Both majors are least represented in Traffic Engineering.

Q2 When did you start thinking about the study you chose?

Responses are varied and range from early school years to post-secondary, indicating that students arrive at their choice of study at different points in their educational journey. Most students started thinking about their study program in high school or in their last year of high school, a smaller proportion of students thought about their studies already in the earlier years of schooling.

Q3 When did you definitely decide on your chosen course of study?

Most of the participants finally decided on their chosen course of study in their last year of high school, some even in their third year or earlier, which is a typical period of decision-making for further education. 5% of the participants who answered the question decided to study after completing the 4th year.

Q4 Please mark which data corresponds to your registration method:

The majority of participants (79%) chose first deadline and first wish as the enrollment method. A smaller share chose other options, including a third emergency period.

Q5 What did you want to study under your other preferences?

The responses reflect the diversity of students' interests and choices regarding other majors, indicating individual preferences and diversity in exploring potential study paths. The most common answer was "none", which was chosen by 16% of the participants. So some did not have specific backup wishes. Among the rest, most of them expressed interest in technical courses, somewhat less in economic and legal courses.

Q6 Have you been to the information day at FGPA UM in the department where you study?

The majority of participants (59%) attended an information day at the department, indicating their interest and prior research prior to enrolment. A smaller proportion of participants were not present at the information day, which does not necessarily mean that their decision to study was not well thought out or justified.

Q7 Did you receive useful information about your studies at the information day and what else did you expect?

Most of the participants (68%) were satisfied with the information received at the information day. Some expressed strong positive satisfaction, a smaller share had mixed but positive feelings, 3% expressed dissatisfaction or doubt.

Q8 Maybe you didn't like something on the information day? What information were you missing?

Most of the participants seem satisfied with the information day, but there are some comments regarding the lack of information about the program, the subject matter, concrete examples in practice

and a realistic representation of the difficulty of the fax. The personal experience with the students who helped was not the most positive either.

Q9 What attracted you the most at the information day?

The participants most appreciated the personal attitude, reception and friendliness of employees and students. Information about the program and the general atmosphere also contributed to the positive experience. Some emphasized concrete work, such as modeling in 3D programs, indicating an interest in the practical asp ECTS of the study.

Q10 In which media did you get information about studying at FGPA?

FGPA website dominated as the most common source of information, indicating the importance of the college's official website. Instagram is also an important source, especially among the younger generations. The most common other sources of information were online sources, the faculty magazine, the Internet, information days and personal sources such as friends, acquaintances, classmates from high school.

Q11 Was information from the media important to you?

The majority of participants (68%) considered information from the media to be important in the decision-making process about studying, only a smaller proportion of participants did not think so, which shows the diversity of preferences and sources of information among individuals.

Q12 What study information convinced you to choose to study at FGPA UM?

The variety of answers indicates that individuals chose the course for various reasons, including the method of education, practical asp ECTS, information about the program, interdisciplinarity, quality of study, employment opportunities, and personal preferences and opinions of acquaintances.
Individual reasons indicate the importance of personal preferences and experiences in decisions about studies. A few participants answered that they did not know what convinced them.

Q13 Why did you decide to study at FGPA UM?

The results show that the participants chose the study due to a combination of personal interests, interest in a specific field and for practical reasons (e.g. employment opportunities). They also expressed some diverse individual motivations, such as the desire for a different education, the need to graduate, financial motives.

Q14 Who most influenced your decision regarding your chosen course of study?

The results show that the participants most often made their decision based on their own wishes, 73% of them, which emphasizes autonomy and personal motivation when choosing a course of study. Social factors, such as the influence of friends also played a role in this important decision

Q15 Has anyone from FGPA come to your high school to present their studies?

The results show that only 5% of the participants reported that a FGPA UM representative came to their high school and presented the study. Most of the participants (95%) did not have a study presentation at their high school. This may affect how well the participants were informed about the study options at the FGPA UM and highlights the importance of other sources of information such as information days, the faculty website and the media.

Q16 How did the presentation of the study at the time influence your decision?

Respondents who confirmed that the FGPA UM representative came to their high school were of the opinion that the presentation of the study was very convincing or had a great influence on their decision, one participant stated that the presentation did not influence their decision.

Q17 What is more important to you - choose one of the offered options:

The results show that the majority of participants (78%) believe that it is more important for them to gain enough knowledge during their studies to be well prepared for the labor market, while 22% of them believe that it is more important to study as soon as possible fulfill obligations so that they are ready for the labor market as soon as possible.

Q18 What level of education do you want to achieve?

The majority of participants (65%) want to finish their studies at the 1st Bologna level and then continue their studies at the 2nd Bologna level. The second largest share (33%) wants to finish their studies at the 1st Bologna level and then get a job. A smaller share of participants (16%) wants to achieve the highest level of education and obtain a PhD.

If you had the option, you would choose a) a textbook in printed form

Q19 b) e-textbook

The majority of participants (57%) would, if given the choice, prefer a printed textbook, while 43% would choose an e-textbook. The distribution between the choice of printed and electronic textbooks shows that there is a diversity of preferences among the participants regarding the method of accessing the study materials.

Q20 How many hours a day do you use digital technology (smartphone, tablet, TV, laptop)?

Participants gave different answers regarding the number of hours they spend using digital technology. Answers range from exact numbers (e.g. 2 hours) to more general estimates (e.g. around 3 hours) and even to specific situational answers (e.g. how much is class plus 2 hours to study).

The largest group (70%) use digital technology between 3 and 6 hours a day, with the most common answer being about 5 hours a day. There are also some extreme answers such as "16 hours a day" or "too many" which may indicate exceptions. We can summarize that most of the participants are active users of digital technology for several hours a day.

Q21 How many hours a day do you spend on social media?

The participants evaluated the time they spend on social networks differently. Answers range from less than half an hour to more than 10 hours a day. The largest group (71%) is on social networks from 1 to 3 hours a day. The most common answer is around 2 hours a day. 4% of participants spend less than 1 hour a day on social networks. We note that most of the participants are active users of social networks for several hours a day and that digital technology (including social networks) plays an important role in the lives of most of the participants.

Would it mean a lot to you if the lecturer includes new teaching methods and techniques in the

Q22 pedagogical process?

The results show that the majority of participants appreciate the use of new pedagogical methods and techniques in teaching, which indicates an open and positive attitude towards innovations in *the pedagogical process.*

Q23 Indicate to what extent the following statements are true for you.

The overall assessment shows that the participants have a relatively good command of the use of digital technologies, especially when searching for information, communicating and using the Microsoft software environment. Nevertheless, there is still some room for improvement, especially in programming , where only 15% of participants agree or completely agree, and information security

, where approximately half (47%) of participants agree . These findings can serve as a basis for developing further training or improvements in these areas. The following diagrams (Figures 7-11) show the frequency of responses to five questions related to the use of digital technology.

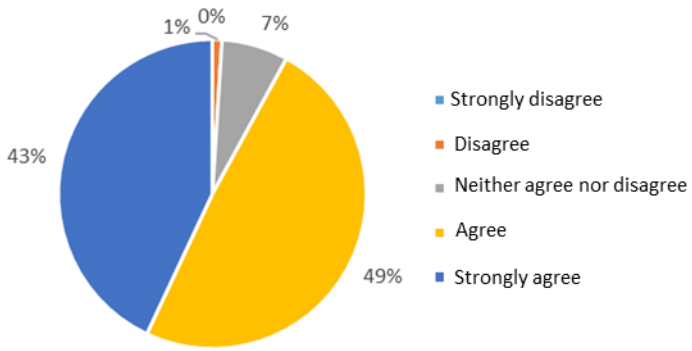


Figure 7: Independent use of digital technology to search and retrieve information.

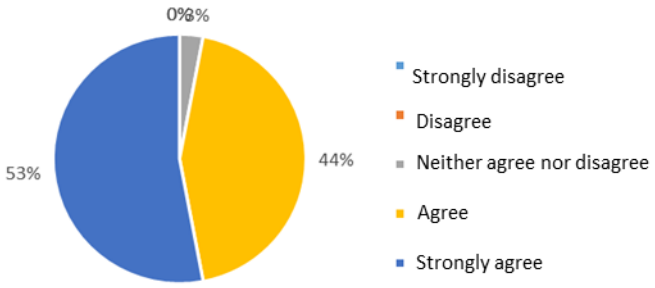


Figure 8: Independent use of digital communication technology.

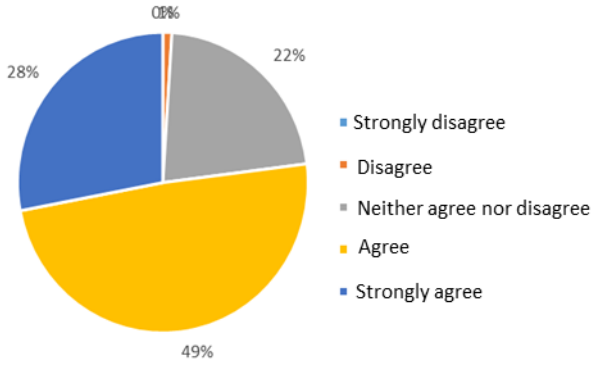


Figure 9: Independent use of the Microsoft software environment.

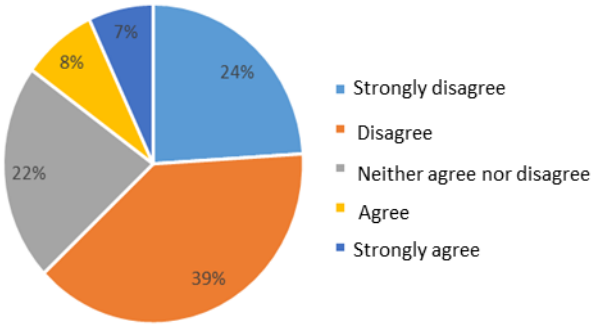


Figure 10: Independent use of at least one programming language or graphical programming interface.

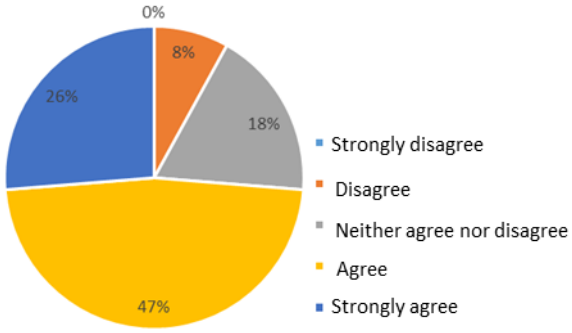


Figure 11: Protection of information, personal data and content in digital technologies.

Q24 Write down which secondary school you completed:

Among the most common secondary schools mentioned by the participants are gymnasiums, secondary construction schools and technical schools. The highest frequency is the Secondary Construction School and Gymnasium Maribor, as well as "gymnasium". The majority (68%) of the listed secondary schools belong to larger educational institutions.

Q25 Record the final high school grades in the following subj ECTS:

There were 72 valid answers for both sub-questions. The average grade in physics is 3.9, while the average grade in mathematics is slightly higher at 4.1. The minimum score for both sub-questions is 2, while the maximum score is 5.

Analysis of survey questionnaires of FNM UM graduates

166 participants took part in the survey (Appendix 2), of which 94 were graduates of pedagogical study programs and 72 were graduates of non-pedagogical study programs. The questions covered the type and time of completion of the study, satisfaction with the study, and the opinion on the inclusion of the competences of algorithmic, logical and abstract learning, natural science competences, digital competences and energy literacy. The complete summary and graphs are attached in Appendix 5. During the analysis, we focused on the opinion on the inclusion of competencies, namely on the difference between pedagogical and non-pedagogical study programs, but we were also interested in the difference between the groups according to the year of enrollment in the study program.

The difference between pedagogical and non-pedagogical study programs

Among the four groups of competence areas, there were statistically significant differences in the comparison between students of pedagogical and non-pedagogical study programs only in the competences of algorithmic, logical and abstract thinking (Table 5).

Table 5: Differences between groups for each of the four competence areas.

	Test	**Statistics**	**p**
Algorithmic, logical and abstract thinking skills	Mann- Whitney U	1749	0.036
Natural science competences	Mann- Whitney U	1878	0.385
Digital competences	Welch's t	1720	0.225
Energy literacy	Welch's t	1753	0.428

Within the groups, however, there were several statistically significant differences between the groups. In terms of algorithmic, logical and abstract thinking competencies, this is artificial intelligence (test: chi-square, p=0.017) (Figure).

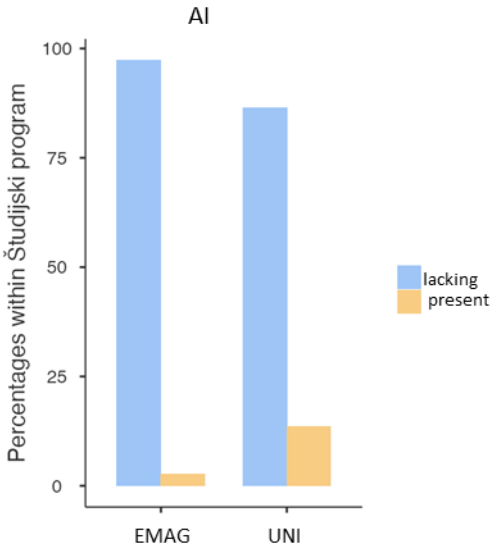


Figure 12: AI involvement by study program.

Regarding natural science competences, the two groups differ in data processing (test: chi-square, p=0.015), research (test: chi-square, p=0.037) and synthesis of conclusions (test: chi-square, p=0.021) (Figure , consecutively).

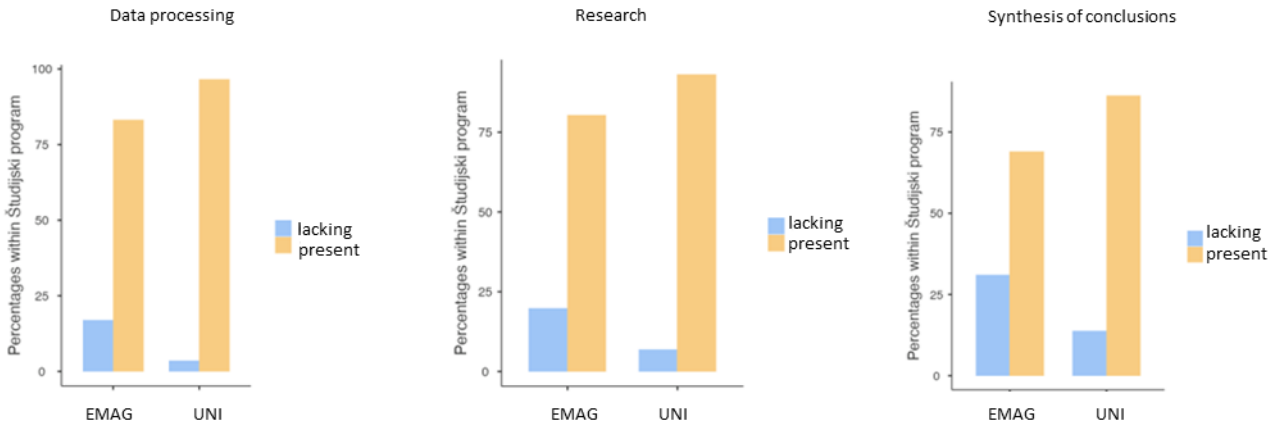


Figure 13: Involvement of natural science competencies according to the study program.

In the group of digital competences, differences were detected only when using the online classroom (test: chi-square, p=0.028) (Figure).

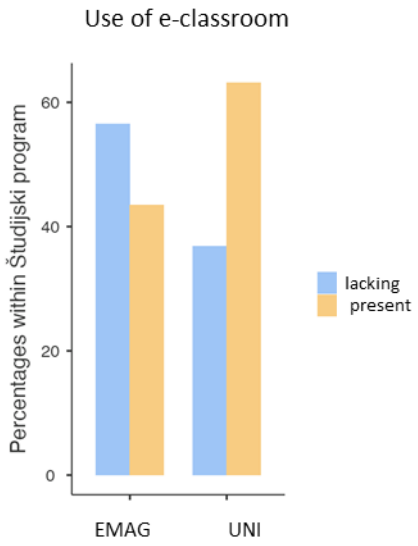


Figure 14: The inclusion of "online classroom" according to the study program.

In energy literacy, there were statistically significant differences in two questions: about saving energy (test: chi-square, p=0.012) and energy sources (test: chi-square, p=0.022) (Figure , respectively).

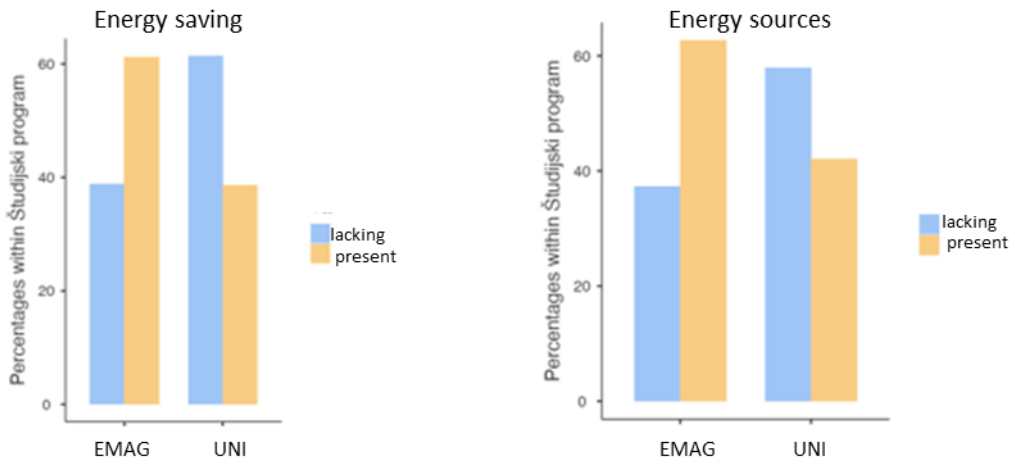


Figure 15: Involvement of energy literacy according to study program.

The difference between the groups according to the year of enrollment in the study program

We further divided the graduates into four groups according to the year of enrollment in the study program, namely: until 1990 (group 1), between 1991 and 2000 (group 2), between 2001 and 2010 (group 3) and after 2010 (group 4). In these groups, we did not further divide them according to study program, as the fragmentation would be too great for statistical processing. According to the Kruskal -Wallis test, statistically significant differences occurred in the group of digital competences (Table).

Table 6: Differences between groups for each of the four competency domains.

	χ^2	df	p
Algorithmic, logical and abstract thinking skills	3.14	3	0.371
Natural science competences	2.10	3	0.552
Digital competences	11.96	3	0.008
Energy literacy	3.69	3	0.297

After comparing the pairs of groups, we found that there are statistically significant differences between groups 1 and 4 (p=0.049) and 2 and 4 (p=0.039) (Figure 3).

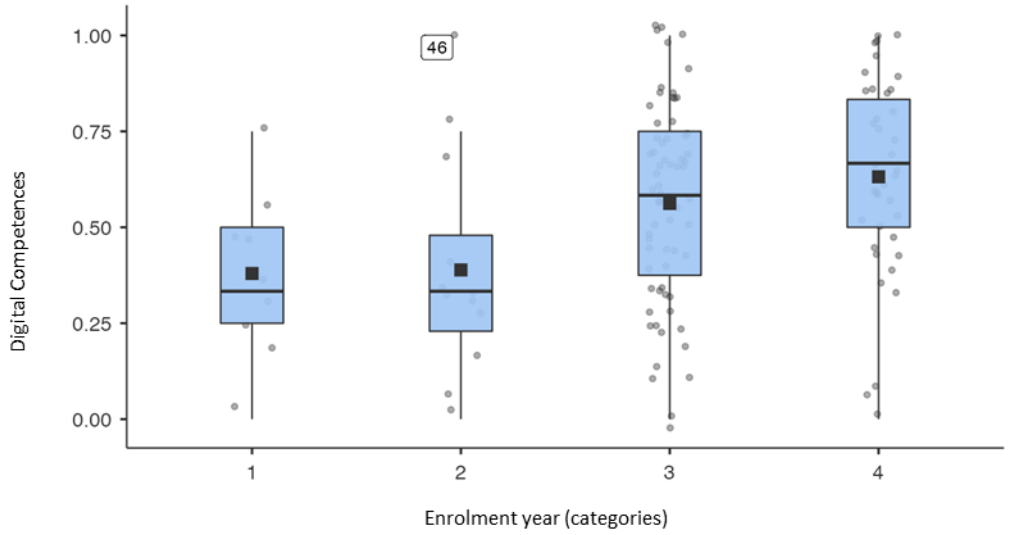


Figure 3: The inclusion of digital competences according to the year of enrolment.

The analysis of the differences between graduates of teaching and non-pedagogical study programs and according to the year of enrollment in the study program reveals the importance and inclusion of various competencies in the education system. There were statistically significant differences, especially in algorithmic, logical and abstract thinking between teaching and non-teaching programs, and in digital competencies by year of entry, which is not surprising given the rapid advancement of technology in recent decades.

Analysis of survey questionnaires of FGPA UM graduates

The complete summary with graphs is attached in Appendix 6.

Q1: In which study program did you study?

21 participants were interviewed. Of these, 10 participants (48%) studied on the UN Construction program (university program) and 11 participants (52%) on the VS Construction program (university professional program).

Q2: Year of enrollment in the first year

Data analysis shows that participants were enrolled in the first year in the period from 1980 to 2020 (but not every year), with the largest number of enrollments occurring in 1993, 2009, 2011 and 2013 (2 students), in the other years 1 student each year.

Q3: Year of completion of studies (graduation)

The highest rate of completion of studies was in 2016, when 8 students graduated, which represents 38% of all graduates. The graduation years of the other participants are spread from 1986 to 2023.

Q4: Do you think the learning material was adequate?

The majority of participants, as many as 14 participants (67%) believe that the learning material was adequate (answer 1 - Yes), while 7 participants (33%) believe that it was not adequate (answer 2 - No). The average score for the answers to the question is 1.3, which means that the majority of participants chose the answer "Yes."

Q5: If NO, what content should be included or excluded?

A total of 7 answers were given, where each answer represents a certain view of the necessary changes in the teaching material. The comments refer to the need for more practical training, for greater use of computer programs and for the exclusion of certain subj ECTS, such as the history of construction and economics, from the curricula.

Q6: DIGITAL COMPETENCES

The analysis of the results shows (Figure 17) that most of the participants recognized the use of ICT in the pedagogical process. Respondents mostly used ICT in the preparation of seminar and project assignments (16 participants, respectively 84%), software tools were used for data processing and analysis (14 participants, respectively 74%). On the other hand, there was very little use of the interactive whiteboard, only 4 students used it, and they were also less familiar with online safety and cyber security.

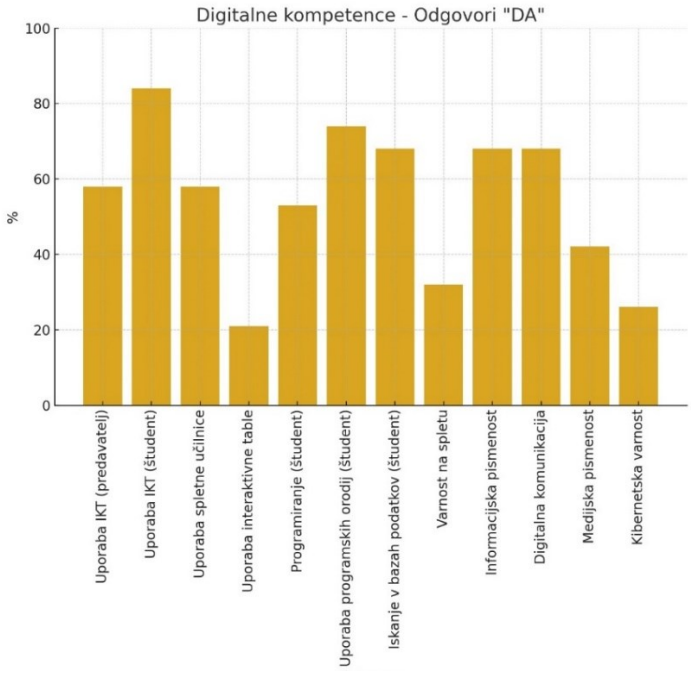


Figure 4: Inclusion of digital competences.

Q7: COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING

The analysis of the results shows (Figure 18) that most of the participants recognized the different competences of algorithmic, logical and abstract thinking in the pedagogical process. This is most often problem solving (18 participants or 95%), followed by systems thinking and data analysis. The smallest share of participants, only 1 participant each, used machine learning and artificial intelligence in their studies.

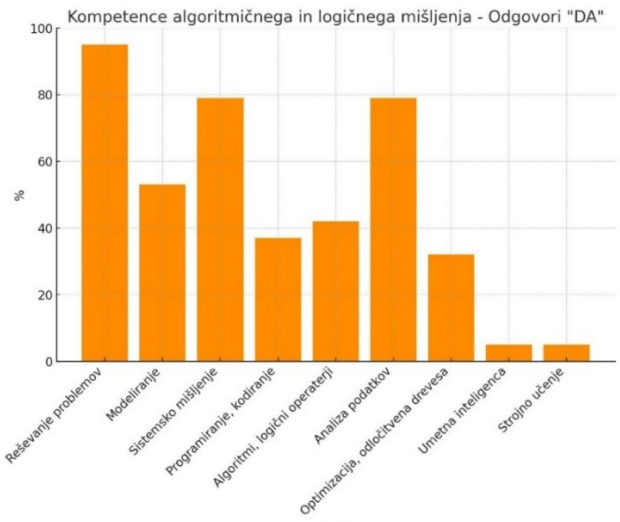


Figure 5: Involvement of algorithmic, logical and abstract thinking competencies.

Q8: SCIENCE COMPETENCES

The analysis of the results shows (Figure 19) that the majority of participants in the pedagogical process also recognized various natural science competencies, such as problem solving and data collection, analysis and interpretation. These competencies were perceived by 16 participants, or 89%. The division between "Yes" and "No" is different for individual competencies, but virtually all competencies are recognized by the majority of participants.

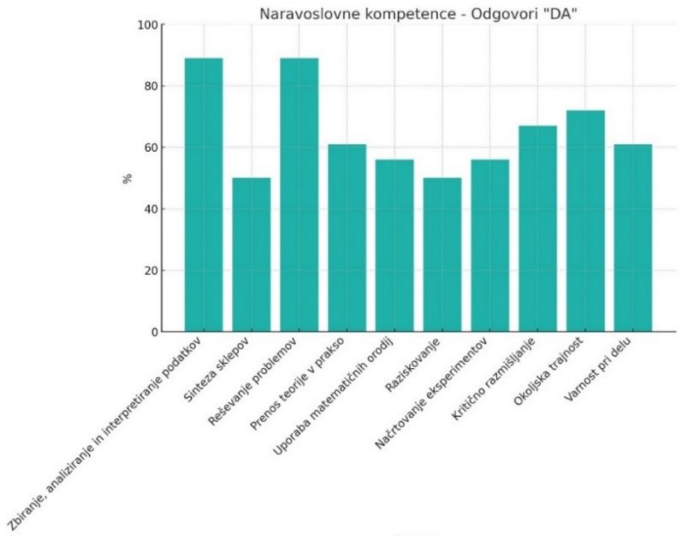


Figure 6: Involvement of science competences

Q9: ENERGY LITERACY

The analysis of the results shows (Figure 20) that these competencies are the least perceived in the educational process and, on the other hand, are also relatively balanced between the topics. 11 participants or 61% emphasized energy efficiency and environmental impact. Less than most

participants encountered energy policy, climate change, energy resources and the circular economy during their studies.

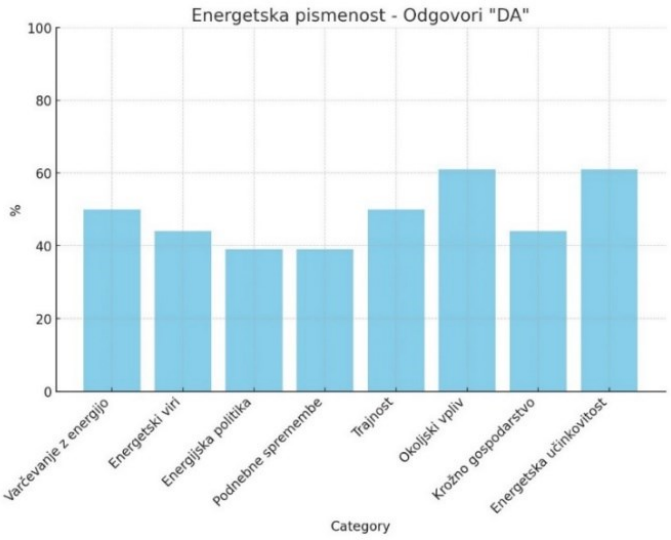


Figure 20: Inclusion of energy literacy.

Q10: Do you think that the competences were included to a sufficient extent?
The majority of participants (10 participants or 56%) believe that the competencies were included to a sufficient extent, but there is also a significant proportion of those (8 participants or 44%) who believe that these competencies were not given enough attention in teaching.
Q11: If not, which competencies would you like to be included?
From the results of the survey, where the participants express which competencies they would like to include to an even greater extent in teaching, the following emerges: the desire for greater use of various computer programs that they need in practice is most often expressed. Also missing is the connection between theory and practice, understanding of the construction process from start to finish, and legislation in practice.
Q12: Are the acquired competences useful to you in practice?
The majority of participants (15 or 83%) believe that the acquired competences are useful in practice, but there is also a smaller share of those (3 or 17%) who consider them not useful.
Q13: Do you think that the content was given to you in such a way that you were able to absorb the material?
14 participants (82%) believe that the content was given in such a way that they could learn it, 3 participants (18%) believe that the content was not given to them in a suitable way. Most of the participants therefore believe that the content was given in a way that enabled them to learn the material.
Q14: If not, how could the method of administration be improved?
Participants who feel that the learning material was not presented in an appropriate way suggest various simulations, animations and films to help them understand. At the same time, they emphasize that this could reduce the need for excursions. 2 participants think that in certain subj ECTS the delivery

of material could be improved, while in others it is adequate. They point out the influence of the professor on the effectiveness of the delivery of the material.

Q15: Were you satisfied with the assessment method during your studies?

14 participants (82%) were satisfied with the balance between theoretical and practical work, 3 participants were not. 15 participants (88%) out of 17 were satisfied with the oral assessment, all who gave answers were satisfied with the written assessment. Therefore, everyone was satisfied with the written assessment, while a smaller proportion expressed dissatisfaction with the relationship between the theoretical and practical work and the oral assessment.

Q16: If not, how do you think you would be more correctly assessed?

Suggestions for a more correct assessment were given by 4 students. 2 students believe that there is too much emphasis on non-theoretical work and that they would like more weight on practical work. They also pointed out that it is not so much about the fairness of the evaluation, but more about the comprehensiveness of the content that is evaluated, since in almost every subject the evaluation consists of three different parts. It would also benefit them if they were given the questions in advance in the oral exam, which they would then prepare for in a short time.

COMMON FINDINGS: digital competences and energy literacy of graduates

In the following, we present the collected findings on the current state of inclusion of digital competences and energy literacy in the study process across various academic study programs: Physics (FNM UM), Mathematics (FNM UM), Civil Engineering (FGPA UM), the unified Master's study program Subject Teacher, with orientations in Educational Physics and Educational Mathematics (FNM UM), and the professional study program Construction (FGPA UM). These findings stem from the analysis of survey questionnaires completed by graduates and potential employers, semi-structured interviews with holders/professors of selected learning units, and document analysis of self-evaluation reports from the faculties. Our focus was on assessing: i) the satisfaction levels of graduates upon completing their studies, ii) the opinions of potential employers, and iii) the employability of graduates.

First, we summarize the findings of the semi-structured interviews in the undergraduate study programs Physics and Mathematics and the unified master's study program Subject teacher, focus on Educational Mathematics and focus on Educational Physics.

Data analysis:

- Digital competences: The analyzed curricula of the selected study units indicate the use of information and communication technology as a teaching method. Students use electronic learning materials and online classrooms. In some learning units, specific software tools for data processing, drawing graphs, modeling and programming are utilized.
- Energy literacy: Content for the development of energy literacy is formally present only in the study unit Environmental Physics, which is a compulsory subject for students of the Subject Teacher study program, orientation Educational Physics, and an optional subject for students of the Physics study program.

According to interviews:

- Digital competences: Analyzes of interviews show that students have many opportunities to develop digital competences. In addition to the use of ICT, modern computer equipment is used as an aid in quantitative calculation, modeling, statistical processing of data and for plotting dependencies between variables. Professors also use animations and simulations to explain abstract concepts. For teaching units focused on experimental work, professors also want to update practicums with modern hardware and software.
- Energy literacy: To a lesser extent, professors include energy literacy at the level of examples and in project work.

Inconsistencies:

- Digital competences: There are no major inconsistencies in the fundamental goals and competences of the graduates, as the use of information and communication technology and computer tools to solve problems are in the foreground. Based on educational trends and progress, we suggest considering modernization and possible expansion.
- Energy literacy: Energy literacy is among the basic goals and competencies of graduates in the Physics study program and the Subject Teacher study program, Educational Physics orientation, but it appears explicitly in only one study unit. Special attention should be paid to this in the continuation of project activities, especially when preparing guidelines.

In the academic study program Construction UN and the professional study program Construction VS, in the analysis of digital competences and energy literacy, we observe more consistency than inconsistency between the data obtained from the interviews with the professors and holders of individual teaching units and the information stated in the accreditation applications.

Data analysis:

- Digital competences: Both study programs emphasize the need for students to be competent in the use of informatics and information and communication technologies, as well as the importance of knowledge of construction informatics.
- Energy Literacy: The emphasis of both programs on basic knowledge of engineering economics and environmental protection issues in the design of building structures and products, including knowledge of ecology, urban planning and environmental policy, is clear.

According to interviews:

- Digital competences: The analyzes of the interviews indicate the key role of digital competences in both programs, with a greater emphasis on a high level of digital literacy in academic program.
- Energy Literacy: While both programs are committed to the inclusion of energy literacy, we note that it is often limited to specific subjects, indicating the potential for a more comprehensive approach.

Inconsistencies:

- Digital competences: In the accreditation application for the university program, knowledge in the field of construction informatics is specifically highlighted, which was not explicitly detected in the findings from the interviews. This can be explained by limiting our review to specific learning units.
- Energy Literacy: The accreditation application for both programs highlight the connection between engineering economics and building construction design, which was not specifically mentioned in the interviews. This inconsistency is the result of not including certain teaching units in the field of construction economics in our review.

Despite these inconsistencies, it is important to understand that they arise mainly from the limited treatment of specific subjects in our analysis. This apparent discrepancy does not detract from the common emphasis that both educational programs place on digital competence and energy literacy. We note that both contribute to the development of key skills required for modern construction, reflecting their importance and impact on educational programmes.

Surveys on satisfaction with the study program after completing their studies, show that students of FNM UM demonstrate an above-average level of competence in the areas of analytical thinking, the ability to quickly acquire knowledge, the ability to express themselves clearly, the ability to work with computers and the Internet, and the ability to write reports, notes and documents. Below-average competence is particularly evident in two areas, namely in the field of practical experiences/training in the field of study and in the ability to write and read in another foreign language.
At FGPA UM, based on the analysis of the results of the survey on satisfaction with the study program, we note that in the last academic year, the proportion of students who estimated that they put more work into their studies than was required increased. The proportion of students aiming for the highest grades has decreased – although the value remains within the multi-year average. The time that students spend weekly on their study obligations and the proportion of students who come to lectures prepared have also decreased. Furthermore, 33% of students believe that the study program is a good basis for personal development, 17% that it is a good basis for developing entrepreneurial skills and 42% that it is a good basis for a further career. Indicators that are slightly lower are (below the average for the University of Maribor): "the program largely met my expectations" (only 17% think so), "the program was largely demanding" (they agree with this 67% of those surveyed), "the program was to a large extent broad-based" (33%).

Based on the self-evaluation reports, the employers' opinion is that the graduates of the pedagogic study programs of FNM UM are very well prepared for teaching in schools in terms of professional and special didactic aspects, and more emphasis should be placed on the training of future teachers in the segment of working with the gifted (preparation for competitions from knowledge, mentoring young researchers, and even more adapted work with the gifted within normal classes) and working in development projects, which are often carried out by schools. For students of non-pedagogical majors, the dispersion of potential jobs is expected to be greater, graduates are distinguished by the breadth of basic knowledge, adaptability and the ability to learn to achieve specialized knowledge in the employer's field of work after employment. Employers of non-pedagogical graduates of FNM UM suggest more intensive contact with students already during their studies. They express a greater need to increase the practical knowledge of future graduates, which indicates the importance of including practical experience in study programs, while at the same time they are extremely satisfied with the level of professional knowledge and flexibility of the graduates.
The main conclusion of the employers of FGPA UM graduates is that they are satisfied with the students on the internship - also because of the student's motivation and good preparation for the internship

Employability of graduates is monitored through data in the eVŠ portal, information from the Employment Office and annual Alumni meetings.

At FNM UM, all graduates are employable, the unemployment rate after completing the first level is below 10% and after completing the second level below 50%. The data show that the need for employment in the field of education is greater than the number of enrolled students. Monitoring the employability of graduates and maintaining a dialogue with graduates are key elements that enable the faculty to stay in touch with the needs of the labor market and provide graduates with adequate support in their career development. This includes systematically tracking employment trends, obtaining feedback from employers, and establishing and maintaining an active dialogue with students after their studies are completed.

At FGPA, we note that the unemployment of construction graduates from FGPA has been decreasing since 2016, which is a result of the business cycle, which directly affects the construction sector.

For academic study program, the data on unemployment and employability are as follows:

- Unemployment: 2020 7, 2021 6, 2022 9, 2023 2;
- Employability: 2020 14, 2021 11, 2022 1, 2023 7.

We note that there is currently a shortage of civil engineers in Slovenia and the wider region, especially those who have completed the professional study program. This is also confirmed by the "Professional Barometer for Slovenia", where it is stated that there is a shortage of construction engineers. All interested FGPA graduates are immediately employable, especially in the operational construction sector. Regarding the recruitment itself, according to the reactions and comments of the users, the Personnel Exchange, which is established on the FGPA website and is updated and upgraded every year, has performed very well.

The overall findings of the survey questionnaires are summarized in Table 7.

Table 7: Overview of survey questionnaire findings.

faculty	FNM UM		FGPA UM	
Completed study program	**UN Physics and UN Mathematics**	**Subject teacher** orientation Educational physics orientation Educational mathematics	**UN Construction**	**Construction VS**
Digital competences	High self-esteem Use of ICT, knowledge of Microsoft Office programs, modeling and programming programs, and data analysis and graphing programs Computational Physics, Physical Multimedia, Numerical Methods, Physics of Complex Systems, System Dynamics Modeling, Systems Thinking are compulsory subjects at Fizika UN. At Matematika UN, the compulsory subj ECTS are Basics of Computer Science	High self-esteem Use of ICT, knowledge of Microsoft Office programs, data analysis and graphing programs, handling of digital measuring devices... At PU Educational Physics, the compulsory subject Computer in Physics, Physics of Complex Systems and Information Communication Technology. At the PU Educational Mathematics, the compulsory subjects are Fundamentals of Computer Science, Statistics in	High self-esteem Use of ICT, knowledge of data processing and analysis programs, use of online classrooms. Greater complexity and depth of the discussed topics	High self-esteem Use of ICT, less depth and complexity of the topics discussed, basic level of digital literacy

	and Informatics, Computer Practice, Data Structures, Algorithms, Mathematical Modeling. Quite a few electives on both programs supports the development of digital competences.	Education and Mathematical Modeling. Quite a few electives on both programs supports the development of digital competences.		
Energy literacy	Lower awareness Less emphasis on UN Physics at the level of examples and understanding of energy flows and within the compulsory course Applied Physics. At Matematika UN less involvement in formal teaching at the level of cases.	Higher awareness and awareness. At PU Educational Physics compulsory courses are Environmental Physics and Applied Physics. At PU Educational Mathematics, involvement at the level of cases.	Energy literacy is not part of the learning content in most of the learning units, however, from the interviews we perceive a greater awareness and awareness, the inclusion of topics such as environmental sustainability and climate change. On an informal level, it strives for students to acquire these competencies and use their knowledge to meet these needs in all areas. Emphasis is placed on the circular economy and the importance of this area in design.	Energy literacy is not part of the learning content in most teaching units. We perceive a lower awareness of these competencies compared to the UN program, as well as the basic inclusion of energy efficiency and energy saving topics. Treatment is limited to specific subj ECTS such as construction physics.

LIST OF SKILLS AND CONTENTS FOR THE DEVELOPMENT OF COMPETENCES

Based on the findings of the situation analysis, including the findings of semi-structured interviews, and the analysis of freshman and graduate questionnaires, the project council defined skills and content for the development of competences, with an emphasis on digital competences, natural science competences, algorithmic, logical and abstract thinking competences and energy literacy.

Digital competences are developed through:

- the use of digital tools for work planning, organization, communication, teamwork and problem solving,
- the use of online quizzes, online classrooms,
- the use of an interactive whiteboard,
- the use of ICT for the preparation of seminar, project assignments, presentations,
- the use of software tools for data processing and analysis, visualization of results, preparation of graphic displays,
- modeling, programming, projecting (programming languages).

On the basis of the work on the project so far, we notice that the awareness of those involved in the pedagogical process (both teachers and students) is important for the development of competences. It would be good to familiarize workshop participants with competencies in general, with the importance of developing competencies, and with the challenges of evaluating individual progress. We also want to familiarize the participants with the European competence frameworks of digital competences for citizens and educators.

Science competences are developed through:

- problem-based teaching,
- experiential learning,
- experimental work and safety at work,
- project work,
- mentoring,
- the use of mathematical tools,
- synthesis of conclusions.

All analyzed study programs are from the natural science-mathematical and technical fields, so natural science competences are already present to a greater extent. From this point of view, we are planning to hold workshops that will introduce participants to innovative pedagogical approaches that are proven to be effective in the development of competences in the fields of science and mathematics. Examples of these approaches are problem-solving, consultative mentoring, flipped teaching, and inquiry-based learning.

Competencies of algorithmic, logical and abstract thinking are developed through:

- problem-based teaching,
- systems thinking,
- modeling, programming, coding,
- mathematical proofs (induction, deduction),
- the use of statistical tests,
- optimization, decision trees,
- machine learning,
- using artificial intelligence tools.

We are planning to hold workshops that will introduce participants to the use of these skills and approaches in the fields of science and mathematics.

Energy literacy is formally the least represented in the analyzed study programs. To this end, we would offer participants workshops on the following topics:

- dynamics of systems and systems thinking,
- biodiversity ,
- energy policies, energy saving,
- energy efficiency,
- circular economy,
- sustainability in construction, environmental impact.

The defined skills and contents will be the basis for planning a set of workshops through which we want to empower the participants in the development of competences. The workshops will thus be oriented either to the development of skills and abilities or to the delivery of content.

The final definition of skills and content for the development of competences will be given after the first implementation and evaluation of the workshops in the next elaboration.

POTENTIAL PROBLEMS

In the period from February 15, 2023 to December 31, 2023, we did not detect any major problems. We solved minor problems as they appeared. Depending on the number of responses to the survey questionnaires, we changed the method of analysis. Due to the lower response, we focused on the descriptive analysis on the FGPA UM, while the larger response on the FNM UM enabled the statistical analysis to be carried out. We used the Mann- Whitney U test and the Welch's t test, and searched for statistically significant differences using the Kruskal -Wallis test .

CONCLUSIONS

The present report offers a comprehensive summary of the project activities that were conducted between February 15th, 2023 and December 31st, 2023. Over this period, internal workshops aimed at unifying and consolidating researchers' understanding of competencies were conducted. Furthermore, the analysis of the curricula documentation presented in the situation analysis was refined by including an analysis of semi-structured interviews with the leaders or implementers of selected teaching units. All of the analyzed study programs contributed to the development of graduates' key competences. With regard to digital competences, there was a notable degree of consistency between the interviews and formal records in the documents included in the analysis. Most of the teaching units emphasized the use of information and communication technology and computer tools for problem-solving. Nonetheless, it is necessary to consider revising and expanding the content to keep pace with current educational trends. Energy literacy was addressed to a lesser extent and was primarily limited to specific subjects. There is potential for improvement in this area, particularly with respect to integrating the content into the study programs.

As part of activity A2, we focused on collecting and analyzing information about the assessment of graduates' current level of competence and employers' opinions on the same. We conducted a survey of freshmen and graduates from FNM UM and FGPA UM. The analysis of graduates' responses showed that they are satisfied with the competencies they gained during their studies, but they are less confident about the usage of artificial intelligence, which is understandable considering the official release of the OpenAI API in June 2020. They also lack knowledge and awareness of energy literacy. The analysis of freshmen's responses showed that they are keen on acquiring competencies and are independent in using digital tools for communication. However, they are less independent in using digital technologies for creating digital content and programming. Surprisingly, freshmen mostly prefer to use printed learning materials.

We also reviewed self-evaluation reports that included students' satisfaction with the study program after completing their studies, opinions of employers, and employability. The employability of graduates is systematically monitored, emphasizing the need to maintain a dialogue with the labor market and support graduates in their career development. The analysis showed that graduates of the analyzed study programs are employable, and employers are satisfied with their competencies. However, most recruiters (employers) believe that graduates require more practical experience and opportunities to establish contacts before completing their studies.

To summarize, we have outlined a set of skills and content that will aid in the development of specific competencies. The workshops will be planned based on these competencies. This report serves as the foundation for ongoing efforts related to Project Activity A3, which involves implementing comprehensive measures to develop competencies for the digital and green transition as well as lifelong learning.

APPENDICES

Appendices are translated to English using Google machine translator.

APPENDIX 1: SURVEY QUESTIONNAIRE FOR FRESHMEN

Hello student, hello student!

The Student Council of the Faculty of Natural Sciences and Mathematics of the University of Maribor (ŠS FNM UM) pays special attention to quality in all areas of operation, so we kindly ask you to realistically fill out the questionnaire
nobody. Complete anonymity is guaranteed!

Thank you for your opinion.

Management of FNM UM

Q1 - 1. State the study program and direction you are studying:

Q2 - 2. When did you start thinking about the study you chose?

Q3 - 3. When did you definitely decide on it?

Q4 - 4. Please mark which data corresponds to your entry:

- first deadline: first wish
- first term: second wish
- second term: first wish
- second term: second wish
- other:

Q5 - What did you want to study under your other preferences?

Q6 - 5. Have you been to the information day at FNM UM in the department where you study?

YES

NO

Q7 - 6. If the answer to the previous question is YES, did you receive useful information about the study and what else do you expect? rolls?

Q8 - 7. If the answer to question 5 is YES, what attracted you the most at the information day?

Q9 - 8. If the answer to question 5 is YES, what did you not like about the information day? What information are you missed?

Q10 - 9. In which media did you get information about studying at FNM? Several answers are possible.

Several answers are possible

Facebook

newspaper

website of FNM UM

website of department

other:

Q11 - 10. Was information from the media important to you?

YES

NO

Q12 - 11. What information about the study convinced you to choose to study at FNM UM?

Q13 - 12. Why did you decide to study at FNM UM?

Q14 - 13. Who most influenced your decision regarding the chosen course of study?

Several answers are possible

friends, teachers

in the secondary school

parents

other relatives own

desire

other:

Q15 - 14. Has anyone from FNM come to your high school to present their studies?

YES

NO

Q16 - 15. If the answer to the previous question is YES, how did the presentation of the study at that time affect your divorce?

Q17 - 16. What level of education do you want to achieve?

I want to finish university studies of the 1st Bologna level and get a job. I want to finish university studies of the 2nd Bologna level.

I want to achieve a Ph.D.

Q18 - 17. Have you ever wondered how beliefs (often false) affect our actions?

YES

NO

Q19 - 18. What is more important to you - choose one of the offered options: to acquire enough competences (knowledge) during your studies to be ready for the labor market. fulfill your obligations as soon as possible during your studies so that you are ready for the job market as soon as possible.

Q20 - 19. If you had the chance, you would choose - choose one of the offered options:

textbook in printed form

e-textbook

Q21 - 20. How many hours a day do you use digital technology (mobile phone, TV, laptop)?

Q22 - 21. How many hours a day do you spend on social networks?

Q23 - 22. Would it mean a lot to you if the lecturer included new teaching methods and techniques in the pedagogical process? them?

YES

NO

Q24 - 23. Indicate to what extent the following statements are true for you.

	no way I agree	I do not agree	not even I agree/neither I agree	I agree	completely I agree
independently I use digital technology for search and get- information to them					
independently i use digi- floor technologies for communication (email, cloud, online classrooms, social networks)					
independently i use pro- gram the environment Microsoft (Word, PowerPoint, Excel …)					

independently
I use at least one
programming language
or graphical interface
for programming
I can protect and-
formations, personal
data and all-
bine in digital
technologies

Q25 - 24. Write down which secondary school you completed:

Q26 - 25. Write down the final marks:

	Assessment
physics	
biology	
chemistry	
mathematics	

Q27 - 26. Write if you want to tell us anything else that this questionnaire did not cover.

APPENDIX 2: SURVEY QUESTIONNAIRE FOR GRADUATES

Dear graduates!

An important activity in the light of maintaining the quality of teaching and research work at FNM UM is also contact with alumni graduates.

With this aim in mind, we have prepared a questionnaire for you.

The questions refer to lectures or exercises that you listened to as a student of a pedagogical or non-pedagogical study program.

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

Management of FNM UM

The project is co-financed by the Republic of Slovenia, the Ministry of Higher Education, Science and Innovation, and the European Union - NextGen-erationEU. The project is implemented in accordance with the plan within the development area Smart, sustainable and inclusive growth, components Strengthening competences, especially digital and those required by new professions and the green transition (C3 K5), for measure investment F. Implementation of pilot projects, the results of which will be the basis for the preparation of starting points for the reform of higher education for a green and resilient transition to society 5.0: the project Pilot projects for the renovation of higher education for green and resilient transition.

Q1 - Which study program at FNM did you attend?

Pedagogical study program

Non-pedagogical study program

IF (1) Q1 = [1]

Q2 - Which two orientations did you study on the subject teacher study program?

Educational Biology

Educational physics

Educational Chemistry

Educational mathematics

Educational computing

Educational technique

IF (2) Q2 = [Q2a, Q2b, Q2c, Q2d]

Q3 - What level of study did you complete at FNM UM?

1st stage

2nd stage

3rd stage

Other

IF (3) Q3 = [1]

Q4 - Which study program did you complete?

Biology

Ecology with nature conservation

Physics

Mathematics

IF (4) Q3 = [2]

Q5 - Which study program did you complete?

Biology and ecology with nature conservation

Physics

Educational technique

Educational mathematics

Mathematics

Subject teacher

IF (5) Q3 = [3]

Q6 - Which study program did you complete?

- Ecological sciences
- Physics
- Mathematics
- Technology - the field of education

IF (6) Q3 = [4]

Q7 - Which study program did you complete?

IF (1) Q1 = [1]

Q8 - What level of study have you completed in general?

- 1st stage
- 2nd stage
- 3rd stage
- Other

IF (7) Q8 = [1]

Q9 - State the faculty and field of study completed

IF (8) Q8 = [2]

Q10 - State the faculty and field of study completed

IF (9) Q8 = [3]

Q11 - State the faculty and field of study completed

IF (10) Q8 = [4]

Q12 - State the faculty and field of study completed

IF (11) Q1 = [2]

Q13 - Which university program did you study?

Biology

Ecology with nature conservation

Physics

Mathematics

IF (12) Q13 = [1, 2, 3, 4]

Q14 - What level of study did you complete at FNM UM?

1st stage

2nd stage

3rd stage

Other

IF (13) Q14 = [1]

Q15 - Which study program did you complete?

Biology

Ecology with nature conservation

Physics

Mathematics

IF (14) Q14 = [2]

Q16 - Which study program did you complete?

Biology and ecology with nature conservation

Physics

Educational mathematics

Educational technique

Mathematics

Subject teacher

IF (15) Q14 = [3]

Q17 - Which study program did you complete?

Ecological sciences

Physics

Mathematics

Technology - the field of education

IF (16) Q14 = [4]

Q18 - Which study program did you complete?

IF (17) Q14 = [1, 2, 3, 4]

Q19 - What level of study have you completed in general?

1st stage

2nd stage

3rd stage

Other

IF (18) Q19 = [1]

Q20 - State the faculty and field of study completed

IF (19) Q19 = [2]

Q21 - State the faculty and field of study completed

IF (20) Q19 = [3]

Q22 - State the faculty and field of study completed

IF (26) Q19 = [4]

Q23 - State the faculty and field of study completed

Q24 - Year of enrollment in the first year

2023

2022

2021

2020

2019

2018

2017

2016

2015

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Q25 - Year of completion of studies

2023

2022

2021

2020

2019

2018

2017

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Q26 - Do you think that the learning material that was given to you during school was adequate?

Yes

No

IF (21) Q26 = [2]

Q27 - If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?

Q28 - In practice, did you need the learning content that was given to you during your schooling?

YES

No

Q29 - ALGORITHMICAL, LOGICAL AND ABSTRACT THINKING COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process?

	Yes	No
Solving problems mov.		

Modeling.

Systems thinking thinking, which focuses on whole and inter- combat connection elements in the sys- this).

programming, coding.

Algorithms, logical operators.

Data analysis.

Optimization, from- splitting trees.

Artificial and- telegenic.

Mechanically learning study and development algorithms and techniques with which computers add- reside ability learning and improve- operations on based on experience and data).

Q30 - SCIENCE COMPETENCES

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
collection, anal- ing and interpreting tyranny of data.		
Synthesis of conclusions.		

Solving problems mov.
Transferring the theory to practice.
Use of mathematical tools.
Researching.
Planning experiments.
Critical think- lamb.
Environmental sustainability.
Safety at Work.

Q31 - DIGITAL COMPETENCES

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
Usage ICT (informational communication technology) for presentations, ani- mations, simulations, creation,... (lecturer).		
Use of ICT for preparation semi- of the people order, project on- log, presentation (student).		
Using the web classrooms (materials, show order, quizzes).		

Using the interactive boards.

Programming (student).

Use of program-tools for processing and analysis data, drawing of graphs (student).

Search, edit and formations in the bases of of taxes (student).

Safety online.

Informational literacy (understanding, and use of informations in digital environment).

Digital communication (use email, messages applications, social networks, video calls, forums).

Media literacy (understanding and critical evaluation media content).

Cybernetic security (practices, technologies and measures intended protect computer- of Niš systems, networks, data).

Q32 - ENERGY LITERACY

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
Saving with en- ergy.		
Energy resources.		
Energy policy.		
Climate change membe.		
Durability.		
Environmental impact.		
Circular a gift.	Mrs-	
Energetic efficiency.		

Q33 - Do you think that the competencies were sufficiently included in the teaching?

Yes

No

IF (22) Q33 = [2]

Q34 - If not, which competences would you like or would like to be included to an even greater extent?

Q35 - Do the acquired competences benefit you in practice?

Yes

No

Q36 - Do you think that the content was given to you in such a way that you were able to absorb the material?

Yes

No

IF (23) Q36 = [2]

Q37 - If not, how do you think the way the substance is administered could be improved?

Q38 - Were you satisfied with the assessment method during your studies?

	Yes	No
The ratio is theoretical – practical part.		
Oral exam.		
Written assessment		

IF (24) Q38a = [2] or Q38b = [2] or Q38c = [2]

Q39 - If not, how do you think you would be assessed more correctly (more objectively and fairly)?

Q40 - Were the exam dates appropriate?

Yes

No

IF (25) Q40 = [2]

Q41 - Why were the exam dates not suitable?

Q1 - In which study program did you study?

construction UN program

construction VS program

Q2 - Year of enrollment in the first year

Q3 - Year of completion of studies (graduation):

Q4 - Do you think that the learning material that was given to you during school was adequate? Was given content which did you need it during your studies or later in practice?

Yes

No

IF (1) Q4 = [2]

Q5 - If NO, what contents do you think should be included or excluded in order to obtain the appropriate ones knowledge?

Q6 - DIGITAL COMPETENCES

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
Usage ICT (informational communication technologies) for presentations, animations, simulations, creation,... (lecturer).		

Use of ICT for preparation of the people semi-order, project on-log, presentation (student).
Using the web classrooms (materials, show order, quizzes).
Using the interactive boards.
Programming (student).
Using the programski tools for processing and analysis data, drawing of graphs (student).
search, sorting information in databases data (student).
Safety online.
Informational literacy (understanding and use of information tions in digital environment).

Digital communication (use email, messages applications, social networks, video calls, forums).	
Media literacy (understanding and critical evaluation media content).	
Cybernetic security (practices, technologies and measures intended protect computer- of Niš systems, networks, data).	

Q7 - COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
Solving problems mov.		
Modeling.		
Systems thinking thinking, which focuses on whole and interconnection elements in the system).		
programming, coding.		

Algorithms, logical operators.
Data analysis.
Optimization, from- splitting trees.
Artificial and- telegenic.
Mechanically learning study and development algorithms and techniques with which computers add- reside ability learning and improve- operations on based on experience and data).

Q8 - SCIENCE COMPETENCES

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
collection, anal- ing and interpreting tyranny of data.		
Synthesis of conclusions.		
Solving problems mov.		
Transferring the theory to practice.		
Using math- Attic tools.		
Researching.		
Planning experiments.		

Critical think-
lamb.

Environmental sustainability.

Safety at Work.

Q9 - ENERGY LITERACY

As a listener, which competencies from the table below did you perceive in the pedagogical process?

	Yes	No
Saving with en- ergy.		
Energy resources.		
Energy policy.		
Climate change membe.		
Durability.		
Environmental impact.		
Circular Mrs- a gift.		
Energetic efficiency.		

Q10 - Do you think that the competencies were sufficiently included in the teaching?

Yes

No

IF (6) Q10 = [2]

Q11 - If not, which competences would you like or would like to be included to an even greater extent?

Q12 - Do the acquired competences benefit you in practice?

Yes

No

Q13 - Do you think that the content was given to you in such a way that you were able to absorb the material?

Yes

No

IF (7) Q13 = [2]

Q14 - If not, how do you think the way the substance is administered could be improved?

Q15 - Were you satisfied with the assessment method during your studies?

	Yes	No
The ratio is theoretical – practical part.		
Oral exam.		
Written assessment		

IF (8) Q15a = [2] or Q15b = [2] or Q15c = [2]

Q16 - If not, how do you think you would be assessed more correctly (more objectively and fairly)?

APPENDIX 3: ANALYSIS OF SEMI-STRUCTURED INTERVIEWS OF FNM UM

APPLIED PHYSICS

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	The lectures will present current topics in physics and examples of the use of physics in practice.	#N/5 #N/8
		The possibilities of using physics in a wide variety of ways will be presented areas of economy and everyday life .	#N/6 #C/6
		Students will get an overview of the basic physical principles and technological implementations of various apparatus and measuring techniques, as well as the possibilities of their further development.	#N/5
		As part of field exercises, tours and professional excursions will be organized in Slovenia and abroad.	
		Students will visit companies, institutes , hospitals , laboratories and other institutions , where they will learn about the content and technological processes of applied physics, such as laser technology, NMR, radiology and the like.	#N/5
	An interview	automating solutions with algorithmic thinking , identifying, analyzing and implementing possible solutions with the goal of optimization	#C/4 #C/5
		example, a cell phone with solar cells. Typical sizes of fuses, energy per kg mass of lead batteries, How much energy comes to Earth from the Sun and what is the solar radiation?	#E/1
		What is the energy consumption of people on Earth?	#E/2
		Consumption of an electric car, equivalent in gasoline. The energy density of gasoline and electricity, and how thick should the cable be in order to fill the car at the same speed as filling the gasoline? How big are the electrical fuses in the house wiring and how many electric stoves can you put on one fuse?	#E/4
		How much is the total electrical power of the household wiring? Power plant transformer losses compared to wire losses. Alternative energy sources. Nuclear power plants, thermal power of a nuclear plant. Peak coverage in the electricity economy and typical start-up time of power plants.	
objectives and results	**Curriculum**	The student acquires the practical knowledge and experience necessary for understanding physical phenomena, processes and solving real physical problems in various work areas and applications, and develops the ability to transfer theoretical physics knowledge into successful physics applications.	#N/5 #N/6 #C/6
		acquire practical knowledge and experience in various work areas	#N/5
		recognizes the possibilities of applying theoretical knowledge of physics into practice, plans and implements the transfer of theoretical knowledge of physics into practice	#N/6
		connects theoretical knowledge of physics with content in other research and professional fields ,	#C/6
		is aware of the importance of applying theoretical knowledge.	#N/6
		acquires the knowledge necessary to create a proposal for a solution or solution specific physical problem	#C/3
		develops skills of independent and group professional research work	#N/10, #N/11, #N/12
		develops communication skills and reports on his project work to others	#N/12, #N/13
	An interview	In addition, the aim is to obtain information from a variety of sources, including scientific articles and online resources. They learn to systematically analyze and organize the obtained information. Based on the acquired knowledge, they must come to meaningful conclusions. The goal is also to learn how to effectively plan and organize their work, which helps them achieve their goals in a research environment, and to develop communication skills, both verbal and written, which are crucial when presenting their research findings.	#N/1, #N/3, #N/4, #N/11, #N/12
		Students develop an understanding of the importance and role of order of magnitude in physical phenomena.	

		Students gain a deep understanding of energy flows, sources, and energy use, and develop the ability to communicate meaningfully about energy, make informed decisions about energy use, and learn sustainably about energy throughout life.	#E/1, #E/2, #E/5, #E/6
methods	**Curriculum**	Lectures (explanation, interview, demonstration), experimental lectures, field work (method of working with text, written and graphic works, method of practical works, project work) Individualization of teaching	#N/5, #N/6, #N/7, #N/12, #N/13
		elements of flipped teaching	#N/5
		Teaching and learning take place with the didactic use of information and communication technology	#D/1, #D/2, #D/3, #D/5
	An interview	Teaching with PPT, audio -video recordings, searching for data, making independent assignments, programming.	#D/1, #D/2, #D/3, #D/5
		During the exercises, they investigate a practical problem and solve it with the help of a computer. In doing so, they must demonstrate algorithmic thinking competencies, including using a computer to solve problems, logically organize and analyze data, use models and simulations, automate solutions, optimize problems, and generalize and transfer procedures to other problems.	#C/1, #C/2, #C/3, #C/4, #C/5

MECHANICS

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Kinematics and dynamics of motion of a point body , straight and curved motion. Force, Newton's laws. Kinetic energy and work of a force, potential energy, work of a conservative force, theorem on conservation of the sum of kinetic and potential energy, work of non-conservative forces, law of conservation of energy. Particle systems. Momentum , impulse of force, law of conservation of momentum . Elastic and inelastic collisions in 1D and 2D. Rotation and rolling: description of motion, kinetic energy during rotation, moment of inertia, torque, Newton's 2nd law for rotation. Rotational amount point and dimensional body, law of conservation of momentum . Equilibrium of a rigid body. Mechanics of deformable solids. Gravitation: gravitational force, gravitational potential energy, Kepler's laws, gravity between massive bodies, tidal forces. Hydrodynamics: Fluids : hydrostatic pressure, Pascal's principle , connecting vessels, Archimedes' law, Bernoulli's equation , viscous fluids , Poiseuille's law, surface tension.	#N/5 #N/7
		*EMAG: Laboratory exercises: basics of measurement and processing of obtained data, experiments from measurements of mechanical physical quantities .	#N/5 #N/7
	An interview	In order to understand the material, they must combine the knowledge of different branches. They have to think about what is cause and effect. In doing so, they must be able to organize and analyze data logically. They must also be able to present data with models and simulations. They generalize and transfer procedures for solving problems to other problems.	#C/2, #C/3, #C/6
		Learning energy and other fundamental concepts (energy literacy). Concrete examples from the field of energy are also presented during the lectures, e.g. comparing the energy power of power plants.	#E/1
objectives and results	**Curriculum**	Students acquire fundamental theoretical knowledge in the field of mechanics and know how to use them in solving relevant problems using mathematical tools	#N/5 #N/7
		They are able to define a physical system, define factors in the environment that affect the state of the system, and qualitatively and quantitatively predict changes in the state of the selected physical system depending on the parameters and variables in the system and the environment	#C/1 #C/3 #N/3 #N/4 #N/5 #N/7
		They are able to use Newton's laws and conservation laws (laws of conservation of energy, momentum and momentum) to analyze the tortuous motion, rotation, rolling and motion of astronomical bodies and to determine the mechanical equilibrium of rigid and elastic bodies	#N/5 #N/7
		They are able to deal with the laminar flow of an ideal and viscous fluid and to predict the movement of bodies through the fluid depending on the properties of the body and the fluid	#N/5 #N/7
		EMAG: They are able to display the measurements in a graph, linearize the graph and adjust the linear function	
		They are able to use modern computer software as an aid ˇ in quantitative calculations and to plot the dependence between variables depending on the parameter values	#D/5 #C/1 #C/3 #N/7
		They are able to prepare thought patterns and sketches and report meaningfully (cause/effect) on the chosen topic	#N/10 #N/12 #N/13
		They are able to apply basic knowledge of linear algebra and analysis to solve physical problems	#N/7
	An interview	the same as in the curriculum	
methods	**Curriculum**	experimental lectures	#N/5 #N/6
		theoretical exercises	#N/7
		explains	

		interview	#N/5
		demonstration	#N/5 #N/12
		work with text	#N/5 #N/6
		method of written and graphic works	#N/12
		use of simulations	#N/12 #D/3
		elements of flipped teaching	
		Teaching and learning take place with the didactic use of information and communication technology	#C/3
		EMAG: laboratory exercises	#N/5
		EMAG: use of data processing programs	#D/2
	An interview	use of the online classroom (Moodle)	#D/1 #D/2 #D/3
		Conducting hybrid lectures (if someone gets sick, they can join via MS Teams).	
		Homework and solutions are published in a folder on MS Teams	#D/1
		They must also publish their computer programs	#D/3

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Temperature: temperature measurement, gas thermometer; zeroth law of thermodynamics, temperature expansion Heat, specific heat and heat capacity, phase transitions; Heat transfer: a) conduction, conduction through a composite plate , radial heat flow in a tube; b) convection, c) radiation, black body, black body radiation, Newton's law of cooling; Ideal gas and kinetic theory of gases: equation of state of an ideal gas, kinetic theory of gases, mean free path of molecules, velocity distribution of molecules (Maxwell-Boltzmann distribution), typical velocities of molecules; The first law of thermodynamics: internal energy, circular change, what is an adiabatic process, change at constant volume, isobaric process, isothermal process, specific heat capacity of an ideal gas, adiabatic processes and the adiabatic equation , isothermal and adiabatic compressibility, heat capacity of gases, uniform distribution of energy ; Heat engines and the second law of thermodynamics: Carnot heat engine, cooling engine, entropy, second law of thermodynamics; Thermodynamic potentials: reciprocity theorem and cyclicity theorem , heat capacity, characteristics of state functions, Clausius - Clapeyron equation , Van der Waals equation , thermodynamic potentials (Helmholtz free energy, Gibbs free energy, enthalpy) Open systems: Chemical potential, equilibrium rule, material flow; Dilute solutions: solute, solvent, Helmholtz free energy of a dilute solution, osmotic pressure, change in phase transition temperature for solutions and change in vapor pressure; Transport phenomena: diffusion in gases, heat conduction in gases, viscosity of gases	#N/5 #N/7 #E/1 #E/2
	An interview	They focus on larger systems (this is the difference with the rest of physics), we can measure "at home". Here is the pressure/temperature...	#N/1 #N/5 #N/6 #N/7
objectives and results	**Curriculum**	Students acquire basic theoretical knowledge in the field of thermodynamics and are able to use it in solving relevant problems using the adopted concepts and mathematical tools	#N/5 #N/7
		define a physical system, define factors in the environment that affect the state of the system, and qualitatively and quantitatively predict changes in the state of the selected physical system depending on the parameters and variables in the system and the environment	#C/3 #N/3 #N/4 #N/5 #N/7
		to use the laws of thermodynamics to analyze phenomena related to heat transfer, to analyze different states of an ideal gas depending on factors in the environment, to describe and distinguish transitions between different states of the observed system (primarily ideal gas) on the pV diagram, to mathematically describe circular processes and calculation of device efficiency, for describing a system with a suitable thermodynamic potential, for analyzing a system consisting of several components and an appropriate choice of thermodynamic potential for description	#C/3 #N/3 #N/4 #N/5 #N/7 #E/1
		consider the pV diagram of any liquid and determine critical point of the system and predict the typical system behavior	#N/4 #N/5 #N/7
		to use modern computer software as an aid in quantitative calculations and to plot the dependence between variables depending on the parameter values	#D/5 #C/1 #C/3 #N/5 #N/7
		prepare physical sketches and diagrams of state transitions and meaningfully report on the chosen topic	#D/3 #N/12
		apply basic knowledge of linear algebra and analysis to solve physical problems	#N/5 #N/7

	An interview	of course many things related to energy. Thermodynamic terms (enthalpy, entropy, Gibbs free energy, etc.) are used to gain a deeper understanding of energy flows. Example: Helmholz energy indicates the maximum value of work that a system can do. What work it can do under certain conditions (efficiency!).	#E/1
methods	**Curriculum**	experimental lectures	#N/5 #N/6
		theoretical exercises	#N/7
		explains	#N/5
		interview	#N/5 #N/12
		demonstration	#N/5 #N/6
		work with text	#N/12
		method of written and graphic works	#N/12 #D/3
		elements of flipped teaching	#N/5
		Teaching and learning take place with the didactic use of information and communication technology	#D/2
	An interview	Footage of experiments that we can't do at college because there's no equipment. This is, for example, footage of air/gas liquefaction (an interesting experiment, but we cannot do it)	#D/3
		The topics they already know are in the form of a powerpoint , so that they go through them faster. The substance, which is new, is on the board to follow the derivation.	#D/3

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	1. Physical processes and phenomena in the environment: Atmospheric processes and phenomena and their impact on the earth's surface (solar spectrum, coupling between light and matter, biological molecules, ozone and UV light) Climate and climate change (weather and climate, climate change modeling) . Treatment of physical processes and phenomena in the environment (pollutant transport , diffusion, flow in rivers, groundwater, sea currents, fluid dynamics equation , mountains, forest, urban centers , earthquake zones , volcanoes, tectonics, erosion,...). The impact of the biosphere on physical processes in the environment (biogeochemical circulation , microclimate,...).	#N/1, #N/2, #N/3, #N/4, #N/5, #N/6, #N/7
		2. Physical processes and phenomena in different technical applications: Consideration of physical processes and phenomena in technical applications and their impact on the environment (power plants, residential buildings, ports , reservoirs , means of transport, society and the environment, politics and environmental protection, disaster prevention , acoustics and human perception of sound, noise criteria, reduction sound permeability, active sound control...).	#N/1, #N/2, #N/3, #N/4, #N/5, #N/6, #N/7
		3. Physics of energy sources: Where does energy come from on Earth and energy sources (renewable, non-renewable). Energy resources in Slovenia. Nuclear energy (nuclear fusion and fission, safety and radiation, nuclear waste). Alternative energy sources. Economical and environmentally friendly use of energy resources.	#E/1, #E/2, #E/3, #E/4
		4. Physics of waste management: Household waste. Waste in industry. Special waste (nuclear, chemical , biological and other waste). Transport, storage and decomposition of various types of waste.	#N/1, #N/2, #N/3, #N/4, #N/5, #N/6, #N/7
	An interview	The emphasis is on how energy is produced, what are the consequences, understanding the enthalpy and entropy laws, the consequences of energy production for the environment, the connection between energy production and climate change.	#E/1, #E/2, #E/3, #E/4, #E/5, #E/6
		Same as in the syllabus	
objectives and results	**Curriculum**	Students acquire the knowledge necessary for a more complex understanding of physical phenomena and processes in the environment.	#N/1 #N/2 #N/3 #N/4 #N/5
		Using various examples from natural and technical environments, they get to know and understand the meaning and types of energy sources and energy conversions.	#N/6 #E/1
		They get to know the types of waste and understand how they are transported and stored in an environmentally friendly way.	#E/5
		understands complex natural phenomena and processes in the environment, energy and waste management	#E/4 #E/5
		can describe environmental systems, phenomena and processes with physical models	#E/1 #N/7 #C/3
		is able to measure physical parameters in the environment and interpret them	#N/1 #N/3
		analytically and numerically solve physical models of environmental systems	#C/3 #N/7
		The student is able to use analytical and computer tools to solve complex physical problems.	#D/5 #C/1 #N/7
		He is also aware of the importance of environmental protection and is ready to work on physical projects in the field of environmental protection.	#E/5 #E/6

	An interview	Numerical solving of more demanding problems.	#C/4 #C/5
		understands energy sources, knows how to describe a system, knows how to model systems in a simple way...	#E/1 #N/7 #C/1 #C/3
		The rest is the same as in the curriculum	
methods	**Curriculum**	Explanation	#N/5
		interview	#N/3 #N/4 #N/5 #N/12
		demonstration	#N/6
		case studies	#C/1 #C/5 #C/6 #N/5
		problem-based learning and field work	
	An interview	solving equations numerically with different software.	#D/5
		Lectures are combined; on the board + PPT, watch videos, ...	#D/2
		analytical solution of equations, some modeling is possible for the final assignments.	#C/1 #C/3
		The rest is the same as in the curriculum	

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Lectures: Theoretical review of the contents of more demanding laboratory exercises and more demanding physical measurement techniques and methods used in the exercises.	#N/5
		Laboratory exercises FIZ1: The student performs 15 laboratory exercises in the field of mechanics (kinematics, dynamics, hydrostatics and hydrodynamics) EMAG: The student performs 10 laboratory exercises in the field of mechanics (kinematics, dynamics, hydrostatics and hydrodynamics)	#N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/9 #N/10 #N/11 #N/14
		Project work: With a project assignment, the student delves into a more demanding problem in the field of mechanics and proposes its solution in the form of an experiment, which requires the use of a more demanding measuring technique. He reports on the results of the project work in the form of a laboratory report and an oral presentation	#C/2 #C/5 #C/6 #N/6 #N/12
		Seminar: Presentation of project work in front of colleagues.	#N/12
	An interview	The difference between FIZ1 and EMAG is only in the range of hours, EMAG has a smaller range of exercises. Everyone has 5 hours of lectures from exercises, the review of exercises is the same. When it comes to project work, they can organize themselves, let's just talk about ideas.	
		Digital: Finding, processing and evaluating data, communication and collaboration; communication and collaboration in the time of COVID; development of digital content, they decide for themselves how to create a report for an independent project task (diagrams, calculations...). Log./alg./abs.: Presentation of data with models; use of computer measurements in independent project tasks; identifying, analyzing and implementing possible solutions. Natural sciences: looking for values of material constants, sources, modules, important data; the measured data are analyzed and prepared accordingly in the form of tables; the ability to interpret (have they measured and calculated correctly and are able to eliminate errors; the ability to synthesize conclusions; the ability to learn and solve problems; they check the theory based on experiments, in the subject they solve problems experimentally using a model; data analysis; concern for quality (control of measured data); team work, preparation and creation of exercises; let's talk about ideas; interpersonal interaction; energy literacy currents and thinking in terms of energy systems; knows how much energy it uses and where it comes from; knows how to make informed decisions about energy and energy use, based on understanding the impacts and consequences.	#D/1 #D/2 #D/3 #C1 #C/3 #C/5 #N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N/14 #E/1 #E/2#E/3 #E/4 #E/5
objectives and results	**Curriculum**		#N/5 #N/6 #N/1 #N/2 #D/1 #D/5 #C/1 #C/2 #C/3 #C/4
		In-depth understanding of mechanical phenomena and the ability to demonstrate and analyze them in a suitably equipped laboratory.	#N/5 #N/2
		Students acquire fundamental theoretical knowledge of measuring techniques and methods in the field of mechanics and acquire appropriate practical knowledge and laboratory skills for the independent implementation of demanding school experiments at the university level of education.	#N/5

		Students learn to evaluate and analyze the meaning and accuracy of experimentally obtained data using professional literature, other information sources, simulation tools and special software for data analysis.	#N/3 #N/4 #D/1 #D/5 #C/3
		Students are trained to accurately and adequately report on their experimental findings.	#N/12
		Written and oral communication skills: preparation of laboratory reports, oral defenses of laboratory exercises, presentation of project work.	#N/12
		Use of information technology: use of simulation tools and data analysis software tools.	#D/1 #D/5 #C/3
		Practical knowledge and laboratory skills: handling measuring devices and laboratory equipment	#N/6 #N/14
		EMAG: Didactic approach in dealing with natural phenomena and the ability to transfer knowledge to the layman.	#N/12 #N/13
		Mathematical skills: the ability to judge the reasonableness of using computational approximations.	#N/7
	An interview	There are no differences between FIZ1 and EMAG	
		Competence development is foreseen.	#D/1 #D/2 #D/3 #C1 #C/3 #C/5 #N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N/14
methods	**Curriculum**	lectures (explanation, interview, demonstration)	#N/3 #N/4 #N/5 #N/12
		laboratory exercises (method of working with text, written and graphic works, method of practical works, use of simulations and software tools for data processing, collaborative learning, discussion of results)	#N/12 #C/3 #D/5 #N/13 #N/3 #N/4
		project work (individualization of teaching)	#N/10 #N/11
		seminar (explanation, interview)	#N/12
		elements of flipped teaching	#N/5
	An interview	There are no differences in the teaching and learning method between FIZ1 and EMAG	#D/1 #C1 #C/3 #C/5
		Digital: data search, integration of tools in experiments, integration of computer systems in experiments, preparation of computer control; search , processing and evaluation of data, communication and collaboration; development of digital content, they decide for themselves how to create a report for an independent project task (diagrams, calculations...). Log./alg./abs.: Presentation of data with models; use of computer measurements in independent project tasks; identifying, analyzing and implementing possible solutions.	#D/1 #D/2 #D/3 #C1 #C/3 #C/5 #N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/7 #N/9

			#N/10 #N/11 #N/12 #N/13 #N/14

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Lectures: theoretical overview of more demanding content of laboratory exercises and used measurement techniques	#N/5
		Laboratory exercises: The student completes more demanding exercises in the field of thermodynamics and electromagnetism. The contents represented in the exercises in thermodynamics are: dependence of the boiling point of water on pressure, heat of vaporization and melting. Exercises in electromagnetism include: electric circuits, internal resistance, resistance coefficient, electric current and voltage meters, induction and generators, electric motors, electrons in electric and magnetic fields, Coulomb's law, Hall phenomenon	#N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/9 #N/10 #N/11 #N/14
	An interview	Digital: problem solving, security, measurement analysis with origin . The desire is to enter more simulations, modeling with tools e.g. mathematica and links to e-materials for subject teachers. Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; use of mathematical ideas and techniques; concern for quality; ability to work independently and in a team; organizing and planning work; verbal and written communication; interpersonal interaction; Safety at Work.	#D/4 #D/5 #N/1 #N/2 #N/3 #N/4 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N /14 (wish #C/1 #C/2 #C/3 #C/6)
objectives and results	**Curriculum**	The goal of this course is for the student to acquire basic knowledge of measurement techniques and methods in the field of electromagnetism and thermodynamics and to train himself to independently and safely perform laboratory exercises in the field of electromagnetism and thermodynamics. On the basis of experimentally obtained data, in combination with relevant theoretical knowledge of electromagnetism and thermodynamics and other information sources and computer simulation environments, they are capable of meaningfully designing the final solution to the problem.	#N/5 #N/6 #N/1 #N/2 #D/1 #D/5 #C/1 #C/2 #C/3 #C/4
		use theoretical knowledge in the field of thermodynamics and electromagnetism to perform laboratory exercises	#N/5
		apply theoretical knowledge about measurement techniques	#N/6 #C/6
		use appropriate methods for data processing and analysis	#N/2 #C/1 #D/5
		evaluate and interpret results and relate them to theory	#N/3 #N/4 #N/6
		accurately and adequately report their experimental findings	#N/12
		acquires the laboratory skills necessary for independent work in demonstrations and experimental exercises in the field of electromagnetism and thermodynamics	#N/6
		learns how to handle measuring devices and laboratory equipment	#N/6

		recognizes possible sources of danger in experimental work and knows the procedures for safe work in the laboratory	#N/14
		acquire the knowledge necessary to prepare a quantitative and qualitative experiment in the field of electromagnetism and thermodynamics	#N/5 #N/6
		becomes familiar with searching, sorting and appropriate use of resources	#N/1 #N/2
		acquires skills in using software tools for data analysis of experiments in the field of electromagnetism and thermodynamics	#D/5
		is able to assess the reasonableness of using approximations	#N/7
		is capable of collaborative learning	#N/10 #N/13
		EMAG: learns didactic approaches in dealing with natural phenomena and acquires the ability to transfer knowledge to the layman	#N/12 #N/13
	An interview	Digital: problem solving, security, measurement analysis with origin . Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; use of mathematical ideas and techniques; concern for quality; ability to work independently and in a team; organizing and planning work; verbal and written communication; interpersonal interaction; Safety at Work.	#D/4 #D/5 #N/1 #N/2 #N/3 #N/4 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N /14
methods	**Curriculum**	lectures (explanation, interview, demonstration)	#N/3 #N/4 #N/5 #N/12
		laboratory exercises (method of working with text, written and graphic works, method of practical works, use of simulations and software tools for data processing, collaborative learning, discussion of results)	#N/12 #C/3 #D/5 #N/13 #N/3 #N/4
		elements of flipped teaching	#N/5
	An interview	Digital: problem solving. Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; transferring theory into practice; concern for quality; verbal and written communication; interpersonal interaction; Safety at Work.	#D/5 #N/1 #N/2 #N/3 #N/4 #N/6 #N/9 #N/12 #N/13 #N/14

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Lectures: theoretical overview of the more demanding content of laboratory exercises and used measurement techniques.	#N/5
		Laboratory exercises: The student performs experiments in the field of oscillations and waves as well as wave and geometric optics. The laboratory exercises are from the following topics: damped and undamped oscillation, forced oscillation and resonance, electric oscillating circuit, traveling and standing waves, lenses and mirrors, lenses, diffraction and interference, spectroscopy, black body radiation	#N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/9 #N/10 #N/11 #N/14
		Project work: The student prepares a project task: plans and makes a measurement, prepares instructions for carrying out the measurement, performs the measurement and writes a report.	#C/2 #C/5 #C/6 #N/6 #N/12
		Seminar: Presentation of project work.	#N/12
	An interview	Digital: problem solving, security, measurement analysis with origin . The desire is to enter more simulations, modeling with tools e.g. mathematica and links to e-materials for subject teachers. Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; use of mathematical ideas and techniques; concern for quality; ability to work independently and in a team; organizing and planning work; verbal and written communication; interpersonal interaction; Safety at Work.	#D/4 #D/5 #N/1 #N/2 #N/3 #N/4 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N /14 (wish #C/1 #C/2 #C/3 #C/6)
		The student prepares a project assignment: plans and makes a measurement, prepares instructions for carrying out the measurement, performs the measurement and writes a report.	
objectives and results	**Curriculum**	The aim of this course is for students to acquire fundamental knowledge of measurement techniques and methods in the field of oscillation, waves and optics. Students are trained to independently solve more demanding problems in the field of oscillations, waves and optics, and are able to propose, design and carry out an appropriate physical experiment. On the basis of experimentally obtained data, in combination with the relevant theoretical knowledge of oscillation, waves and optics and other information sources and computer simulation environments, they are able to sensibly design the final solution to the problem.	#N/5 #N/6 #N/1 #N/2 #D/1 #D/5 #C/1 #C/2 #C/3 #C/4
		apply knowledge in the field of oscillations and waves and optics	#N/5
		apply theoretical knowledge about measurement techniques	#N/6 #C/6
		use appropriate methods for data processing and analysis	#N/2 #C/1 #D/5
		evaluate and interpret results and relate them to theory	#N/3 #N/4 #N/6
		accurately and adequately report their experimental findings	#N/12
		acquires the laboratory skills necessary for independent work in demonstrations and experimental exercises in the field of oscillations, waves and optics	#N/6
		learns how to handle measuring devices and laboratory equipment	#N/6

		recognizes possible sources of danger in experimental work and knows the procedures for safe work in the laboratory	#N/14
		acquire the knowledge necessary to prepare a quantitative and qualitative experiment in the field of oscillation, waves and optics	#N/5 #N/6
		becomes familiar with searching, sorting and appropriate use of resources	#N/1 #N/2
		acquire skills in the use of software tools for data analysis of experiments in the field of oscillation, waves and optics	#D/5
		is able to assess the reasonableness of using approximations	#N/7
		is capable of collaborative learning	#N/10 #N/13
		develops the skill of independent and group professional and research work	#N/10
		EMAG: learns didactic approaches in dealing with natural phenomena and acquires the ability to transfer knowledge to the layman	#N/12 #N/13
	An interview	Digital: problem solving, security, measurement analysis with origin . Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; use of mathematical ideas and techniques; concern for quality; ability to work independently and in a team; organizing and planning work; verbal and written communication; interpersonal interaction; Safety at Work.	#D/4 #D/5 #N/1 #N/2 #N/3 #N/4 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N /14
methods	**Curriculum**	lectures (explanation, interview, demonstration)	#N/3 #N/4 #N/5 #N/12
		laboratory exercises (method of working with text, written and graphic works, method of practical works, use of simulations and software tools for data processing, collaborative learning, discussion of results	#N/12 #C/3 #D/5 #N/13 #N/3 #N/4
		project work (individualization of teaching)	#N/10 #N/11
		seminar (explanation, interview)	#N/12
		elements of flipped teaching	#N/5
	An interview	Digital: problem solving. Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; transferring theory into practice; concern for quality; verbal and written communication; interpersonal interaction; Safety at Work.	#D/5 #N/1 #N/2 #N/3 #N/4 #N/6 #N/9 #N/12 #N/13 #N/14

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	Lectures: Contents from Modern Physics, which are directly related to the successful execution of experiments. Basic knowledge of protection against ionizing radiation.	#N/5
		Laboratory exercises: Experiments with X-ray light, Experiments with microwaves, Photo effect, Measurement of Planck's constant, Gaussian distribution in radioactive decay, Measurement of the ideal efficiency of a heat engine, Diffusion of liquids, Deflection of beta rays in a magnetic field, Gamma spectroscopy, Michelson interferometer (FIZ1: Absorption of beta and gamma rays; EMAG: Franck-Hertz experiment and de Broglie equation)	#N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N/9 #N/10 #N/11 #N/14
	An interview	The difference between FIZ1 and EMAG is only in the range of hours, EMAG has a smaller range of exercises. There are no special differences, as it concerns fundamental knowledge in the field of modern physics.	
		Digital: information literacy; communication and collaboration; security. Computational : logical arrangement and analysis of data. Natural sciences: the ability to gather information; ability to analyze and organize information; ability to interpret; the ability to synthesize conclusions; ability to learn and solve problems; transferring theory into practice; use of mathematical ideas and techniques; adapting to new conditions; concern for quality; ability to work independently and in a team; organizing and planning work; verbal and written communication; interpersonal interaction; basic knowledge of protection against ionizing radiation. Energy literacy: able to follow energy flows and think in terms of energy systems; knows how much energy it uses, for what and where it comes from; can assess the credibility of energy information; knows how to communicate meaningfully about energy and its use; knows how to make thoughtful decisions about energy and energy use, based on an understanding of impacts and consequences; he continues to learn about energy throughout his life.	#D/1 #D/2# D/4 #D/5 #C/2 #C/6 #N/1 #N/2 #N/3 #N/4 #N/5 #N/6 #N /7 #N/8 #N/10 #N/11 #N/12 #N/13 #N/14 #E/5
objectives and results	**Curriculum**	The goal of this course is for the student to acquire basic knowledge of measurement techniques and methods in the field of modern physics and to train himself to independently and safely perform laboratory exercises in the field of modern physics. On the basis of experimentally obtained data, in combination with relevant theoretical knowledge from modern physics and other information sources and computer simulation environments, they are capable of meaningfully designing the final solution to the problem.	#N/5 #N/6 #N/1 #N/2 #D/1 #D/5 #C/1 #C/2 #C/3 #C/4
		Students will be able to analyze basic processes in nature based on the laws of quantum mechanics and relativistic physics. They will be able to demonstrate the acquired knowledge in a suitably equipped laboratory	#N/2 #N/5 #N/6 #N/11
		Transferable/key skills and other attributes: Sovereign oral defense, laboratory exercises and professional correct expression in the written exam. The ability to explain the discussed topics to a layman and to propose physical solutions for problems arising from a research-oriented environment.	#N/3 #N/12 #N/13

		EMAG: The student learns didactic approaches in dealing with natural phenomena and acquires the ability to transfer knowledge to the layman	#N/12 #N/13
	An interview	There are no special differences, as it concerns fundamental knowledge in the field of modern physics.	
		At EMAG, the goals and results are more in the direction of teaching. With FIZ1, it is more related to the use of gauges and where we meet them; use of radioactive materials.	#D/1 #D/2 #D/3 #D/4 #D/5 #C/2 #C/6 #N/1 #N/2 #N/3 #N/4 #N/5 #N /6 #N/7 #N/8 #N/10 #N/11 #N/12 #N/13 #N/14 #E/5
methods	**Curriculum**	lectures (explanation, interview, demonstration)	#N/3 #N/4 #N/5 #N/12
		laboratory exercises (method of working with text, written and graphic works, method of practical works, use of simulations and software tools for data processing, collaborative learning, discussion of results)	#N/12 #C/3 #D/5 #N/13 #N/3 #N/4
		elements of flipped teaching	#N/5
	An interview	There are no special differences, as it concerns fundamental knowledge in the field of modern physics. Certain specifics could be adapted to more engineering work, and some others to pedagogical work in school.	
		The method of working with text, written and graphic works, the method of practical works, data processing, familiarization with materials, safety against ionizing radiation, cooperative learning, making a report and discussing the results.	#D/1 #D/2 #D/3 #D/4 #D/5 #C/2 #C/6 #N/1 #N/2 #N/3 #N/4 #N/5 #N /6 #N/7 #N/8 #N/10 #N/11 #N/12 #N/13 #N/14 #E/5

MODERN PHYSICS

Section	Content type	Content description	Recognized competencies
content	**Curriculum**	The special theory of relativity. Basic principles, Lorentz transformation, length contraction and time dilation, Doppler phenomenon, own full and kinetic energy; experiments that confirm the equations of special relativity. Introduction to Quantum Physics. Photo effect, Compton phenomenon, bremsstrahlung, interference experiments with particle jets; indeterminacy of position and momentum, Rutherford's and Bohr's model of the atom; laser. Fundamentals of quantum physics. Wave function, expected values; basic law for stationary case, particle in potential well, tunneling phenomenon, harmonic oscillator. A hydrogen atom. Eigen energies and eigenfunctions of states, degeneracy of states, ionization energy; magnetic moment and the Stern-Gerlach experiment, electron spin, total spin and total magnetic moment; hydrogen spectrum, width of spectral lines. Atoms with more electrons. Exclusion principle, periodic table of elements. Molecules. Ionic, covalent bond and Van der Walls bond. Ties in crystals. Energy levels of electrons in crystals, ionic and covalent crystals, metals, semiconductors, semiconductor elements. Properties of the nucleus and nucleons. Models, radioactive decay; nuclear reactions, chain fission, fusion; particles, antiparticles, conservation laws, particle meters; standard model of particles, elementary forces and particles; Cosmology. Big Bang; modern cosmological theories.	#N/5
	An interview	EMAG students are presented with many examples in nature that are related to the taught material. The connection with biological systems, cosmology and particle physics is emphasized here. FIZ1 students are presented with additional content where they can gain deeper knowledge. Their activity is taken into account in the final assessment.	#D/1 #C/1 #C/2 #C/3 #C/4 #C/5 #C/6# N/1 #N/2 #N/3 #N/4 #N/5 #N /6 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N/14 #E/1 #E/2#E/3 #E/4 #E/5 #E/5
objectives and results	**Curriculum**	FIZ1: Students acquire fundamental theoretical knowledge in the field of modern physics and are able to use it in solving relevant problems using mathematical tools	#N/5 #N/7
		EMAG: Students acquire basic theoretical knowledge in the field of special relativity and quantum physics.	#N/5

		FIZ1: After successfully completing the learning unit, students will be able to: - use the basic equations of quantum mechanics to demonstrate key quantum phenomena in nature; - describe the basic properties of atoms, molecules and crystals; - predict the qualitative properties of a system depending on the constituents of the system	#N/3 #N/4 #N/5 #N/7
		EMAG: Understanding basic processes in nature. They know how to qualitatively and quantitatively describe basic phenomena in the field of modern physics	#N/5
		FIZ1: Understanding of basic processes in nature and a holistic approach to problem solving.	#N/5 #N/7
		EMAG: Problem Solving with Mathematical Tools and a Holistic Approach to Problem Solving	#N/5 #N/7
	An interview	At EMAG, the emphasis is on understanding the basic mechanisms that dictate natural phenomena. At FIZ1, the emphasis is on independent problem solving. At EMAG, the emphasis is on researching qualitative phenomena in nature, so they are looking for presentations on the web with a focus on the mentioned aspect. FIZ1 students are encouraged to find content that is helpful in solving specific problems. Lectures are adapted to computer technology, which is available and improves over time.	#D/1 #C/1 #C/2 #C/3 #C/4 #C/5 #C/6# N/1 #N/2 #N/3 #N/4 #N/5 #N /6 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N/14 #E/1 #E/2#E/3 #E/4 #E/5 #E/5
methods	**Curriculum**	lectures and experimental lectures (theoretical introduction to the problem with explanation and interview, numerical solution of individual problems, demonstration experiments during lectures)	#N/5 #N/6 #N/7 #C/1 #C/4 #D/5
		theoretical exercises (work with text, method of written and graphic works, use of simulations)	#N/12 #C/3
		elements of flipped teaching	#N/5
		Teaching and learning take place with the didactic use of information and communication technology	#D/1 #D/2 #D/3 #D/5
	An interview	Teaching via computer; students perform tasks that are solved using a computer program. Students are encouraged to search for information independently.	#D/1 #C/1 #C/2 #C/3 #C/4 #C/5 #C/6# N/1 #N/2 #N/3 #N/4 #N/5 #N /6 #N/7 #N/9 #N/10 #N/11 #N/12 #N/13 #N/14 #E/1 #E/2#E/3 #E/4 #E/5 #E/5

APPENDIX 4: RESULTS OF THE SURVEY QUESTIONNAIRE FOR FNM UM FRESHMEN WITH GRAPHS

ANALYSIS - GRAPHS

1. State the study program and direction you are studying:

Q1	1. State the study program and direction you are studying:				
	Answer	Frequency	Percent	Valid	Cumulative
	subject teacher, math -chem	1	2%	2%	2%
	mathematics	1	2%	2%	5%
	physics 1st level	1	2%	2%	7%
	subject teacher, mathematics and chemistry	2	5%	5%	12%
	subject teacher (mathematics/physics)	1	2%	2%	14%
	mat uni	1	2%	2%	17%
	subject teacher, educational physics and educational institution	1	2%	2%	19%
	subject teacher math-physics	1	2%	2%	21%
	ecology with nature conservation	1	2%	2%	24%
	unified master's program subject teacher physics and mathematics	1	2%	2%	26%
	FNM Physics Univ	1	2%	2%	29%
	subject teacher of mathematics and chemistry	1	2%	2%	31%
	m	1	2%	2%	33%
	educational bio and chem	1	2%	2%	36%
	subject teacher, math and physics	1	2%	2%	38%
	subject teacher (math/physics)	1	2%	2%	40%
	fnm-biology	1	2%	2%	43%
	double subject mathematics technique	1	2%	2%	45%
	mathematics as a single subject	1	2%	2%	48%

	subject teacher of physics and mathematics	1	2%	2%	50%
	biology - technology	1	2%	2%	52%
	biology	11	26%	26%	79%
	Mathematics Univ	5	12%	12%	90%
	mat un	1	2%	2%	93%
	1st level biology	1	2%	2%	95%
	mathematics uni	1	2%	2%	98%
	subject teacher physics computer science	1	2%	2%	100%
Valid	Together	42	100%	100%	
Missing	Together		0%		
	TOGETHER	42	100%		

2. When did you start thinking about the study you chose?

Q2	2. When did you start thinking about the study you chose?				
	Answer	Frequency	Percent	Valid	Cumulative
	last year	1	2%	2%	2%
	end of 3rd year	1	2%	2%	5%
	end of the 2nd year of high school	1	2%	2%	7%
	because they are all science subjects for me	1	2%	2%	10%
	4th year of high school	1	2%	2%	12%
	4th year of high school	1	2%	2%	14%
	end of high school	1	2%	2%	17%
	in the third year of the middle sola	1	2%	2%	19%
	at the beginning of high school	1	2%	2%	21%
	I do not know	1	2%	2%	24%
	4th year	2	5%	5%	29%

	about a month before submitting the application form for the fax	1	2%	2%	31%
	in the 4th year of high school	1	2%	2%	33%
	8th grade	1	2%	2%	36%
	in the third year of high school	1	2%	2%	38%
	in the 4th year	1	2%	2%	40%
	at the beginning of the 4th year	1	2%	2%	43%
	about five years ago	1	2%	2%	45%
	from kindergarten	1	2%	2%	48%
	in the 3rd year of secondary school.	1	2%	2%	50%
	in 8th grade	1	2%	2%	52%
	in elementary school	1	2%	2%	55%
	1 year ago	1	2%	2%	57%
	February 2023	1	2%	2%	60%
	December 2022	1	2%	2%	62%
	when I realized that it would be difficult for me to come directly to physics	1	2%	2%	64%
	in the 3rd year of high school	1	2%	2%	67%
	in high school	1	2%	2%	69%
	4th year	3	7%	7%	76%
	in medium salt	1	2%	2%	79%
	since elementary school	1	2%	2%	81%
	in the middle of his senior year of high school	1	2%	2%	83%
	Mr	1	2%	2%	86%
	January 2023	1	2%	2%	88%
	1 year before enrollment	1	2%	2%	90%
	during the application submission time	1	2%	2%	93%
	a few months before the application deadline for studying	1	2%	2%	95%
	end of the 3rd year of high school	1	2%	2%	98%

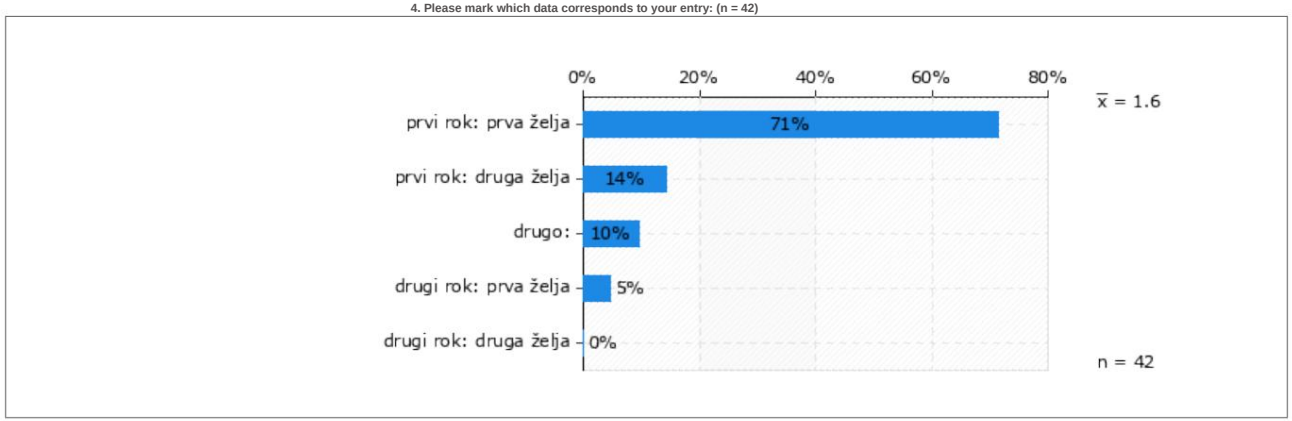
	in high school	1	2%	2%	100%
Valid	Together	42	100%	100%	
Missing	Together		0%		
	TOGETHER	42	100%		

3. When did you decide for sure?

Q3	3. When did you decide for sure?				
	Answer	Frequency	Percent	Valid	Cumulative
	after the information day	2	5%	5%	5%
	in the 4th year	4	10%	10%	14%
	last year	2	5%	5%	19%
	a short time before submitting the registration form	1	2%	2%	21%
	during information days	1	2%	2%	24%
	March 2023	1	2%	2%	26%
	in the fourth year	1	2%	2%	29%
	after the first failed attempt to study when I she rewrote herself	1	2%	2%	31%
	third year of high school	1	2%	2%	33%
	in high school	2	5%	5%	38%
	when registering	1	2%	2%	40%
	May 2023	1	2%	2%	43%
	in the first year of high school	1	2%	2%	45%
	on informative ones	1	2%	2%	48%
	0	1	2%	2%	50%
	two years ago	1	2%	2%	52%
	t	1	2%	2%	55%

	in high school	1	2%	2%	57%
	in the 3rd year of high school	2	5%	5%	62%
	4th year of high school	1	2%	2%	64%
	4th year	2	5%	5%	69%
	January 2023	1	2%	2%	71%
	1 year ago	1	2%	2%	74%
	when I saw that there is no registration limit	1	2%	2%	76%
	April 2023	1	2%	2%	79%
	in February 2023	1	2%	2%	81%
	during registration	1	2%	2%	83%
	before enrollment.	1	2%	2%	86%
	about a week before submitting the application form for the fax	1	2%	2%	88%
	at the information day	1	2%	2%	90%
	1 month before submitting the application form	1	2%	2%	93%
	4th year	1	2%	2%	95%
	I do not know	1	2%	2%	98%
	during high school	1	2%	2%	100%
Valid	Together	42	100%	100%	
Missing	Together		0%		
	TOGETHER	42	100%		

4. Please mark which data corresponds to your entry: (n = 42)



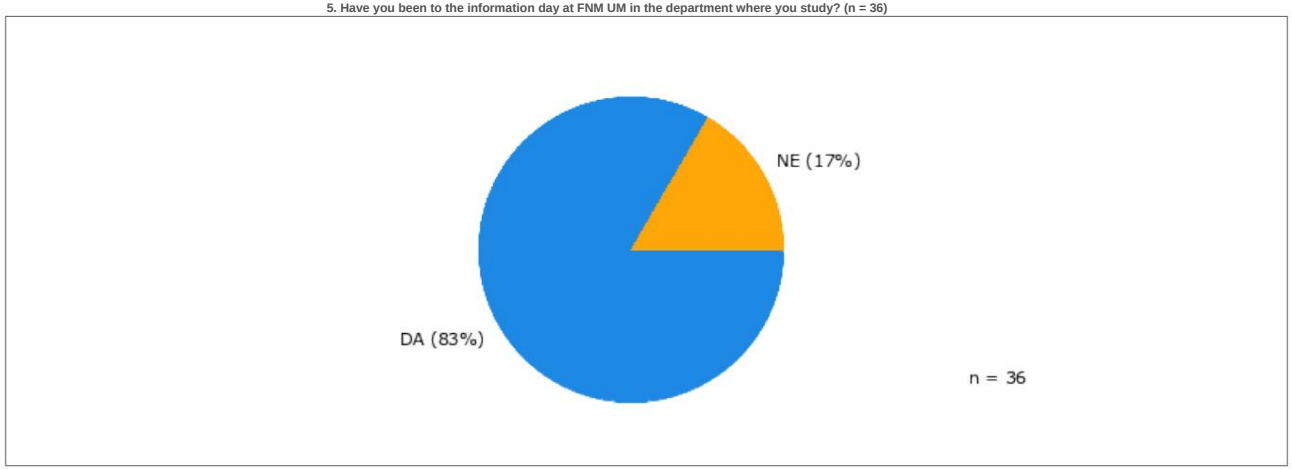
Q4_5_text	Q4 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative
	second entry: first deadline: first wish	1	2%	25%	25%
	first deadline: third wish	2	5%	50%	75%
	transcript	1	2%	25%	100%
Valid	Together	4	10%	100%	
Missing	-2 (Skip (if))	38	90%		
	Together	38	90%		
	TOGETHER	42	100%		

What did you want to study under your other preferences?

Q5	What did you want to study under your other preferences?				
	Answer	Frequency	Percent	Valid	Cumulative
	biology in Ljubljana	1	2%	3%	3%
	nothing else	1	2%	3%	6%
	general mathematics	1	2%	3%	8%
	physics, mathematics and computer science	1	2%	3%	11%
	chemical technology	1	2%	3%	14%
	window	1	2%	3%	17%
	general mathematics, chemical technology	1	2%	3%	19%
	I didn't think about other wishes	1	2%	3%	22%
	mathematics 1st level	1	2%	3%	25%
	biology-chemistry subject teacher	1	2%	3%	28%
	chemistry, chemical engineering	1	2%	3%	31%
	medicine	1	2%	3%	33%
	nothing	2	5%	6%	39%
	economy	1	2%	3%	42%
	nothing	1	2%	3%	44%
	computer science and mathematics in Croatia	1	2%	3%	47%
	biology at another university	1	2%	3%	50%
	class lessons	3	7%	8%	58%
	Faculty of Health Sciences in Maribor	1	2%	3%	61%
	classroom instruction and English	1	2%	3%	64%
	mathematics	2	5%	6%	69%
	Faculty of Economics	1	2%	3%	72%
	textile and clothing design, biology v loved ones	1	2%	3%	75%
	physiology	1	2%	3%	78%
	separate lessons	1	2%	3%	81%
	dental medicine	1	2%	3%	83%

	finance or economy	1	2%	3%	86%
	geology	1	2%	3%	89%
	also mathematics or physics in a non-pedagogical way directions	1	2%	3%	92%
	biology in Ljubljana or a double-subject program teacher (biology and home economics) at pedagogical faculties	1	2%	3%	94%
	biology at the biotechnical faculty	1	2%	3%	97%
	economy	1	2%	3%	100%
Valid	Together	36	86%	100%	
Missing	-3 (Discontinued)	6	14%		
	Together	6	14%		
	TOGETHER	42	100%		

5. Have you been to the information day at FNM UM in the department where you study? (n = 36)



6. If the answer to the previous question is YES, did you receive useful information about the study and what else did you expect?

Q7	6. If the answer to the previous question is YES, did you receive useful information about the study and what else did you expect?				
	Answer	Frequency	Percent	Valid	Cumulative
	the information was quite helpful.	1	2%	3%	3%
	Yes	13	31%	36%	39%
	yes, my expectations were met	1	2%	3%	42%
	maybe you could say a little more about what you can do with you then continue with these studies	1	2%	3%	44%
	I got all the information	1	2%	3%	47%
	I received all the information I wanted	1	2%	3%	50%

	I received useful information	1	2%	3%	53%
	I received all the information and more trivia.	1	2%	3%	56%
	.	2	5%	6%	61%
	/	3	7%	8%	69%
	everything great	1	2%	3%	72%
	that I found it useful	1	2%	3%	75%
	yes	2	5%	6%	81%
	no	1	2%	3%	83%
	Yes, I received a lot of information, but I would like this I can probably find the information myself at website of the faculty.	1	2%	3%	86%
	I got a lot of useful information	1	2%	3%	89%
	Yes.	1	2%	3%	92%
	kinda	1	2%	3%	94%
	yes, my expectations were met	1	2%	3%	97%
	I didn't have high expectations to choose this one I had already decided to study.	1	2%	3%	100%
Valid	Together	36	86%	100%	
Missing	-3 (Discontinued)	6	14%		
	Together	6	14%		
	TOGETHER	42	100%		

7. If the answer to question 5 is YES, what attracted you the most at the information day?

Q8	7. If the answer to question 5 is YES, what attracted you the most at the information day?				
	Answer	Frequency	Percent	Valid	Cumulative

	relaxed attitude, friendliness	1	2%	3%	3%
	detailed presentation of the program	1	2%	3%	6%
	the possibility of a scholarship for first-year students	1	2%	3%	8%
	authenticity	1	2%	3%	11%
	relaxation, Professor Taranenko was very open	1	2%	3%	14%
	kindness, hospitality	1	2%	3%	17%
	homely atmosphere and interesting professors	1	2%	3%	19%
	vivarium	2	5%	6%	25%
	relaxed and homely atmosphere	1	2%	3%	28%
	the professor's approach to students and the atmosphere at faculties	1	2%	3%	31%
	nc ig	1	2%	3%	33%
	relationship between students and professors	1	2%	3%	36%
	interesting learning content, interest in science.	1	2%	3%	39%
	kindness of professors, students	1	2%	3%	42%
	the friendliness of the professors	2	5%	6%	47%
	conversation with older students	1	2%	3%	50%
	coffee students	1	2%	3%	53%
	friendly environment	1	2%	3%	56%
	friendliness of students and professors	1	2%	3%	58%
	the time we spent in the classroom with the professor	1	2%	3%	61%
	no	1	2%	3%	64%
	school size	1	2%	3%	67%
	kindness	1	2%	3%	69%
	the openness of the professors	1	2%	3%	72%
	professors	1	2%	3%	75%
	I do not remember	1	2%	3%	78%
	interesting program	1	2%	3%	81%

	.	2	5%	6%	86%
	/	3	7%	8%	94%
	conversation with professors	1	2%	3%	97%
	presentation of the death department	1	2%	3%	100%
Valid	Together	36	86%	100%	
Missing	-3 (Discontinued)	6	14%		
	Together	6	14%		
	TOGETHER	42	100%		

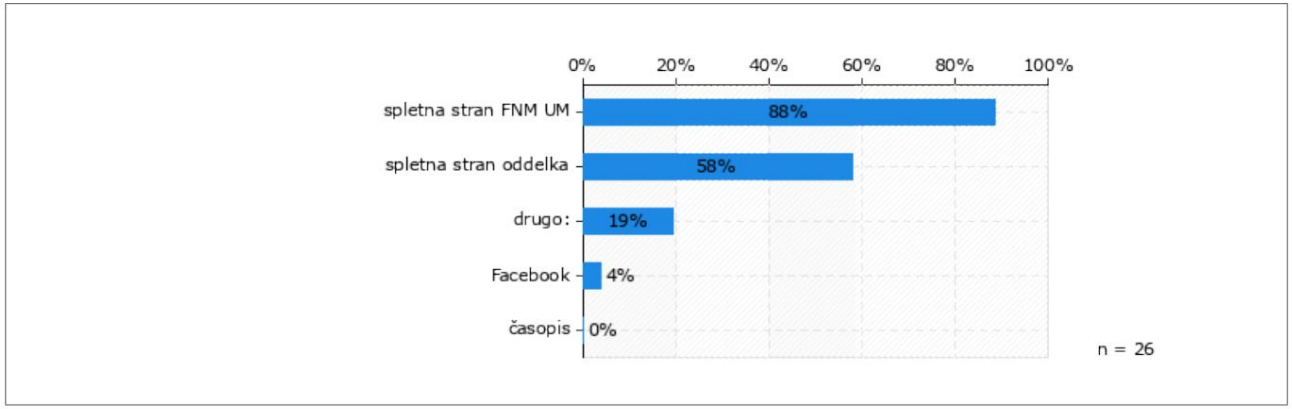
8. If the answer to question 5 is YES, what did you not like about the information day? What information were you missing?

Q9	8. If the answer to question 5 is YES, what did you not like about the information day? What information were you missing?				
	Answer	Frequency	Percent	Valid	Cumulative
	everything was fine.	1	2%	3%	3%
	information about the length of the schedule	1	2%	3%	6%
	information regarding ects, walking in the following annuals	1	2%	3%	8%
	what we will learn.	1	2%	3%	11%
	everything was everything to me	1	2%	3%	14%
	nothing	1	2%	3%	17%
	the complexity of the study	1	2%	3%	19%
	I was fine	1	2%	3%	22%
	I just like everything	1	2%	3%	25%
	designed too systematically	1	2%	3%	28%
	I was fine	1	2%	3%	31%
	the presentation of the program was, despite the fact that covered all the important information, maybe still too short.	1	2%	3%	33%
	.	3	7%	8%	42%
	/	6	14%	17%	58%
	it was worth it	1	2%	3%	61%
	two years ago I was on zoom, where you can't get it of genuine feelings, which are the students and the professors here, after Zoom, they were all strange to me	1	2%	3%	64%
	everything was okay	3	7%	8%	72%
	no	1	2%	3%	75%
	perhaps more specific information about the studio	1	2%	3%	78%

	idk	1	2%	3%	81%
	everything was ok	1	2%	3%	83%
	nothing was missing	1	2%	3%	86%
	I didn't miss anything	1	2%	3%	89%
	I do not know	1	2%	3%	92%
	nothing	1	2%	3%	94%
	appearance of the school	1	2%	3%	97%
	that I was afraid to walk in the basement	1	2%	3%	100%
Valid	Together	36	86%	100%	
Missing	-3 (Discontinued)	6	14%		
	Together	6	14%		
	TOGETHER	42	100%		

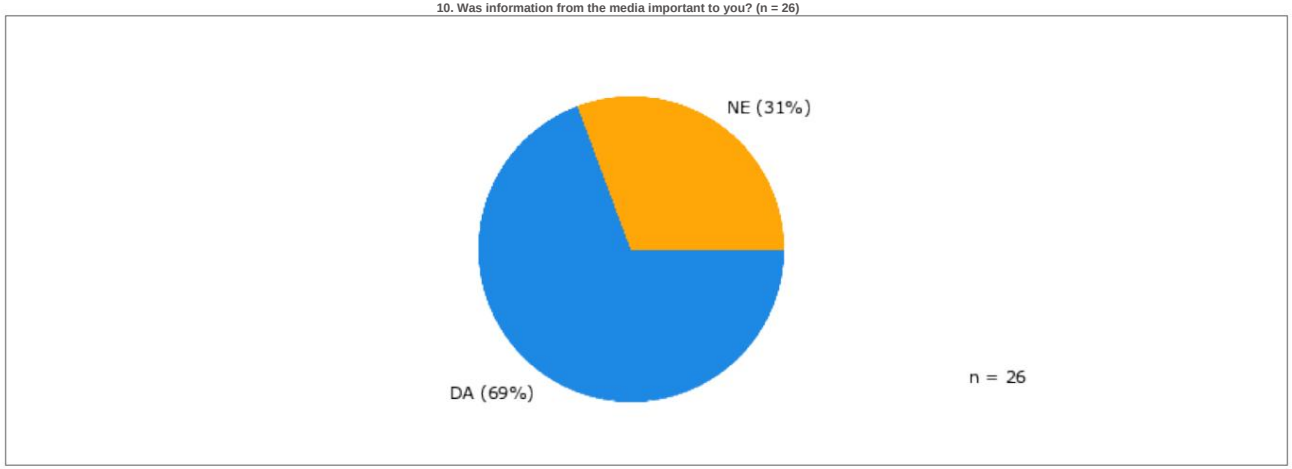
9. In which media did you get information about studying at FNM? Several answers are possible. (n = 26)

Several answers are possible



Q10e_text	Q10 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative
	nowhere	1	2%	20%	20%
	friends	1	2%	20%	40%
	ministry of justice?	1	2%	20%	60%
	school	1	2%	20%	80%
	from former students	1	2%	20%	100%
Valid	Together	5	12%	100%	
Missing	-2 (Skip (if))	21	50%		
	-3 (Discontinued)	16	38%		
	Together	37	88%		
	TOGETHER	42	100%		

10. Was information from the media important to you? (n = 26)



11. What information about your studies convinced you to choose to study at FNM UM?

Q12	11. What information about your studies convinced you to choose to study at FNM UM?				
	Answer	Frequency	Percent	Valid	Cumulative
	schedule	1	2%	4%	4%
	all the information convinced me	1	2%	4%	8%
	friendly professors (I chose between LJ and MB)	1	2%	4%	12%
	exercises and fields, vivarium	1	2%	4%	16%
	I do not know	1	2%	4%	20%
	.	1	2%	4%	24%
	/	3	7%	12%	36%

	the promise of much fieldwork	1	2%	4%	40%
	I do not know	1	2%	4%	44%
	place and object	1	2%	4%	48%
	subject book, schedule	1	2%	4%	52%
	mostly morning schedule, restaurant piano.	1	2%	4%	56%
	nothing special	1	2%	4%	60%
	student program	1	2%	4%	64%
	conversations with previous students	1	2%	4%	68%
	scholarship program	1	2%	4%	72%
	senior information	1	2%	4%	76%
	proximity	1	2%	4%	80%
	friendly professors, good relations between people	1	2%	4%	84%
	subject matter	2	5%	8%	92%
	possibility to choose subjects (mathematics and chemistry)	1	2%	4%	96%
	nwm	1	2%	4%	100%
Valid	Together	25	60%	100%	
Missing	-1 (Did not answer)	1	2%		
	-3 (Discontinued)	16	38%		
	Together	17	40%		
	TOGETHER	42	100%		

12. Why did you decide to study at FNM UM?

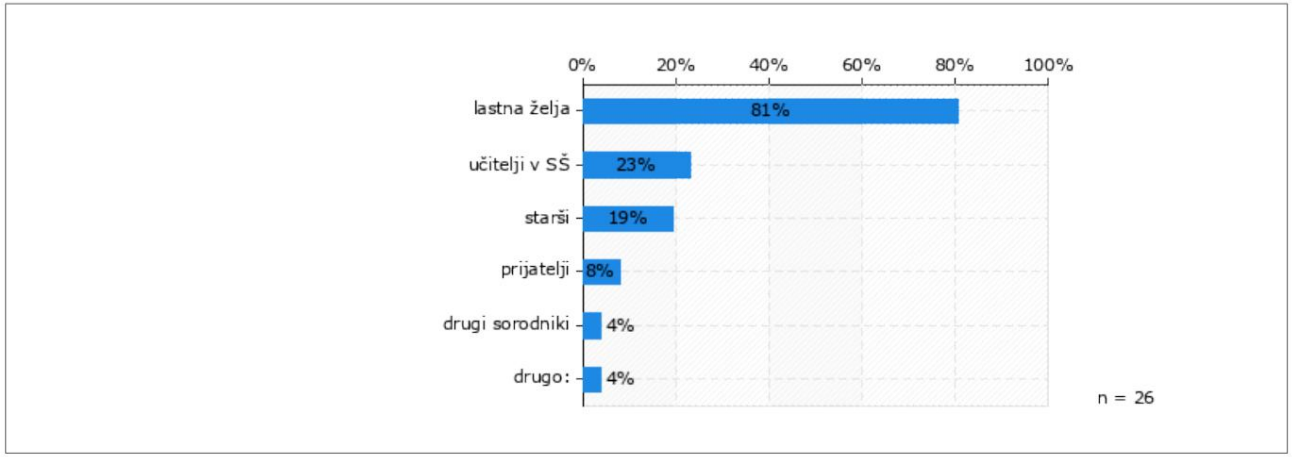
Q13	12. Why did you decide to study at FNM UM?				
	Answer	Frequency	Percent	Valid	Cumulative

	interest in the science of biology and connection with nature.	1	2%	4%	4%
	possibility to choose subjects (mathematics and chemistry)	1	2%	4%	8%
	because I'm interested in science	1	2%	4%	12%
	because I am interested in mathematics.	1	2%	4%	15%
	I am interested in physics	1	2%	4%	19%
	because I wasn't accepted to biology in Ljubljana	1	2%	4%	23%
	he attracted me the most	1	2%	4%	27%
	because I wanted to study biology and engineering together	1	2%	4%	31%
	because it was the only option	1	2%	4%	35%
	friendly surroundings	1	2%	4%	38%
	closer to home	1	2%	4%	42%
	change of environment, friendliness of staff	1	2%	4%	46%
	I want to become a teacher	1	2%	4%	50%
	I have always done well in these areas.	1	2%	4%	54%
	because I was always interested in mathematics	1	2%	4%	58%
	I enjoy mathematics.	1	2%	4%	62%
	because mathematics has always been my favorite everything	1	2%	4%	65%
	employment after studies, the joy of mat	1	2%	4%	69%
	profession - teacher	1	2%	4%	73%
	I already said it	1	2%	4%	77%
	the desire to study biology and the knowledge that in loved ones high limit	1	2%	4%	81%
	because math and physics are interesting to me	1	2%	4%	85%
	because I like biology	1	2%	4%	88%
	because I was always interested in the teaching profession	1	2%	4%	92%

	because I didn't want to go to university in ljubljaba, there it's a bit foggy, I like it better here	1	2%	4%	96%
	i liked mat in high school	1	2%	4%	100%
Valid	Together	26	62%	100%	
Missing	-3 (Discontinued)	16	38%		
	Together	16	38%		
	TOGETHER	42	100%		

13. Who most influenced your decision regarding the chosen course of study? (n = 26)

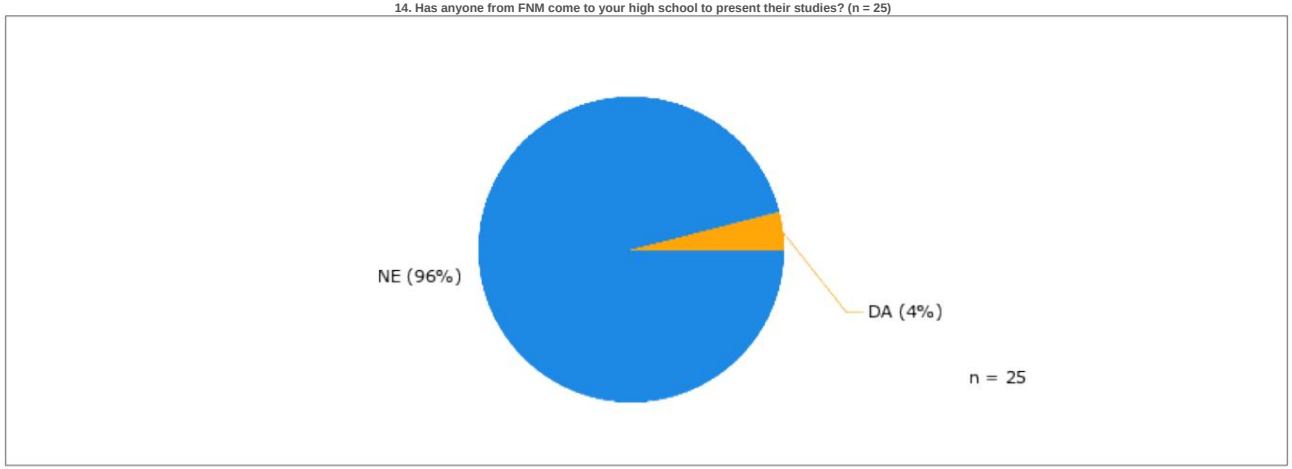
Several answers are possible



Q14f_text	Q14 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative

	partner	1	2%	100%	100%
Valid	Together	1	2%	100%	
Missing	-2 (Skip (if))	25	60%		
	-3 (Discontinued)	16	38%		
	Together	41	98%		
	TOGETHER	42	100%		

14. Has anyone from FNM come to your high school to present their studies? (n = 25)

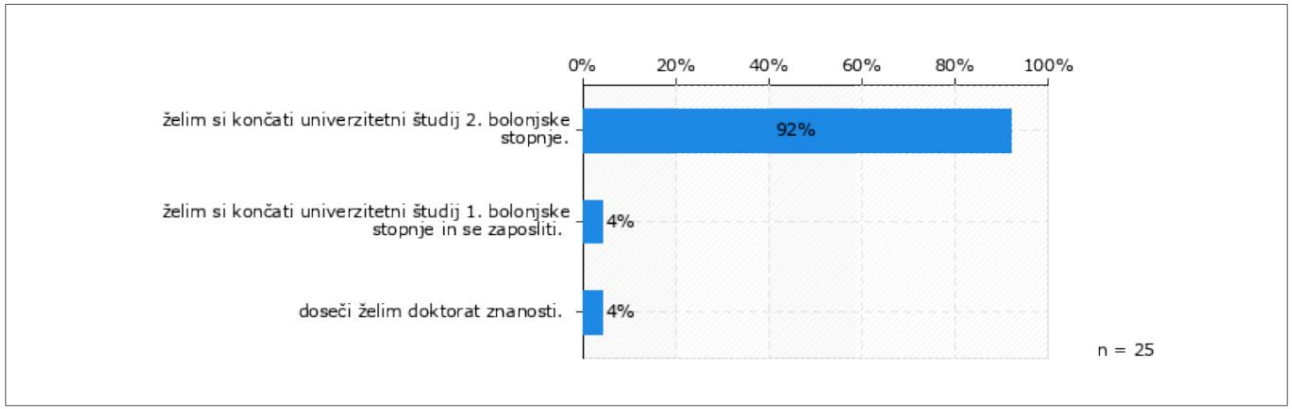


15. If the answer to the previous question is YES, how did the presentation of the study at the time influence your decision?

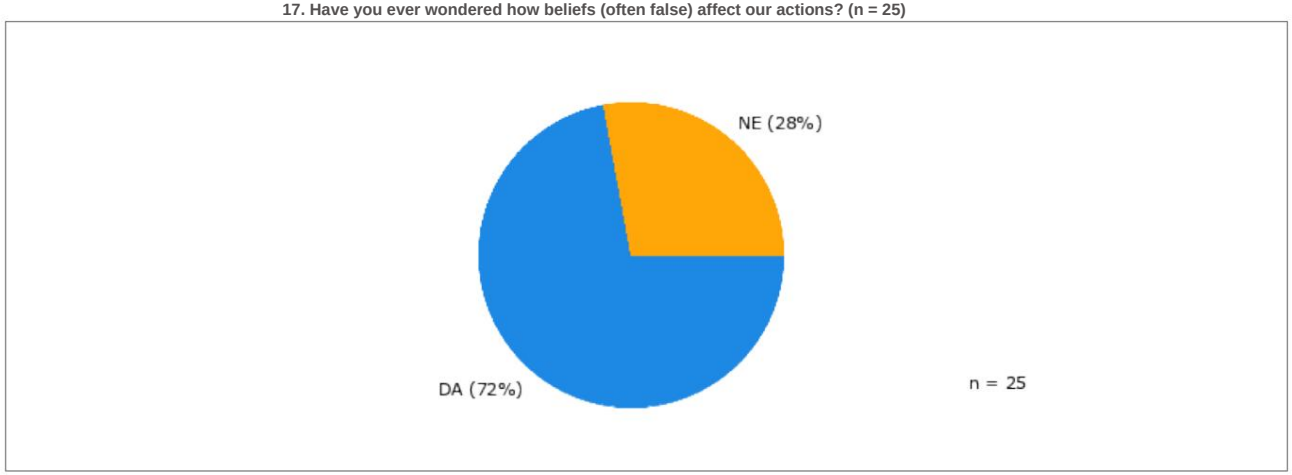
Q16	15. If the answer to the previous question is YES, how did the presentation of the study at the time influence your decision?

	Answer	Frequency	Percent	Valid	Cumulative
	he didn't come to present	1	2%	4%	4%
	.	4	10%	17%	21%
	/	9	21%	38%	58%
	0	1	2%	4%	63%
	x	1	2%	4%	67%
	the answer is no yes	1	2%	4%	71%
	the answer was no	1	2%	4%	75%
	the answer to the previous question was no.	1	2%	4%	79%
	I answered no	1	2%	4%	83%
	positively	1	2%	4%	88%
	no	1	2%	4%	92%
	----	2	5%	8%	100%
Valid	Together	24	57%	100%	
Missing	-1 (Did not answer)	1	2%		
	-3 (Discontinued)	17	40%		
	Together	18	43%		
	TOGETHER	42	100%		

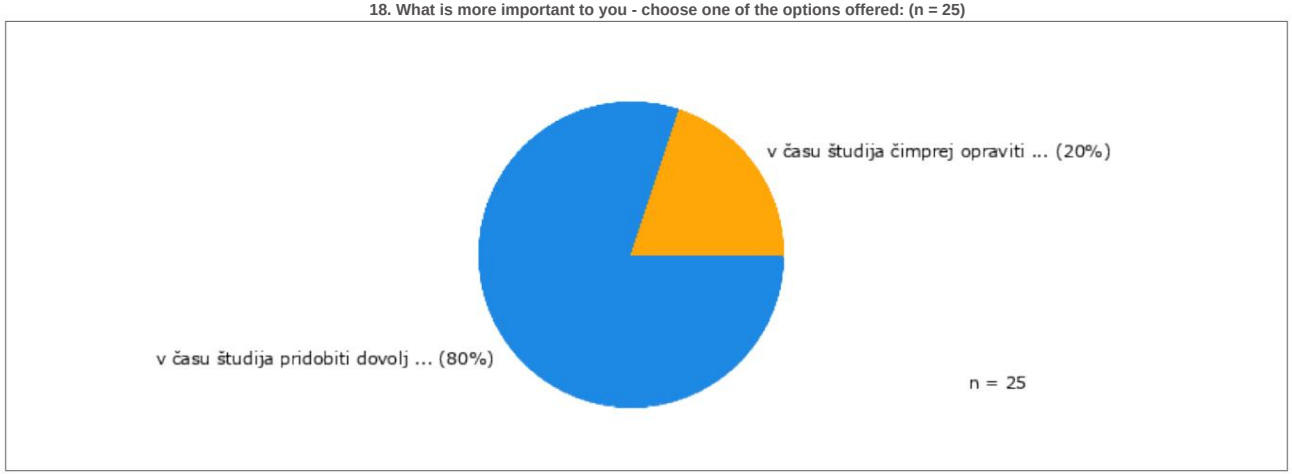
16. What level of education do you want to achieve? (n = 25)



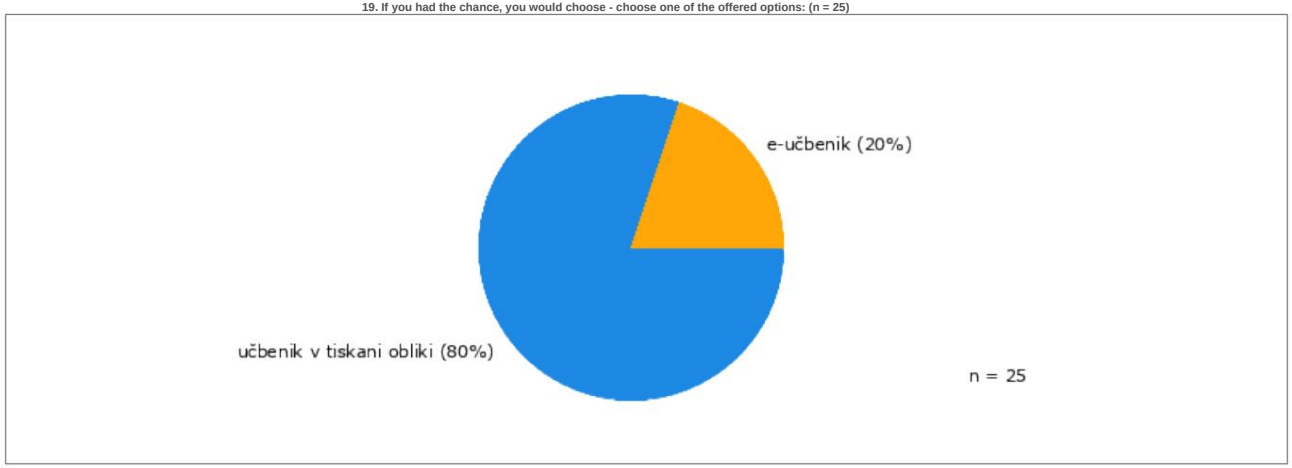
17. Have you ever wondered how beliefs (often false) affect our actions? (n = 25)



18. What is more important to you - choose one of the options offered: (n = 25)



19. If you had the chance, you would choose - choose one of the offered options: (n = 25)



20. How many hours a day do you use digital technology (mobile phone, TV, laptop)?

Q21	20. How many hours a day do you use digital technology (mobile phone, TV, laptop)?				
	Answer	Frequency	Percent	Valid	Cumulative
	3-4	1	2%	5%	5%
	3-4 hours	1	2%	5%	9%
	10	1	2%	5%	14%
	5-6	1	2%	5%	18%
	too much 8h	1	2%	5%	23%
	5 hours	1	2%	5%	27%
	7 hours	1	2%	5%	32%

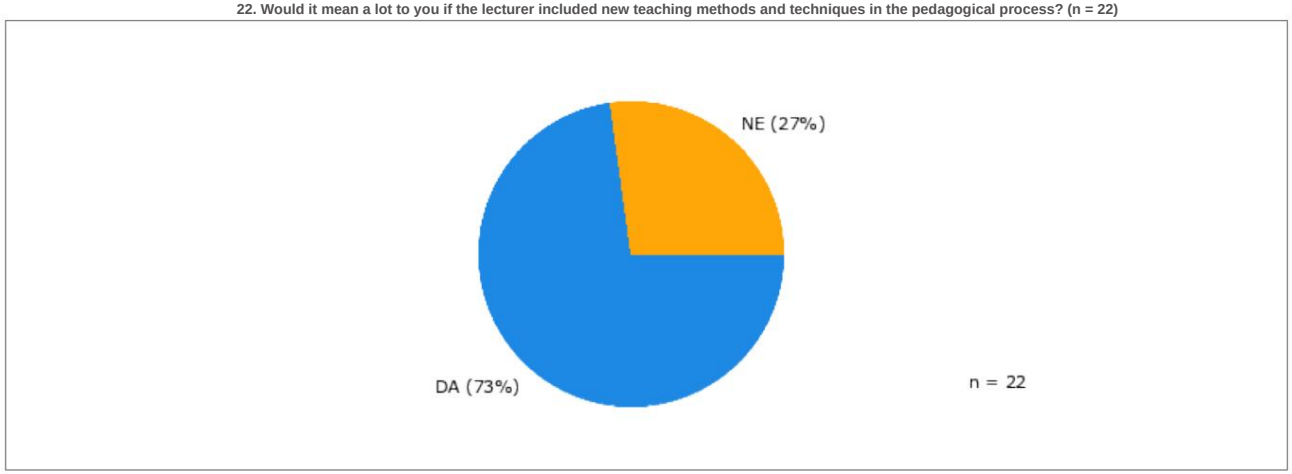
	6 hours	1	2%	5%	36%
	2h	1	2%	5%	41%
	a lot	1	2%	5%	45%
	on average 4-5 hours	1	2%	5%	50%
	3	1	2%	5%	55%
	4	2	5%	9%	64%
	5	1	2%	5%	68%
	6	1	2%	5%	73%
	8	1	2%	5%	77%
	4-5	2	5%	9%	86%
	7 a.m	1	2%	5%	91%
	1 hour	1	2%	5%	95%
	4-5 hours	1	2%	5%	100%
Valid	Together	22	52%	100%	
Missing	-3 (Discontinued)	20	48%		
	Together	20	48%		
	TOGETHER	42	100%		

21. How many hours a day do you spend on social networks?

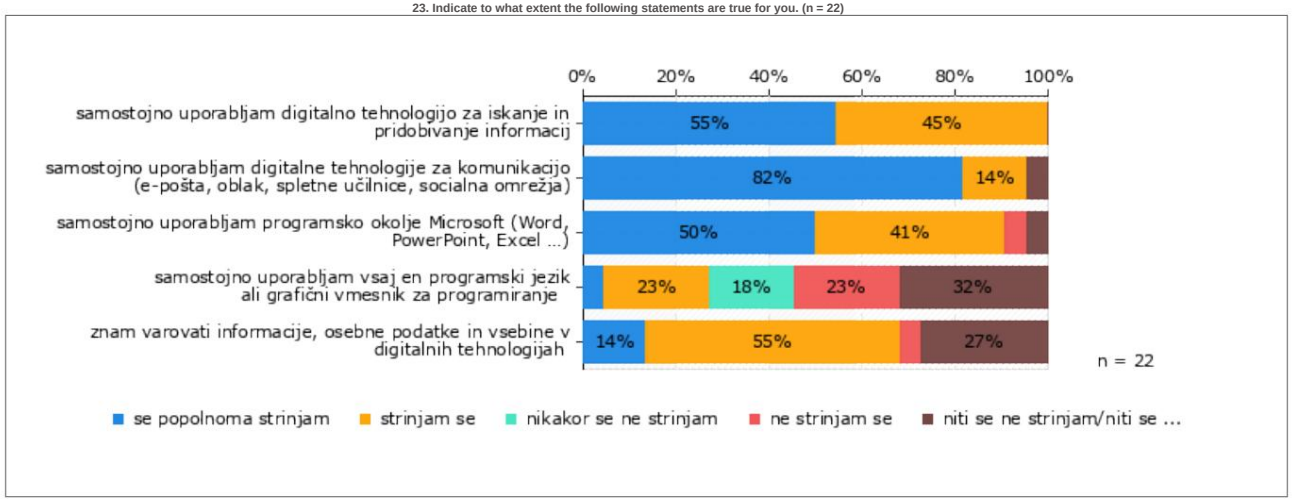
Q22	21. How many hours a day do you spend on social networks?				
	Answer	Frequency	Percent	Valid	Cumulative
	1	3	7%	14%	14%
	2	1	2%	5%	19%
	3	1	2%	5%	24%
	max 1-2	1	2%	5%	29%
	4	2	5%	10%	38%

	2-3	4	10%	19%	57%
	a lot	1	2%	5%	62%
	1 hour	2	5%	10%	71%
	6 hours	1	2%	5%	76%
	2h	1	2%	5%	81%
	1 hour	2	5%	10%	90%
	3 hours	1	2%	5%	95%
	2,3	1	2%	5%	100%
Valid	Together	21	50%	100%	
Missing	-1 (Did not answer)	1	2%		
	-3 (Discontinued)	20	48%		
	Together	21	50%		
	TOGETHER	42	100%		

22. Would it mean a lot to you if the lecturer included new teaching methods and techniques in the pedagogical process? (n = 22)



23. Indicate to what extent the following statements are true for you. (n = 22)

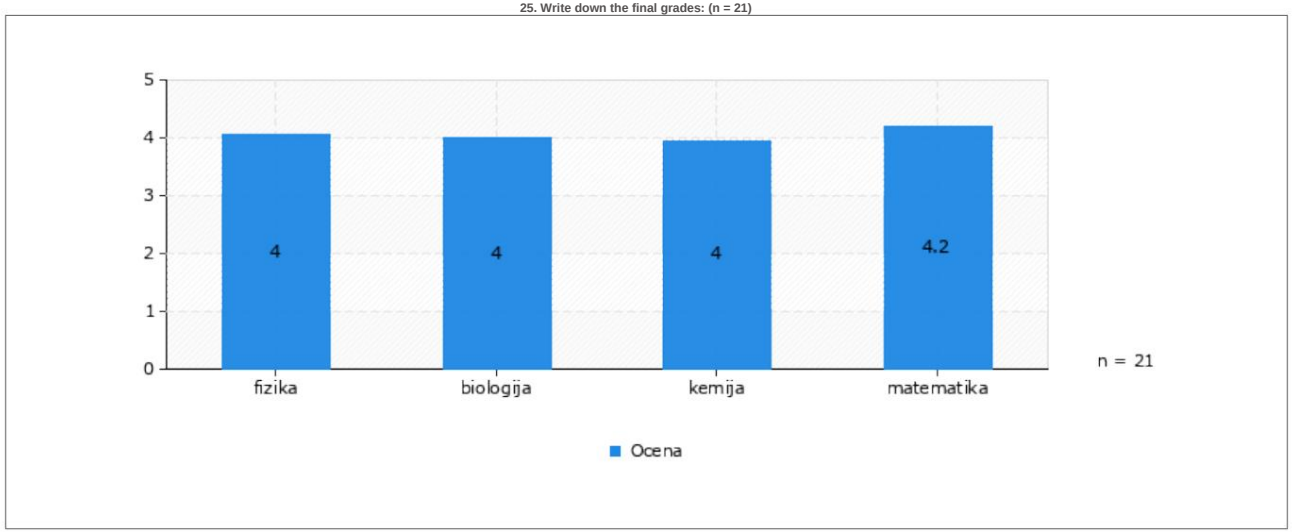


24. Write down which secondary school you completed:

Q25	24. Write down which secondary school you completed:				
	Answer	Frequency	Percent	Valid	Cumulative
	high school piran	1	2%	5%	5%
	Gymnasium Ormož	1	2%	5%	10%
	franca miklošiÿ ljutomer high school	1	2%	5%	14%
	biotechnical school maribor	1	2%	5%	19%
	3 gymnasium	1	2%	5%	24%
	jesenice high school	1	2%	5%	29%

	technical school ýakovec, Croatia - major gymnasium	1	2%	5%	33%
	high school of the Slovenian Cavalry	1	2%	5%	38%
	celje-center high school	1	2%	5%	43%
	economic high school	1	2%	5%	48%
	bic technical high school	1	2%	5%	52%
	first high school	1	2%	5%	57%
	i. gymnasium in Celje	1	2%	5%	62%
	iii. Maribor High School	1	2%	5%	67%
	gymnasium	4	10%	19%	86%
	gymnasium	2	5%	10%	95%
	sšfkz - pharmaceutical technician	1	2%	5%	100%
Valid	Together	21	50%	100%	
Missing	-3 (Discontinued)	21	50%		
	Together	21	50%		
	TOGETHER	42	100%		

25. Write down the final grades: (n = 21)



26. Write if you want to tell us anything else that this questionnaire did not cover.

Q27	26. Write if you want to tell us anything else that this questionnaire did not cover.				
	Answer	Frequency	Percent	Valid	Cumulative
	:)	1	2%	5%	5%
	no	4	10%	19%	24%
	I don't want to tell you anything	1	2%	5%	29%
	.	3	7%	14%	43%
	/	6	14%	29%	71%

	no.	1	2%	5%	76%
	//	1	2%	5%	81%
	x	1	2%	5%	86%
	nothing	1	2%	5%	90%
	nothing	1	2%	5%	95%
	when will all exam dates be known?	1	2%	5%	100%
Valid	Together	21	50%	100%	
Missing	-3 (Discontinued)	21	50%		
	Together	21	50%		
	TOGETHER	42	100%		

ANALYSIS - SUMMARY

Q1	1. State the study program and direction you are studying:
	subject teacher, math -chem
	mathematics
	physics 1st level
	subject teacher, mathematics and chemistry
	subject teacher (mathematics/physics)
	mat uni
	subject teacher, educational physics and educational institutions
	subject teacher math-physics
	ecology with nature conservation
	unified master's program subject teacher of physics and mathematics
	FNM Physics Univ
	subject teacher of mathematics and chemistry
	m
	educational bio and chem
	subject teacher, math and physics
	subject teacher (math/physics)
	fnm-biology
	double subject mathematics technique
	mathematics as a single subject
	subject teacher of physics and mathematics
	biology - technology
	biology
	Mathematics Univ
	mat un
	1st level biology
	mathematics uni
	subject teacher physics computer science

Q2	2. When did you start thinking about the study you chose?
	last year
	end of 3rd year
	end of the 2nd year of high school
	because they are all science subjects for me
	4th year of high school
	4th year of high school
	end of high school
	in the third year of the middle sola
	at the beginning of high school
	I do not know
	4th year
	about a month before submitting the application form for the fax
	in the 4th year of high school
	8th grade
	in the third year of high school
	in the 4th year
	at the beginning of the 4th year
	about five years ago
	from kindergarten
	in the 3rd year of secondary school.

	in 8th grade
	in elementary school
	1 year ago
	February 2023
	December 2022
	when I realized that it would be difficult for me to get into physics directly
	in the 3rd year of high school
	in high school
	4th year
	in medium salt

Q3	3. When did you decide for sure?
	after the information day
	in the 4th year
	last year
	a short time before submitting the registration form
	during information days
	March 2023
	in the fourth year
	after the first failed attempt to study when I transferred
	third year of high school
	in high school
	when registering
	May 2023
	in the first year of high school
	on informative ones
	0
	two years ago
	t
	in high school
	in the 3rd year of high school
	4th year of high school
	4th year
	January 2023
	1 year ago
	when I saw that there is no registration limit
	April 2023
	in February 2023
	during registration
	before enrollment.
	about a week before submitting the application form for the fax
	at the information day

Q4	4. Please mark which data corresponds to your entry:				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (first deadline: first wish)	30	71%	71%	71%
	2 (first deadline: second wish)	6	14%	14%	86%
	3 (second deadline: first wish)	2	5%	5%	90%
	4 (second term: second wish)	0	0%	0%	90%
	5 (other:)	4	10%	10%	100%
Valid	Together	42	100%	100%	

Average	1.6	Std. deflection	1,2

Q4_5_text	Q4 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative
	second entry: first deadline: first wish	1	2%	25%	25%
	first deadline: third wish	2	5%	50%	75%
	transcript	1	2%	25%	100%
Valid	Together	4	10%	100%	

Q5	What did you want to study under your other preferences?
	biology in Ljubljana
	nothing else
	general mathematics
	physics, mathematics and computer science
	chemical technology
	window
	general mathematics, chemical technology
	I didn't think about other wishes
	mathematics 1st level
	biology-chemistry subject teacher
	chemistry, chemical engineering
	medicine
	nothing
	economy
	nothing
	computer science and mathematics in Croatia
	biology at another university
	class lessons
	Faculty of Health Sciences in Maribor
	classroom instruction and English
	mathematics
	Faculty of Economics
	textile and clothing design, biology in Ljubljana
	physiology
	separate lessons
	dental medicine
	finance or economy
	geology
	also mathematics or physics in a non-pedagogical field
	biology in Ljubljana or a two-subject teacher's program (biology and home economics) at the Faculty of Education

Q6	5. Have you been to the information day at FNM UM in the department where you study?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (YES)	30	71%	83%	83%
	2 (NO)	6	14%	17%	100%
Valid	Together	36	86%	100%	

Average	1,2	Std. deflection	0.4

Q7	6. If the answer to the previous question is YES, did you receive useful information about the study and what else did you expect?
	the information was quite helpful.
	Yes
	yes, my expectations were met
	maybe you could say a little more about what you can then continue with this study
	I got all the information
	I received all the information I wanted
	I received useful information
	I received all the information and additional points of interest.
	.
	/
	everything great
	that I found it useful
	yes
	no
	yes, I received a lot of information, but I could probably find this information myself on the college's website.
	I got a lot of useful information
	Yes.
	kinda
	yes, my expectations were met
	I had no high expectations to choose this study, I had already made up my mind.

Q8	7. If the answer to question 5 is YES, what attracted you the most at the information day?
	relaxed attitude, friendliness
	detailed presentation of the program
	the possibility of a scholarship for first-year students
	authenticity
	relaxation, Professor Taranenko was very open
	kindness, hospitality
	homely atmosphere and interesting professors
	vivarium
	relaxed and homely atmosphere
	the professor's approach to students and the atmosphere at the college
	nc ig
	relationship between students and professors
	interesting learning content, interest in science.
	kindness of professors, students
	the friendliness of the professors
	conversation with older students
	coffee students
	friendly environment
	friendliness of students and professors
	the time we spent in the classroom with the professor
	no
	school size
	kindness
	the openness of the professors
	professors
	I do not remember
	interesting program
	.
	/
	conversation with professors

Q9	8. If the answer to question 5 is YES, what did you not like about the information day? What information were you missing?
	everything was fine.
	information about the length of the schedule
	information regarding ects, walking into the following years
	what we will learn.
	everything was everything to me
	nothing
	the complexity of the study
	I was fine
	I just like everything
	designed too systematically
	I was fine
	the presentation of the program, despite covering all the important information, was perhaps still too short.
	.
	/
	it was worth it
	I was at zoom two years ago, where you don't get authentic feelings, what are the students and professors like here, after zoom they were all strange to me
	everything was okay
	no
	perhaps more specific information about the studio
	idk
	everything was ok
	nothing was missing
	I didn't miss anything
	I do not know
	nothing
	appearance of the school
	that I was afraid to walk in the basement

Q10	9. In which media did you get information about studying at FNM? Several answers are possible.							
	Sub questions	Units					Citations	
		Frequencies	Valid	% - Valid	Appropriate	% - Appropriate	Frequencies	%
Q10a	Facebook	1	26	4%	42	2%	1	100%
Q10b	newspaper		26	0%	42	0%		0%
Q10c	FNM website UM	23	26	88%	42	55%	23	2,300%
Q10d	Web page department	15	26	58%	42	36%	15	1,500%
Q10e	other:	5	26	19%	42	12%	5	500%
	TOGETHER		26		42		1	100%

Q10e_text	Q10 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative
	nowhere	1	2%	20%	20%
	friends	1	2%	20%	40%
	ministry of justice?	1	2%	20%	60%
	school	1	2%	20%	80%
	from former students	1	2%	20%	100%
Valid	Together	5	12%	100%	

Q11	10. Was information from the media important to you?				
	Answer	Frequency	Percent	Valid	Cumulative

	1 (YES)	18	43%	69%	69%
	2 (NO)	8	19%	31%	100%
Valid	Together	26	62%	100%	

Average	1.3	Std. deflection	0.5

Q12	11. What information about your studies convinced you to choose to study at FNM UM?
	schedule
	all the information convinced me
	friendly professors (I chose between LJ and MB)
	exercises and fields, vivarium
	I do not know
	.
	/
	the promise of much field work
	I do not know
	place and object
	subject book, schedule
	mostly morning schedule, piano restaurant.
	nothing special
	student program
	conversations with previous students
	scholarship program
	senior information
	proximity
	friendly professors, good relations between people
	subject matter
	possibility to choose subjects (mathematics and chemistry)
	nwm

Q13	12. Why did you decide to study at FNM UM?
	interest in the science of biology and connection with nature.
	possibility to choose subjects (mathematics and chemistry)
	because I'm interested in science
	because I am interested in mathematics.
	I am interested in physics
	because I wasn't accepted to biology in Ljubljana
	he attracted me the most
	because I wanted to study biology and engineering together
	because it was the only option
	friendly surroundings
	closer to home
	change of environment, friendliness of staff
	I want to become a teacher
	I have always done well in these areas.
	because I was always interested in mathematics
	I enjoy mathematics.
	because mathematics has always been the most important thing to me
	employment after studies, the joy of mat
	profession - teacher
	I already said it

	the desire to study biology and the knowledge that there will be a high limit in Ljubljana
	because math and physics are interesting to me
	because I like biology
	because I was always interested in the teaching profession
	because I didn't want to go to university in ljubljaba, it's foggy there, I like it better here
	i liked mat in high school

Q14	13. Who most influenced your decision regarding the chosen course of study?							
	Sub questions	Units					Citations	
		Frequencies	Valid	% - Valid	Appropriate	% - Appropriate	Frequencies	%
Q14a	friends	2	26	8%	42	5%	2	100%
Q14b	teachers in secondary schools	6	26	23%	42	14%	6	300%
Q14c	parents	5	26	19%	42	12%	5	250%
Q14d	other relatives	1	26	4%	42	2%	1	50%
Q14e	own desire	21	26	81%	42	50%	21	1.050%
Q14f	other:	1	26	4%	42	2%	1	50%
	TOGETHER		26		42		2	100%

Q14f_text	Q14 (other:)				
	Answer	Frequency	Percent	Valid	Cumulative
	partner	1	2%	100%	100%
Valid	Together	1	2%	100%	

Q15	14. Has anyone from FNM come to your high school to present their studies?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (YES)	1	2%	4%	4%
	2 (NO)	24	57%	96%	100%
Valid	Together	25	60%	100%	

Average	2.0	Std. deflection	0.2

Q16	15. If the answer to the previous question is YES, how did the presentation of the study at the time influence your decision?
	he didn't come to present
	.
	/
	0
	x
	the answer is no yes
	the answer was no
	the answer to the previous question was no.
	I answered no
	positively
	no
	.....

Q17	16. What level of education do you want to achieve?				
	Answer	Frequency	Percent	Valid	Cumulative

	1 (I want to finish university studies of the 1st Bologna level and se employ.)	1	2%	4%	4%
	2 (I want to finish university studies of the 2nd Bologna level.)	23	55%	92%	96%
	3 (I want to get a Ph.D of science.)	1	2%	4%	100%
Valid	Together	25	60%	100%	

Average	2.0	Std. deflection	0.3

Q18	17. Have you ever wondered how beliefs (often false) affect our actions?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (YES)	18	43%	72%	72%
	2 (NO)	7	17%	28%	100%
Valid	Together	25	60%	100%	

Average	1.3	Std. deflection	0.5

Q19	18. What is more important to you - choose one of the following options:				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (to acquire enough during the course of study competence (knowledge) that you are ready for the labor market.)	20	48%	80%	80%
	2 (during studies as soon as possible fulfill the obligations that you will ready for the job market as soon as possible.)	5	12%	20%	100%
Valid	Together	25	60%	100%	

Average	1,2	Std. deflection	0.4

Q20	19. If you had the chance, you would choose - choose one of the offered options:				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (textbook in printed form)	20	48%	80%	80%
	2 (e-textbook)	5	12%	20%	100%
Valid	Together	25	60%	100%	

Average	1,2	Std. deflection	0.4

Q21	20. How many hours a day do you use digital technology (mobile phone, TV, laptop)?
	3-4
	3-4 hours
	10
	5-6
	too much 8h
	5 hours
	7 hours
	6 hours

	2h
	a lot
	on average 4-5 hours
	3
	4
	5
	6
	8
	4-5
	7 a.m
	1 hour
	4-5 hours

Q22	21. How many hours a day do you spend on social networks?
	1
	2
	3
	max 1-2
	4
	2-3
	a lot
	1 hour
	6 hours
	2h
	1 hour
	3 hours
	2,3

Q23	22. Would it mean a lot to you if the lecturer included new teaching methods and techniques in the pedagogical process?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (YES)	16	38%	73%	73%
	2 (NO)	6	14%	27%	100%
Valid	Together	22	52%	100%	

Average	1.3	Std. deflection	0.5

Q24	23. Indicate to what extent the following statements are true for you.
	Sub questions
Q24a	I independently use digital technology to search and obtain information
Q24b	I independently use digital technologies for communication (e-mail, cloud, online classrooms, social
Q24c	I use the Microsoft software environment independently (Word, PowerPoint, Excel...)
Q24d	I use at least one programming language or graphical programming interface independently
Q24e	I know how to protect information, personal data and content in digital technologies

Q25	24. Write down which secondary school you completed:
	high school piran
	Gymnasium Ormož
	franca miklošiý ljutomer high school

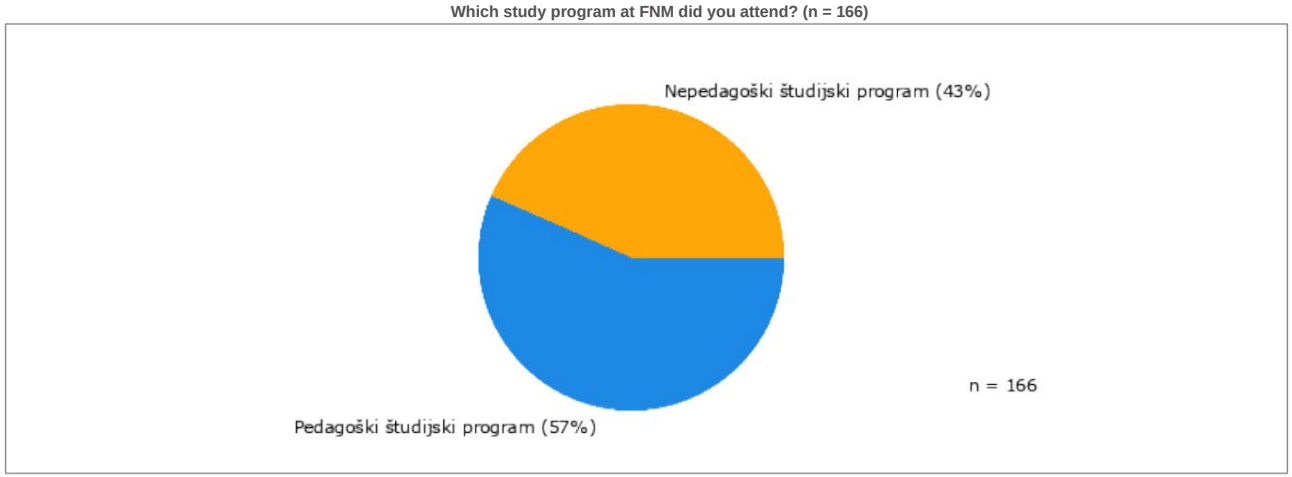
	biotechnical school maribor
	3 gymnasium
	jesenice high school
	technical school ÿakovec, Croatia - high school course
	high school of the Slovenian Cavalry
	celje-center high school
	economic high school
	bic technical high school
	first high school
	i. gymnasium in Celje
	iii. Maribor High School
	gymnasium
	gymnasium
	sšfkz - pharmaceutical technician

Q26	25. Write down the final grades:	
	Sub questions	Averages
		Assessment
Q26a	physics	4.3
Q26b	biology	4.2
Q26c	chemistry	4.2
Q26d	mathematics	4.2

Q27	26. Write if you want to tell us anything else that this questionnaire did not cover.
	:)
	no
	I don't want to tell you anything
	.
	/
	no.
	//
	x
	nothing
	nothing
	when will all exam dates be known?

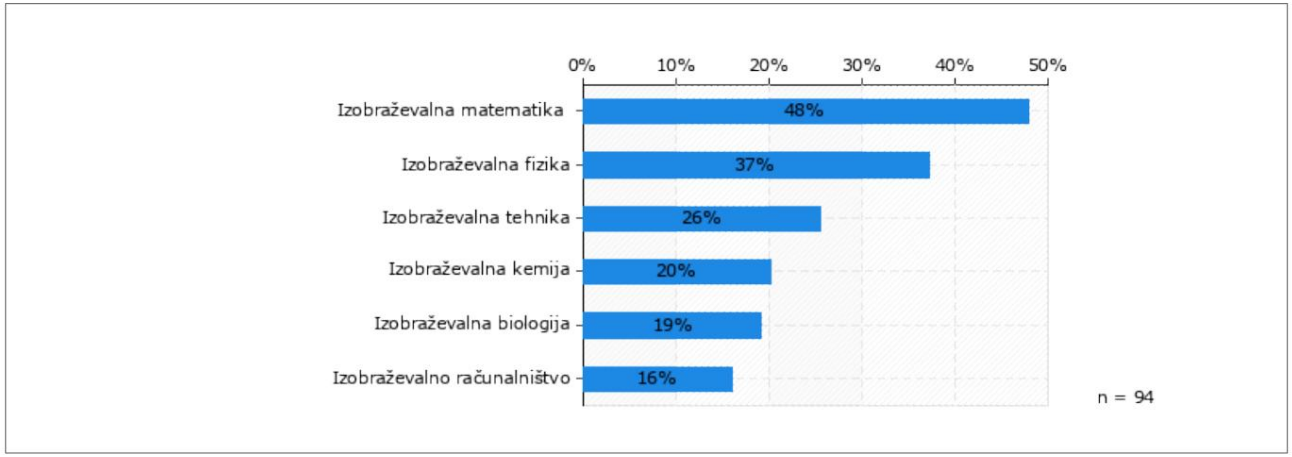
APPENDIX 5: RESULTS OF THE SURVEY QUESTIONNAIRE FOR GRADUATES OF FNM UM - summary with graphs

ANALYSIS - GRAPHS

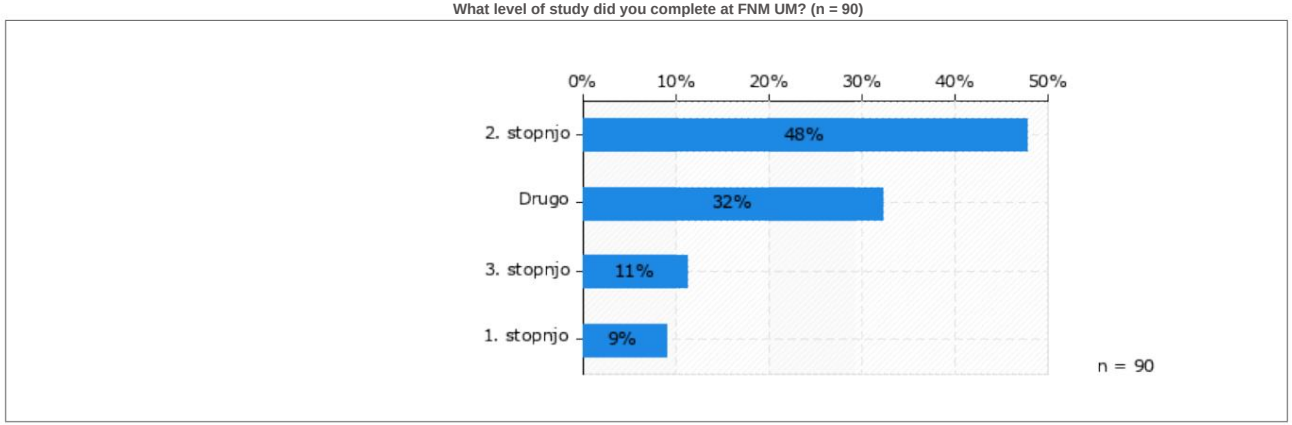


Which two orientations did you study on the subject teacher study program? (n = 94)

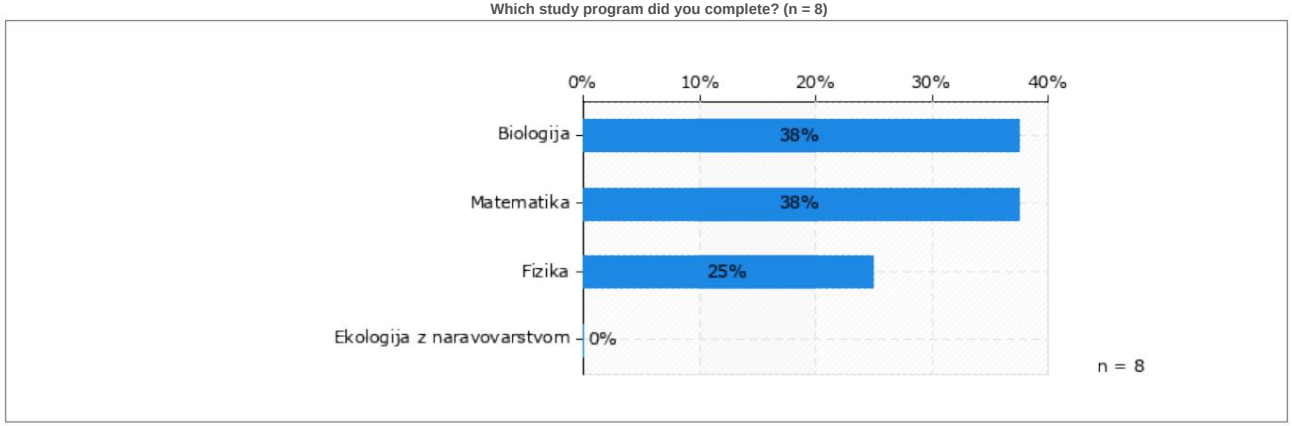
Several answers are possible



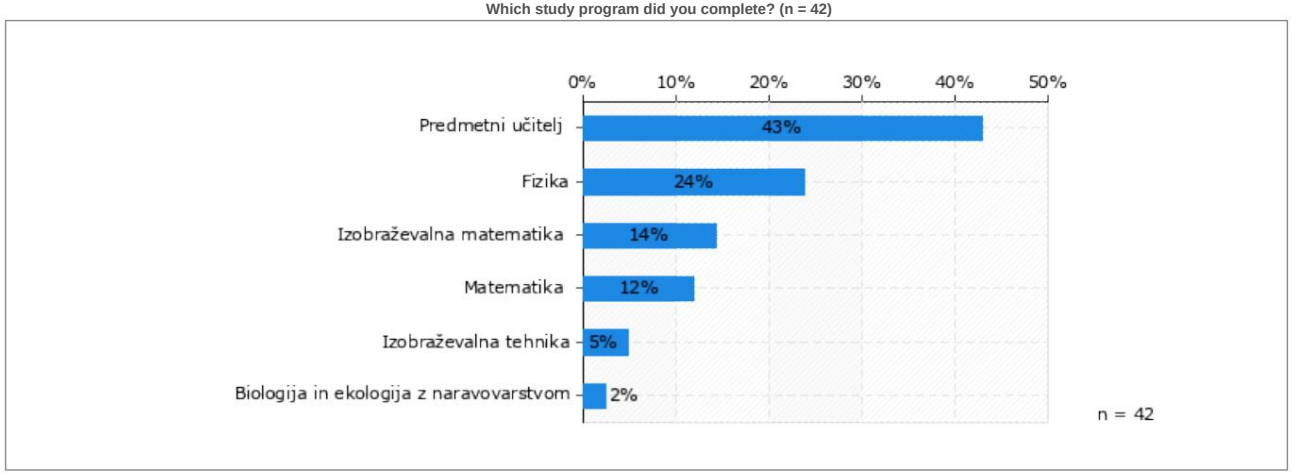
What level of study did you complete at FNM UM? (n = 90)



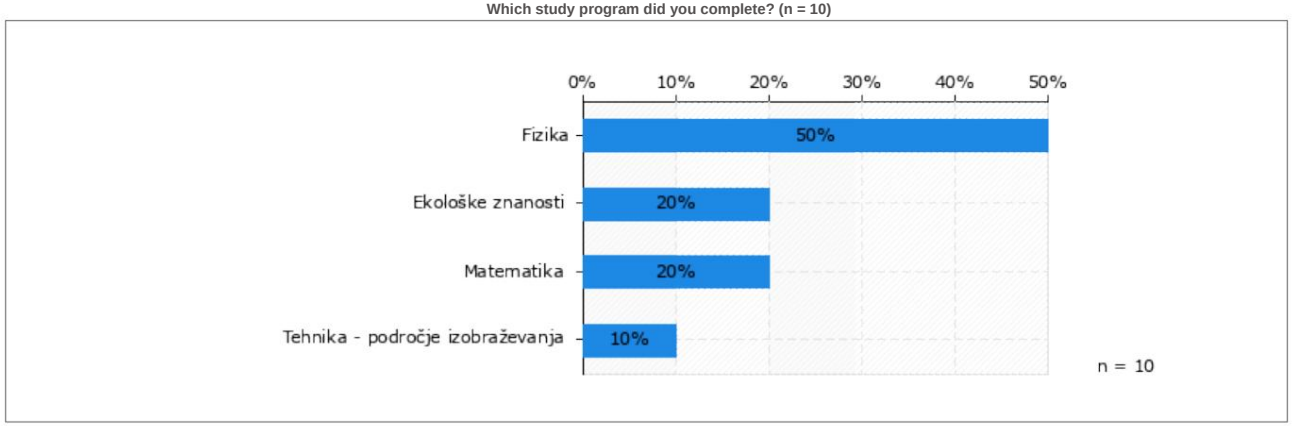
Which study program did you complete? (n = 8)



Which study program did you complete? (n = 42)



Which study program did you complete? (n = 10)

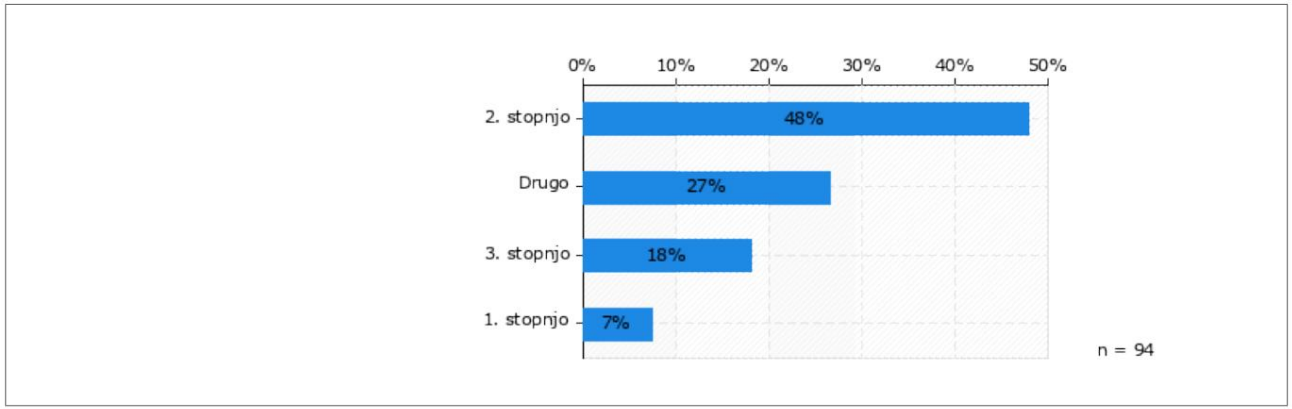


Which study program did you complete?

Q7	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	old university program mathematics and computer science	1	1%	3%	3%
	university (old)	1	1%	3%	7%
	old uni	1	1%	3%	10%
	pedagogy and chemistry, 2nd level	1	1%	3%	14%
	double major	1	1%	3%	17%
	mathematics and ...	1	1%	3%	21%
	university program	2	1%	7%	28%
	computer science with mathematics uni	1	1%	3%	31%
	Level 2 Educational Biology and educational chemistry	1	1%	3%	34%
	university study program / double major mathematics	1	1%	3%	38%
	professor of biology and chemistry	1	1%	3%	41%
	uni - double major	1	1%	3%	45%
	double subject no. mathematics and computer science	1	1%	3%	48%
	old university program	1	1%	3%	52%
	double-subject study program mathematics and technique (old)	1	1%	3%	55%
	double-subject study of mathematics and physics	1	1%	3%	59%
	university, 7th level	1	1%	3%	62%
	last generation uni star system	1	1%	3%	66%

	are you asking before or after the Bologna renovation? i.e. the first pre-Bologna level, sort of fits the 2nd bolognese right? :)	1	1%	3%	69%
	uni - professor of physics	1	1%	3%	72%
	fi-pthv	1	1%	3%	76%
	4 year old	1	1%	3%	79%
	Phys	1	1%	3%	83%
	single subject mathematics - uni	1	1%	3%	86%
	university (before the Bologna system)	1	1%	3%	90%
	biology and ···	1	1%	3%	93%
	university	2	1%	7%	100%
Valid	Together	29	17%	100%	
Missing	-2 (Skip (if))	137	83%		
	Together	137	83%		
	TOGETHER	166	100%		

What level of study have you completed in general? (n = 94)



Indicate the faculty and field of study completed

Q9	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm	1	1%	14%	14%
	physics and computer science fnm	1	1%	14%	29%
	fnm professor of biology and computer science	1	1%	14%	43%
	fnm, educational mathematics and educational technique	1	1%	14%	57%
	pef/fnm (non-Bologna studies) - time when pef disintegrated	1	1%	14%	71%
	um faculty of pedagogy, department of physics and mathematics	1	1%	14%	86%
	mind fnm, isob. mat. and isob. those.	1	1%	14%	100%
Valid	Together	7	4%	100%	
Missing	-2 (Skip (if))	159	96%		
	Together	159	96%		
	TOGETHER	166	100%		

Indicate the faculty and field of study completed

Q10	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	mind	1	1%	2%	2%
	fnm, mat-raÿ	1	1%	2%	4%
	fnm	1	1%	2%	7%

	you will probably know	1	1%	2%	9%
	fnm, single subject mathematics	1	1%	2%	11%
	natural sciences major physics -pthv	1	1%	2%	13%
	Faculty of Pedagogy, Mathematics and Physics, later one more mathematics subject	1	1%	2%	16%
	fnm, mat. and rach.	1	1%	2%	18%
	ghhhh	1	1%	2%	20%
	fnm	6	4%	13%	33%
	fnm - physics	1	1%	2%	36%
	fnm, one-subject pedagogical mathematics	1	1%	2%	38%
	fnm, educational biology and educational chemistry	1	1%	2%	40%
	you can probably tell from the previous ones answers.	1	1%	2%	42%
	Faculty of Mathematics, Physics and Mathematics	1	1%	2%	44%
	Faculty of Natural Sciences	1	1%	2%	47%
	fnm mind	2	1%	4%	51%
	physics	1	1%	2%	53%
	fnm, educational mathematics and biology	1	1%	2%	56%
	Faculty of Education (before division), dual subject chemistry and mathematics	1	1%	2%	58%
	fnm, biology and chemistry	1	1%	2%	60%
	fnm, biology and philosophy	1	1%	2%	62%
	fnm, fi pthv	1	1%	2%	64%
	educational bio and chemistry	1	1%	2%	67%
	fnm, prof mat	1	1%	2%	69%
	Faculty of Science and Mathematics	1	1%	2%	71%
	pef inclusion in education	1	1%	2%	73%
	fnm - chemistry and..., - pedagogy and...	1	1%	2%	76%

	faculty of pedagogy - physics - technology	1	1%	2%	78%
	Faculty of Pedagogy, Physics and Technology	1	1%	2%	80%
	fnm - physics and technology	2	1%	4%	84%
	Faculty of Science and Mathematics (one-subject pedagogical physics)	1	1%	2%	87%
	fnm physics and mathematics, old program	1	1%	2%	89%
	I leave it to you.	1	1%	2%	91%
	faculty of pedagogy major - physics - production technical education	1	1%	2%	93%
	Master of Pedagogy, Math and Phys	1	1%	2%	96%
	pf mb, ma-fi	1	1%	2%	98%
	fnm um, professor of physics and engineering	1	1%	2%	100%
Valid	Together	45	27%	100%	
Missing	-2 (Skip (if))	121	73%		
	Together	121	73%		
	TOGETHER	166	100%		

Indicate the faculty and field of study completed

Q11	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm, physics	1	1%	7%	7%
	Faculty of Science and Mathematics, Physics	1	1%	7%	13%
	fnm - educational technique	1	1%	7%	20%
	fnm mathematics	1	1%	7%	27%
	fnm biology	1	1%	7%	33%
	fnm mind, ecological sciences	1	1%	7%	40%

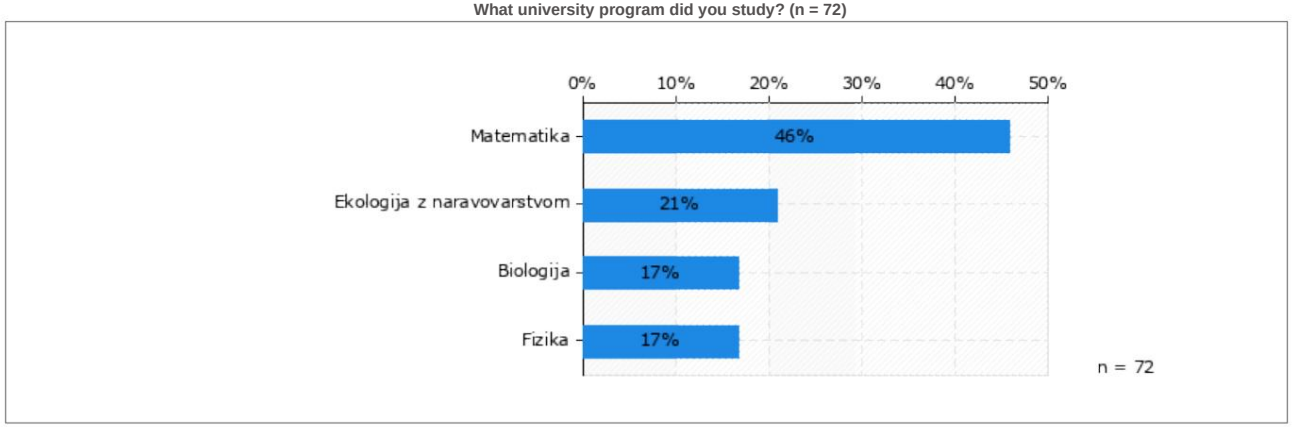
	Faculty of Education; mathematics	1	1%	7%	47%
	feri um - ass	1	1%	7%	53%
	Maribor Faculty of Education, Physics and Technology	1	1%	7%	60%
	Faculty of Science and Mathematics	1	1%	7%	67%
	ul ntf, chemical education	1	1%	7%	73%
	fnm physics	1	1%	7%	80%
	fnm biology, chemistry	1	1%	7%	87%
	epf um, economic and business sciences	2	1%	13%	100%
Valid	Together	15	9%	100%	
Missing	-1 (Did not answer)	2	1%		
	-2 (Skip (if))	149	90%		
	Together	151	91%		
	TOGETHER	166	100%		

Indicate the faculty and field of study completed

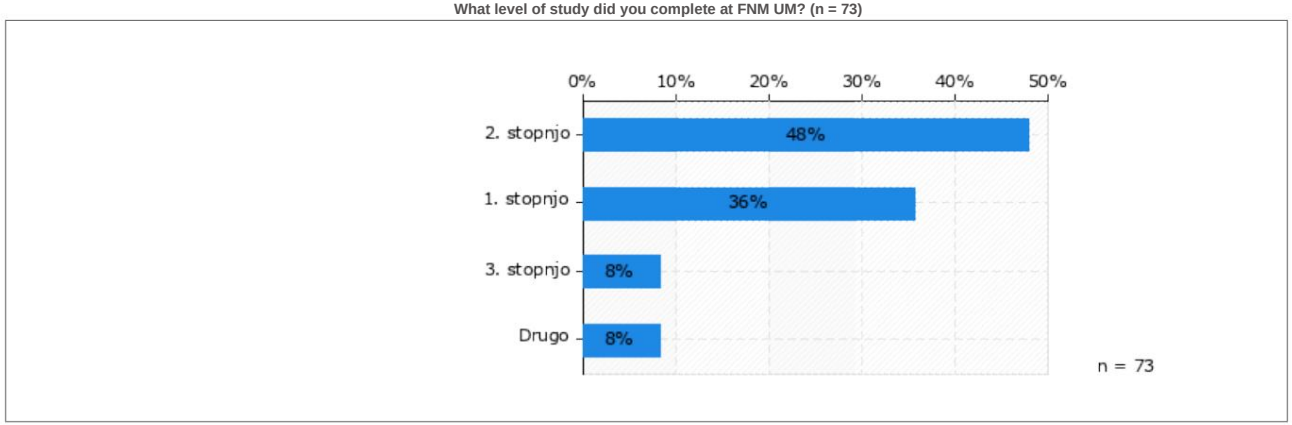
Q12	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm and , biology-geography	1	1%	4%	4%
	single subject mathematics - uni	1	1%	4%	8%
	fnm, biology and chemistry	1	1%	4%	13%
	pef mb double subject mathematics	1	1%	4%	17%
	Faculty of Science and Mathematics, professor of mathematics	1	1%	4%	21%
	pedagogy, then fnm, majoring in bio-chem	1	1%	4%	25%
	feri informatics regular + fnm educational the technique is extraordinary	1	1%	4%	29%

	fnm, mat and rac	1	1%	4%	33%
	university study program (before Bologna)	1	1%	4%	38%
	fnm - old program	1	1%	4%	42%
	fnm, professor of mathematics (university)	1	1%	4%	46%
	uni - professor of physics	1	1%	4%	50%
	fnm, major: mathematics and computer science	1	1%	4%	54%
	fnm. engineering and mathematics	1	1%	4%	58%
	the answer is the same as the previous one. fnm.	1	1%	4%	63%
	fnm chemistry - biology	1	1%	4%	67%
	professor of mathematics and physics, former teacher Faculty of Maribor	1	1%	4%	71%
	fnm, major: chemistry-physics	1	1%	4%	75%
	faculty of pedagogy, computer science with mathematics	1	1%	4%	79%
	pef mb - away	1	1%	4%	83%
	fm koper, master of science	1	1%	4%	88%
	fnm, mat-raÿ	1	1%	4%	92%
	fnm and um, professor of mathematics and of the Slovenian language with literature	1	1%	4%	96%
	fnm	1	1%	4%	100%
Valid	Together	24	14%	100%	
Missing	-1 (Did not answer)	1	1%		
	-2 (Skip (if))	141	85%		
	Together	142	86%		
	TOGETHER	166	100%		

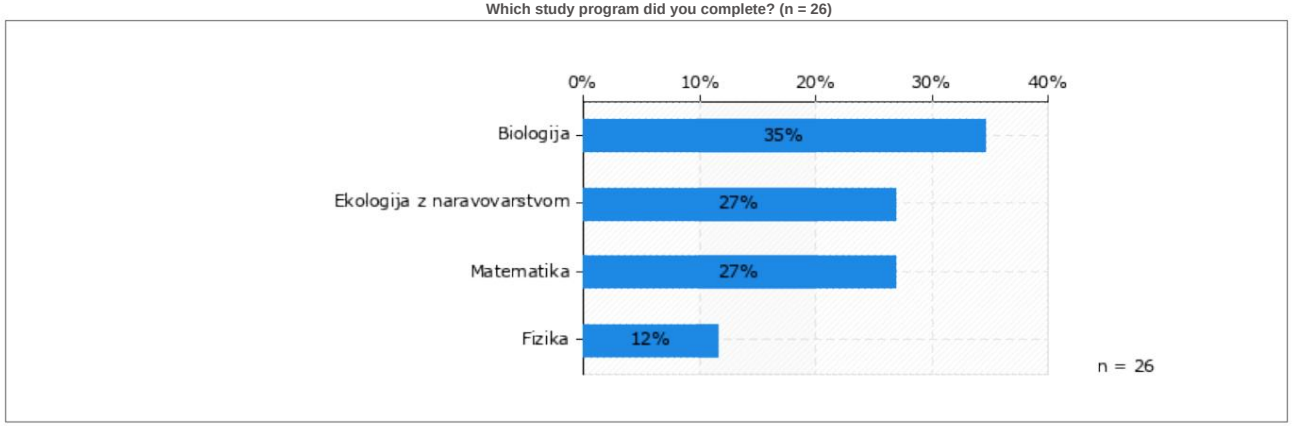
What university program did you study? (n = 72)



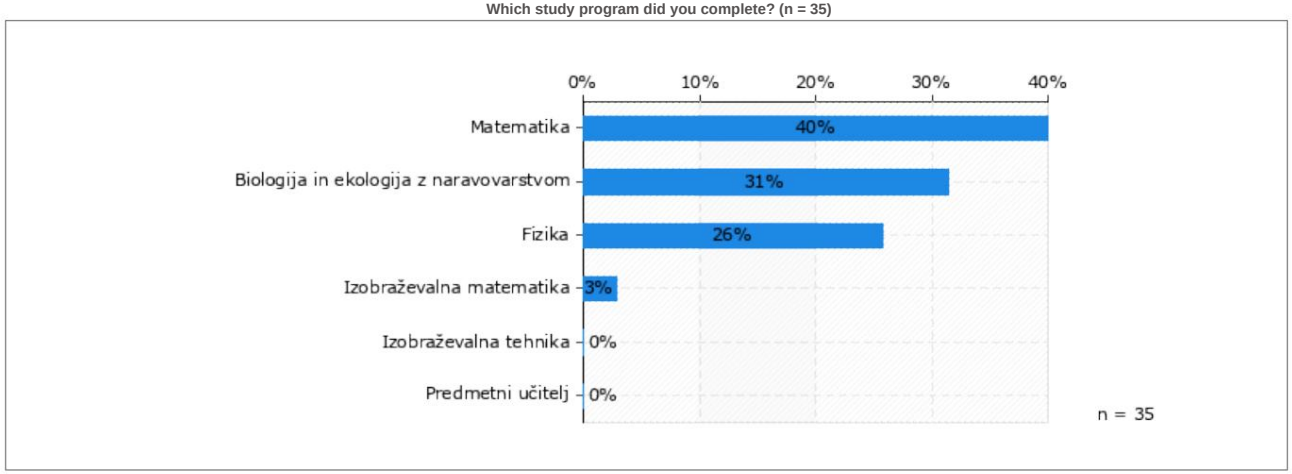
What level of study did you complete at FNM UM? (n = 73)



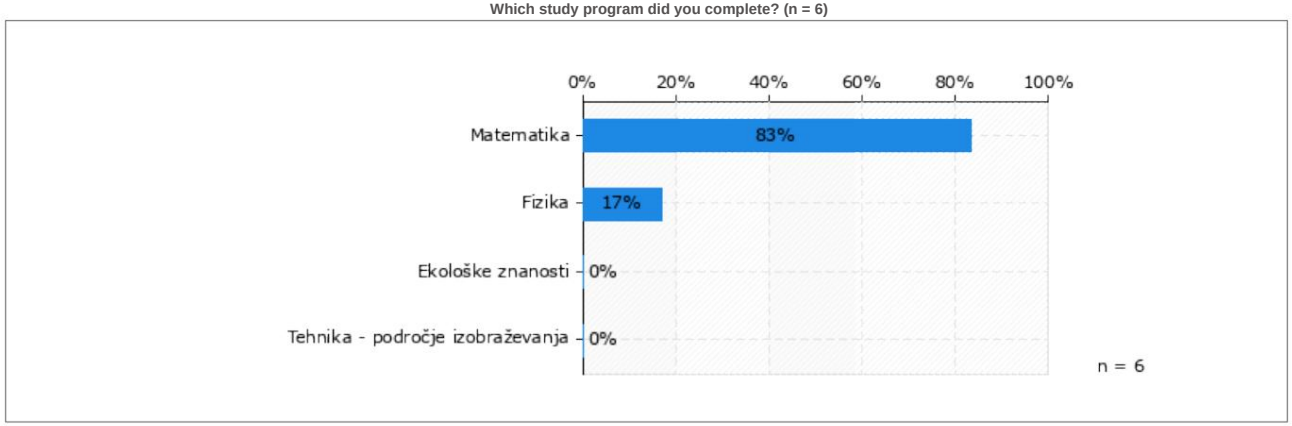
Which study program did you complete? (n = 26)



Which study program did you complete? (n = 35)



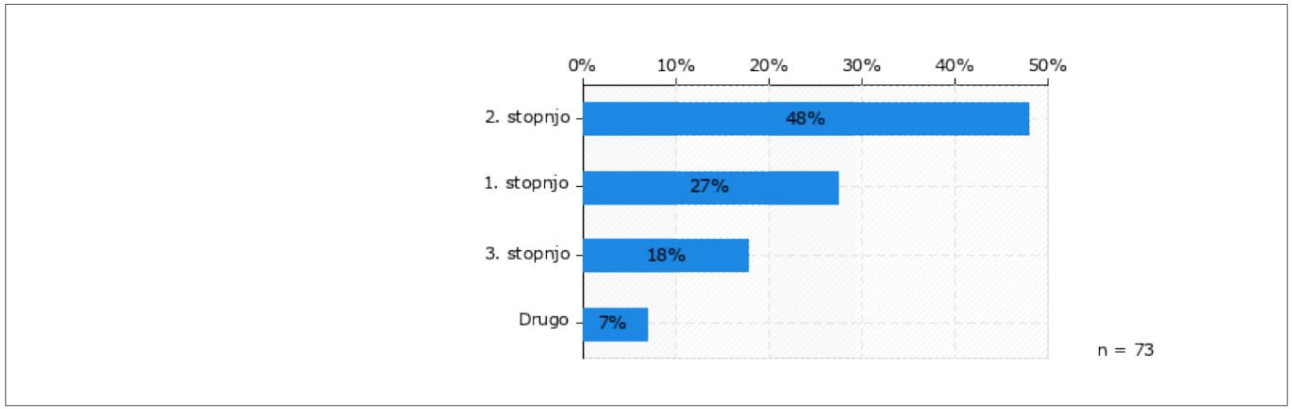
Which study program did you complete? (n = 6)



Which study program did you complete?

Q18	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	mathematics - Non-Bolonic	1	1%	17%	17%
	non-pedagogical mathematics	2	1%	33%	50%
	single subject non-pedagogical mathematics	1	1%	17%	67%
	single-subject non-pedagogical study program mathematics	1	1%	17%	83%
	pre-Bologna university	1	1%	17%	100%
Valid	Together	6	4%	100%	
Missing	-2 (Skip (if))	160	96%		
	Together	160	96%		
	TOGETHER	166	100%		

What level of study have you completed in general? (n = 73)



Indicate the faculty and field of study completed

Q20	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm, ecology with nature conservation	2	1%	10%	10%
	fnm physics	2	1%	10%	20%
	fnm biology	2	1%	10%	30%
	Faculty of Education ; single subject mathematics	1	1%	5%	35%
	biology, fnm mb	1	1%	5%	40%
	fnm, general mathematics	1	1%	5%	45%
	Faculty of Science and Mathematics, major biology	1	1%	5%	50%
	fnm, physics	1	1%	5%	55%
	fnm, mathematics (single subject)	1	1%	5%	60%
	fnm ecology with nature conservation	1	1%	5%	65%
	fnm mathematics	1	1%	5%	70%
	fnm, 2021	1	1%	5%	75%
	Faculty of Science and Mathematics, biology	1	1%	5%	80%
	fnm mind math	1	1%	5%	85%
	fnm - ecology with nature conservation	1	1%	5%	90%
	fnm	1	1%	5%	95%
	Faculty of Science and Mathematics, major mathematics	1	1%	5%	100%
Valid	Together	20	12%	100%	
Missing	-2 (Skip (if))	146	88%		
	Together	146	88%		

	TOGETHER	166	100%		

Indicate the faculty and field of study completed

Q21	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm, educational mathematics	1	1%	3%	3%
	single subject non-pedagogical mathematics	1	1%	3%	6%
	Faculty of Science and Mathematics, Physics	1	1%	3%	9%
	fnm, mathematics	3	2%	9%	17%
	fnm, biology and ecology with nature conservation	3	2%	9%	26%
	biotechnical faculty, molecular and functional biology	2	1%	6%	31%
	fnm mb biology and ecology with nature conservation	1	1%	3%	34%
	Faculty of Science and Mathematics - biology and ecology with nature conservation	1	1%	3%	37%
	fnm mathematics (financial/computing)	1	1%	3%	40%
	fnm mind, majoring in biology and ecology with nature conservation	1	1%	3%	43%
	Faculty of Science and Mathematics, biology and ecology with nature conservation	2	1%	6%	49%
	fnm	5	3%	14%	63%
	biotechnical faculty, university of lj, microbiology	1	1%	3%	66%
	non-pedagogical mathematics	1	1%	3%	69%
	biotechnical, ecology and biodiversity	1	1%	3%	71%
	fnm mathematics	1	1%	3%	74%

	fnm, major: biology and ecology with nature conservation	1	1%	3%	77%
	Faculty of Science and Mathematics Maribor, physics un 2nd level	1	1%	3%	80%
	faculty of natural sciences and mathematics, physics, 2nd level	1	1%	3%	83%
	fnm, financial mathematics	1	1%	3%	86%
	biotechnical faculty, functional and molecular biology	1	1%	3%	89%
	fs, technical environmental protection	1	1%	3%	91%
	Faculty of Science and Mathematics	1	1%	3%	94%
	fnm, mathematics, financial mathematics	1	1%	3%	97%
	fnm mind	1	1%	3%	100%
Valid	Together	35	21%	100%	
Missing	-2 (Skip (if))	131	79%		
	Together	131	79%		
	TOGETHER	166	100%		

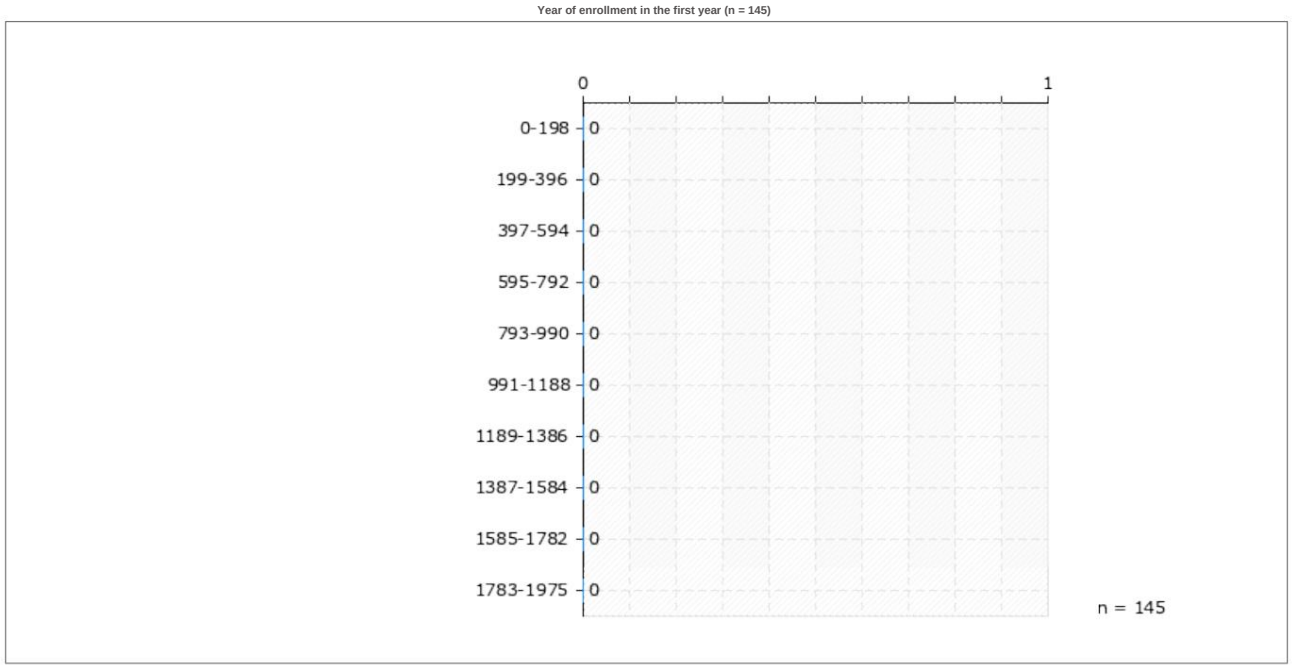
Indicate the faculty and field of study completed

Q22	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fachbereich physik, philipps-universität marburg, physics	1	1%	8%	8%
	mps	1	1%	8%	15%
	Jožef Stefan International Postgraduate School	1	1%	8%	23%
	ferries, electrical engineering	1	1%	8%	31%

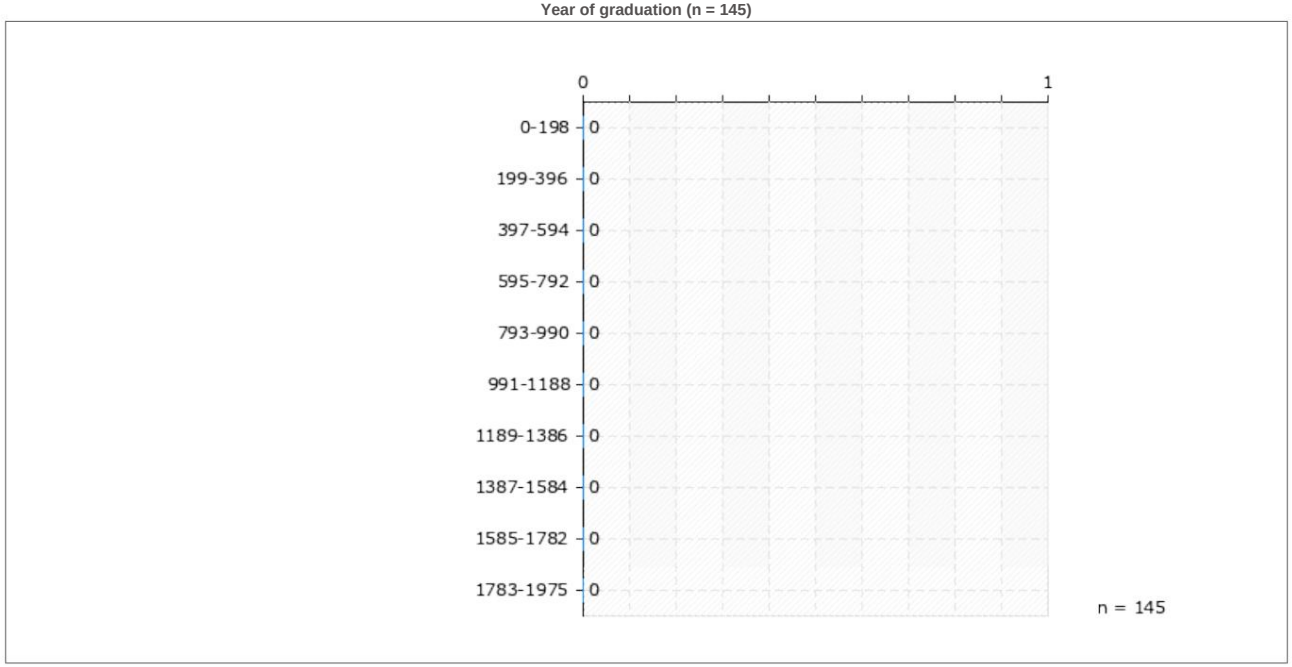
	fnm, mathematics	4	2%	31%	62%
	Faculty of Mathematics, University of Vienna, mathematics	1	1%	8%	69%
	fnm mind	1	1%	8%	77%
	Faculty of Electrical Engineering	1	1%	8%	85%
	fnm mind, mathematics	1	1%	8%	92%
	fmf, ul, mathematics	1	1%	8%	100%
Valid	Together	13	8%	100%	
Missing	-2 (Skip (if))	153	92%		
	Together	153	92%		
	TOGETHER	166	100%		

Indicate the faculty and field of study completed

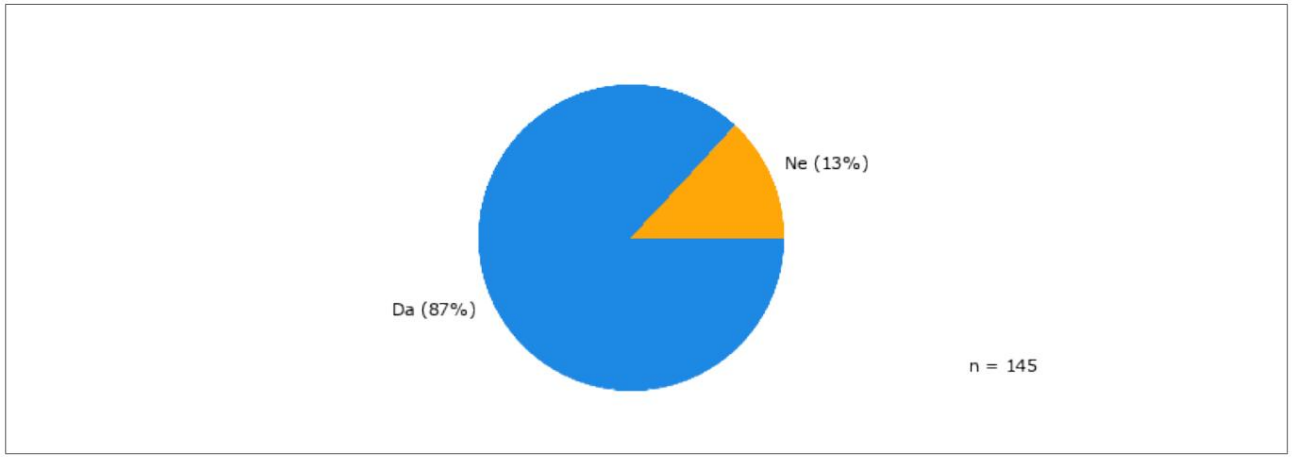
Q23	Indicate the faculty and field of study completed				
	Answer	Frequency	Percent	Valid	Cumulative
	fnm mb	1	1%	20%	20%
	fnm	1	1%	20%	40%
	fnm, non-pedagogical mathematics	1	1%	20%	60%
	fnm, non-pedagogical mathematics, level 7	1	1%	20%	80%
	fnm uni. B.Sc. a mathematician	1	1%	20%	100%
Valid	Together	5	3%	100%	
Missing	-2 (Skip (if))	161	97%		
	Together	161	97%		
	TOGETHER	166	100%		



Year of graduation (n = 145)



Do you think that the learning material that was given to you during school was adequate? (n = 145)



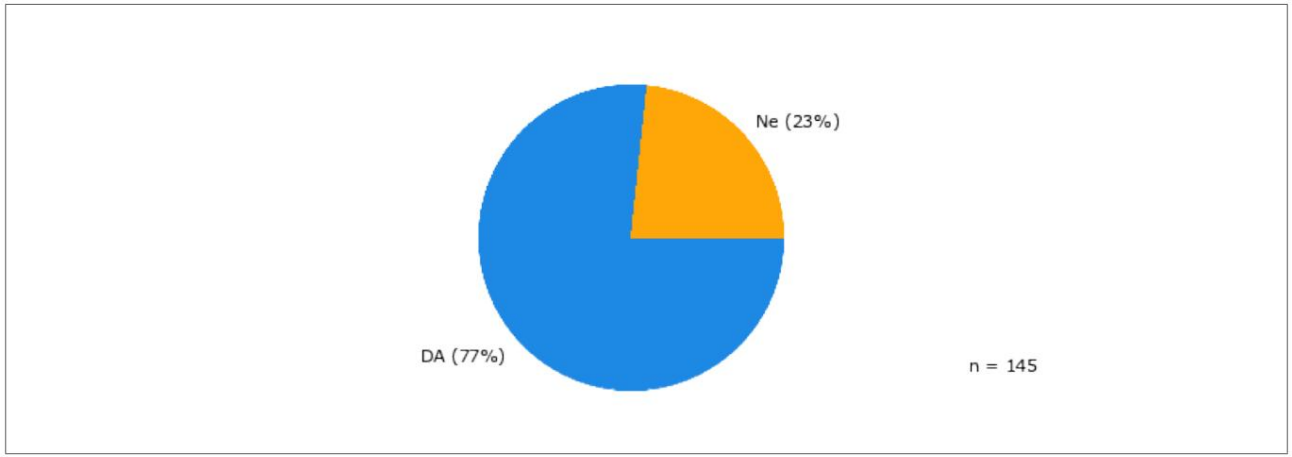
If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?

Q27	If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?				
	Answer	Frequency	Percent	Valid	Cumulative
	more knowledge you need as a classroom teacher	1	1%	5%	5%
	from the field, the real school market, but not from doctoral offices	1	1%	5%	11%
	too much mathematical view, not enough practical from the point of view of teaching	1	1%	5%	16%
	more practice, practical examples. although I appreciate it knowledge of analysis never used. but it would be good to do it in terms of technique more practical products for later teaching	1	1%	5%	21%
	e.g. computer science, is not keeping up with the times	1	1%	5%	26%
	for the teacher, there was too much emphasis on physics mafia, modern. but not enough on technique mechanical engineering, drawing, workshop work, practical skills. otherwise everything was within the limits of good. no urgent modification is required. but you have to go during school hours to schools several times. with didatkiki would had to start introducing students to children s special needs. is no longer alone adhd.we would also need a legal...	1	1%	5%	32%

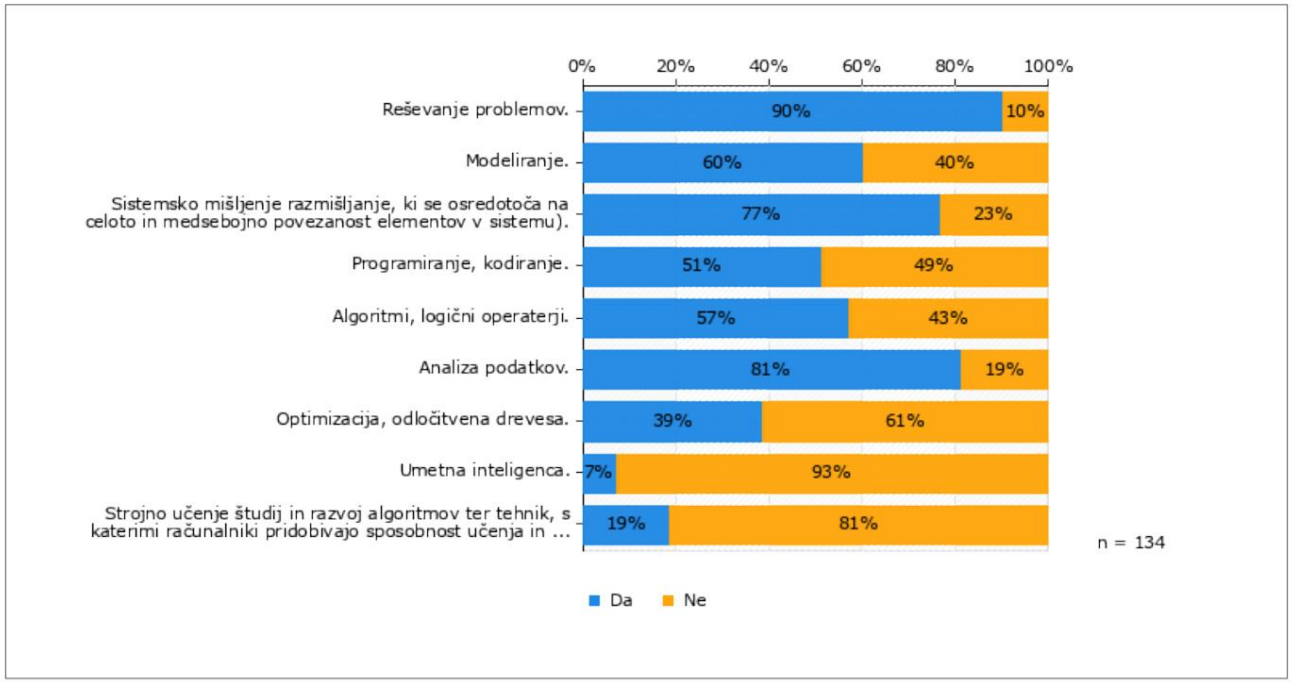
	more didactics, practice, regular hospitalizations teachers at schools, performances, newer methods or teaching methods (e.g. formative monitoring), discipline - concrete examples solving situations; students with pp- how to work with them, not only knowledge of theory... in short, more practice	1	1%	5%	37%
	certain subjects should be more challenging, e.g. biochemistry; fieldwork can only I commend it - it was really pleasant and useful here	1	1%	5%	42%
	eliminate - modern physics, mathematical methods in physics,	1	1%	5%	47%
	too much moodl.	1	1%	5%	53%
	more didactics and teaching practice, less in-depth tasks from analysis ii and more recently multimedia. less mathematical physics.	1	1%	5%	58%
	more content about nature conservation also for biologists	1	1%	5%	63%
	pedagogical, didactic, communication with parents, stress management	1	1%	5%	68%
	more practice	1	1%	5%	74%
	more practice, exclude modern physics, mathematical methods in physics	1	1%	5%	79%
	as for physics, she was up to par. in technique we didn't get enough ideas and knowledge of how to work with machines (3d printer, laser cutter, etc.) and enough of product ideas.	1	1%	5%	84%

	would need more content related to educational work and more emphasis on interdisciplinary connection. different types chemistry (e.g. physical and analytical) they use different labels in equations and different accents and it is difficult to understand it as a whole, meaningfully connect in the same brain.	1	1%	5%	89%
	I don't remember because I don't work in the field mathematics... but there was quite a lot in the analysis abstract things that are a little more difficult for me understood	1	1%	5%	95%
	in computing, more should be included current and useful content which would be more consecrated.	1	1%	5%	100%
Valid	Together	19	11%	100%	
Missing	-2 (Skip (if))	126	76%		
	-3 (Discontinued)	21	13%		
	Together	147	89%		
	TOGETHER	166	100%		

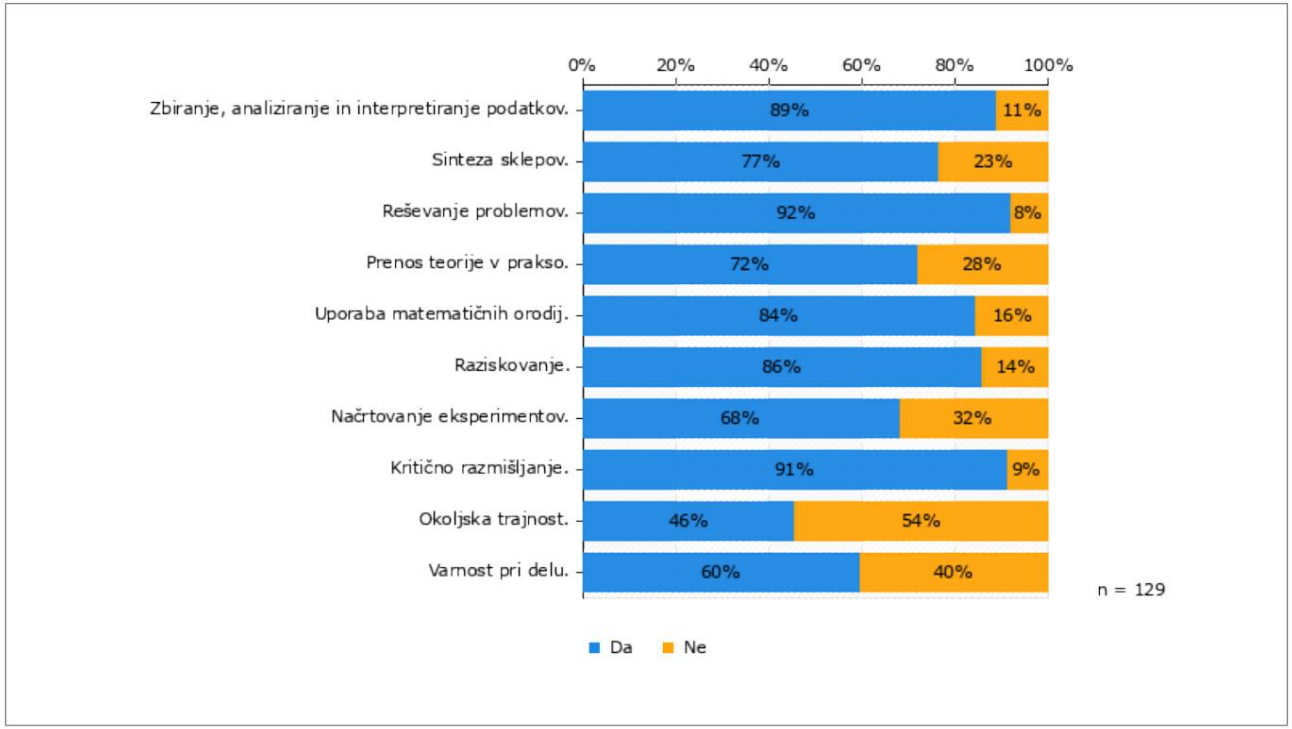
In practice, did you need the learning content that was given to you during your schooling? (n = 145)



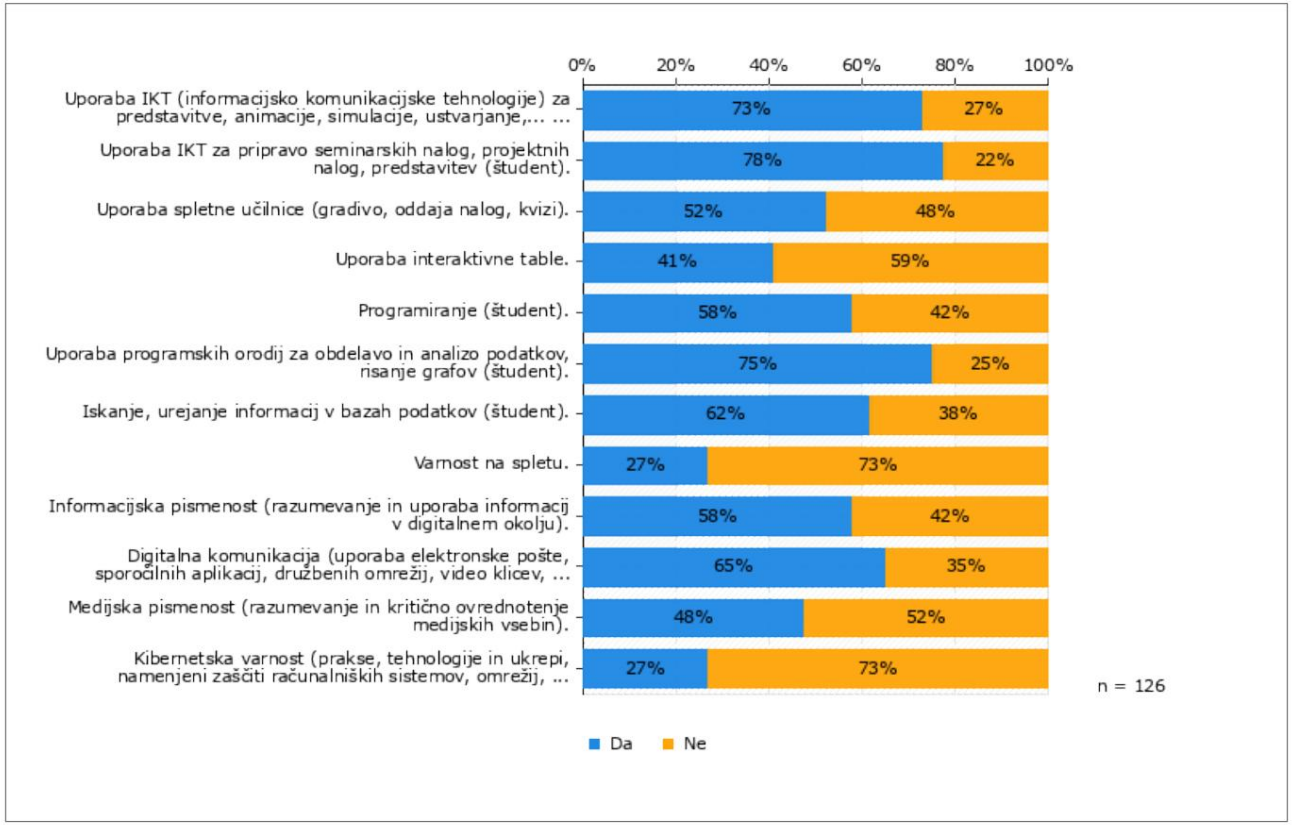
COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 134)



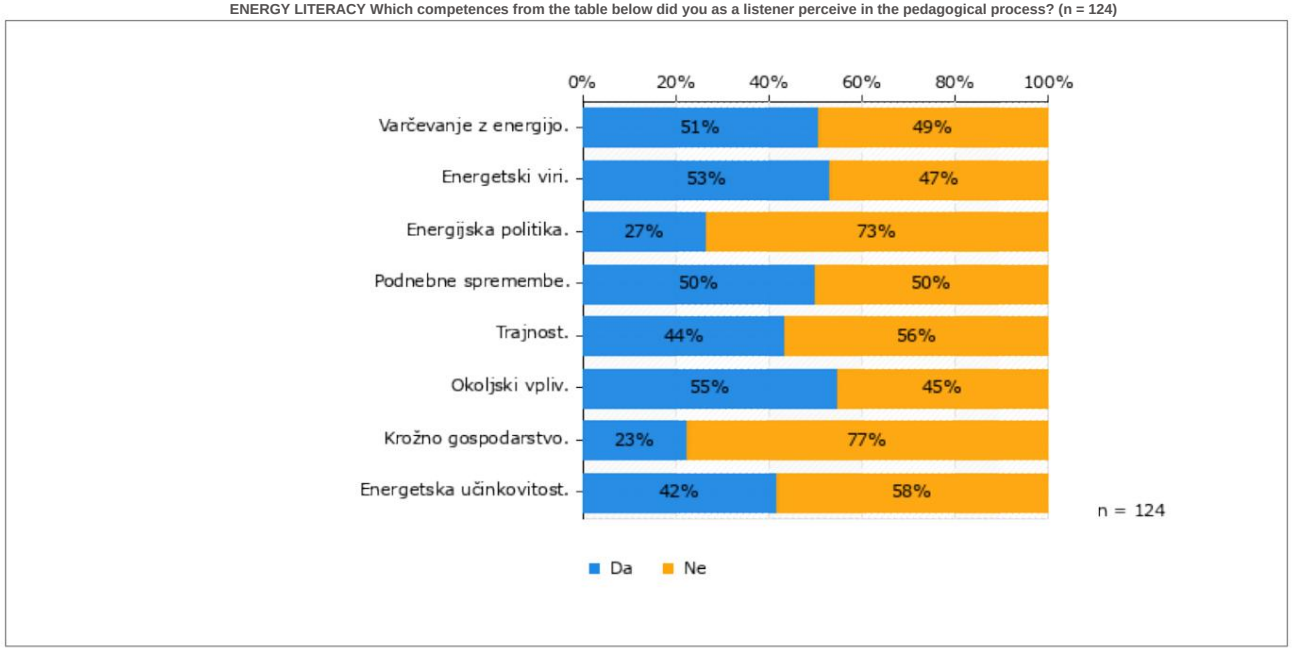
SCIENCE COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 129)



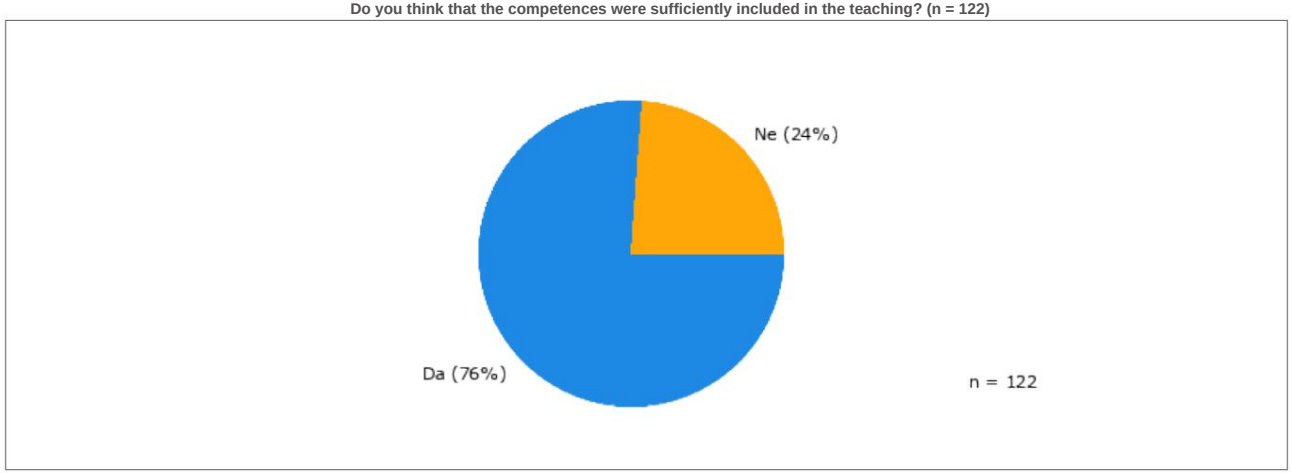
DIGITAL COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 126)



ENERGY LITERACY Which competences from the table below did you as a listener perceive in the pedagogical process? (n = 124)



Do you think that the competences were sufficiently included in the teaching? (n = 122)

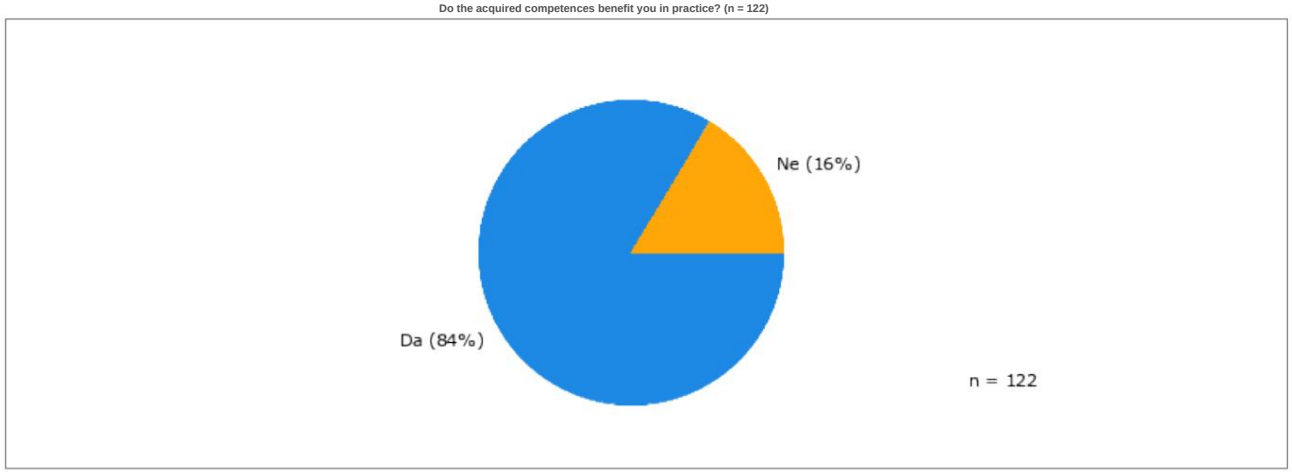


If not, which competences would you like or would like to be included to an even greater extent?

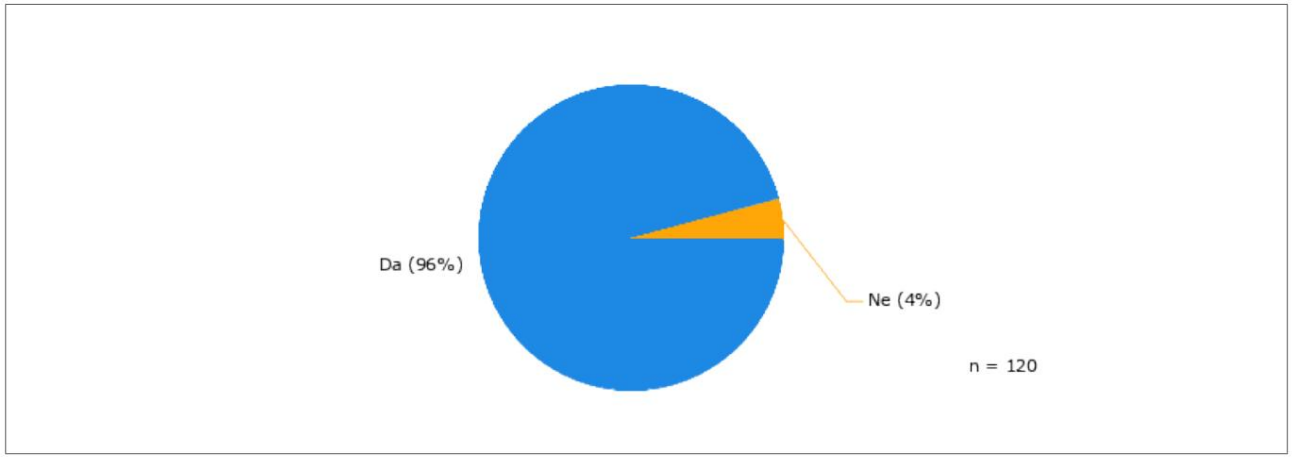
Q34	If not, which competences would you like or wish to be included to an even greater extent?				
	Answer	Frequency	Percent	Valid	Cumulative
	independent research	1	1%	3%	3%
	everyone	1	1%	3%	7%
	transfer of knowledge into practice	1	1%	3%	10%
	we should do more programming, modeling.	1	1%	3%	14%
	modeling	1	1%	3%	17%
	digital literacy	1	1%	3%	21%
	preparation of teacher documentation, rhetoric, solving educational situations, working with students s special needs	1	1%	3%	24%
	everything	1	1%	3%	28%
	dealing with actual situations rather than with something that is expected but does not exist or does not happen	1	1%	3%	31%
	evaluation of students' knowledge, cooperation with difficult parents, overcoming marriage nebulosis in education parents	1	1%	3%	34%
	practical work	1	1%	3%	38%
	all of the above, 2003 has not yet been mentioned spoke	1	1%	3%	41%
	problem solving	1	1%	3%	45%
	artificial intelligence	1	1%	3%	48%
	at the time of my studies, there was no internet and no development digital competences	1	1%	3%	52%
	linking content	1	1%	3%	55%
	design of experiments in the environment	1	1%	3%	59%

	lectures by a didacticist who is actually himself taught at school	1	1%	3%	62%
	design and execution of experiments	1	1%	3%	66%
	competences of the 21st century. teaching with assistance digital technologies. presentation of Danish model.	1	1%	3%	69%
	digital	1	1%	3%	72%
	mentioned in the survey. there are probably more now included in the program.	1	1%	3%	76%
	digital (not yet possible at the time)	1	1%	3%	79%
	work on projects, from inception (planning) to end (implementation, evaluation and reporting)	1	1%	3%	83%
	digital, ui	1	1%	3%	86%
	it was not in use at the time. all digital competencies.	1	1%	3%	90%
	practice	1	1%	3%	93%
	according to the above, you include at least in awareness current competences in stud. the process of this time. then I would have liked more time for critical discussion and exchange of views, for comparison experimental results. tick done is not relevant if I don't know why if not I can clearly see the experiments and results of the others. there could be much less varied content.	1	1%	3%	97%
	connection with practice, professions.	1	1%	3%	100%
Valid	Together	29	17%	100%	
Missing	-2 (Skip (if))	93	56%		
	-3 (Discontinued)	44	27%		

	Together	137	83%		
	TOGETHER	166	100%		



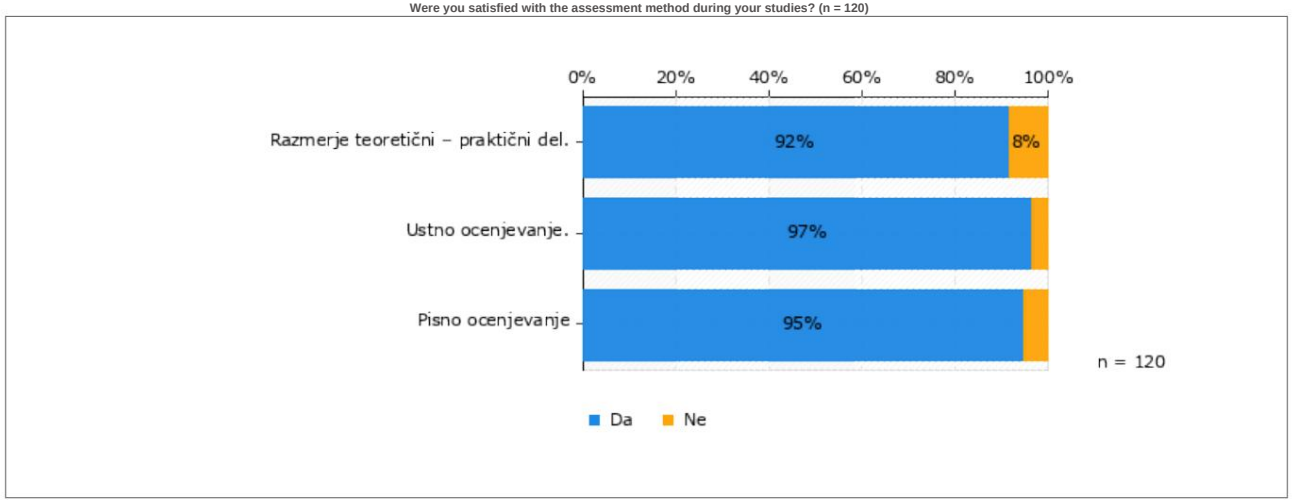
Do you think that the content was given to you in such a way that you were able to absorb the material? (n = 120)



If not, how do you think the delivery method could be improved?

Q37	If not, how do you think the delivery method could be improved?				
	Answer	Frequency	Percent	Valid	Cumulative
	as little frontal lecture as possible	1	1%	20%	20%
	especially at the undergraduate level, it was too much theoretical work.	1	1%	20%	40%
	rehearsals were a disaster - to be expected the student solved the task by himself, while there was no explanation	1	1%	20%	60%
	less content, more connecting, developing debates and problem solving. excited I was over the project work of my classmates physicists who received a passport that would be for professional work very useful.	1	1%	20%	80%
	with talented educators who are not necessarily talented professionals	1	1%	20%	100%
Valid	Together	5	3%	100%	
Missing	-2 (Skip (if))	115	69%		
	-3 (Discontinued)	46	28%		
	Together	161	97%		
	TOGETHER	166	100%		

Were you satisfied with the assessment method during your studies? (n = 120)

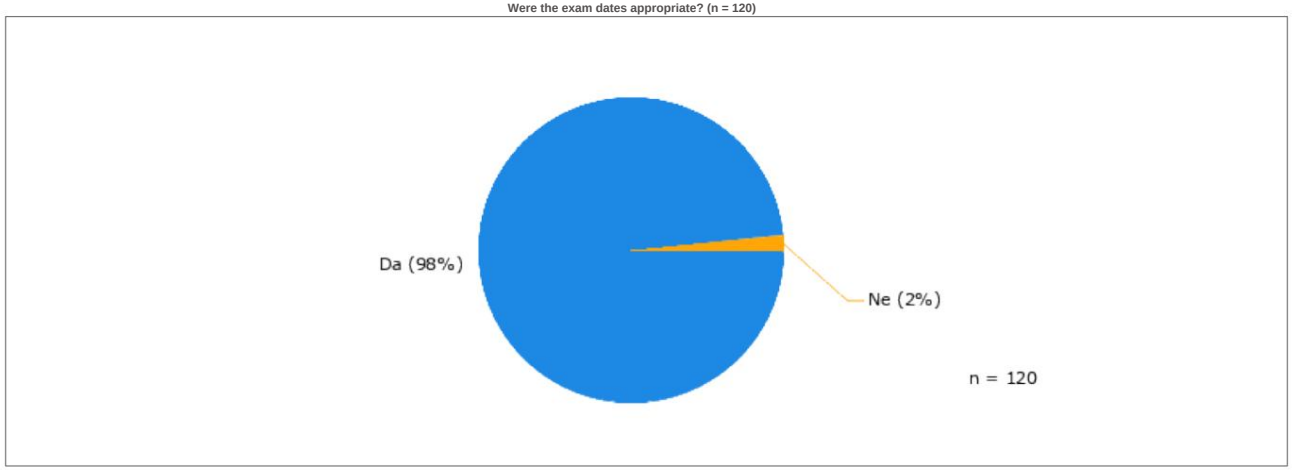


If not, how do you think you would be assessed more correctly (more objectively and fairly)?

Q39	If not, how do you think you would be assessed more correctly (more objectively and fairly)?				
	Answer	Frequency	Percent	Valid	Cumulative
	criteria are not enough for oral assessment clear (also in other educational institutions).	1	1%	9%	9%
	so that Mateja wouldn't sit on my head.	1	1%	9%	18%
	some subjects were evaluated as something, the content of what was written was not even looked at.	1	1%	9%	27%
	practical work was not assessed	1	1%	9%	36%

	there could be more practical work	1	1%	9%	45%
	/	1	1%	9%	55%
	certain professors did not have a suitable one evaluation.	1	1%	9%	64%
	assessment could also include innovative solutions to practical problems	1	1%	9%	73%
	more objectively	1	1%	9%	82%
	using the criteria specified in the following, according to options known to the student	1	1%	9%	91%
	part of the written assessment obtained in some other way than with a written exam (let's say with real-time liabilities)	1	1%	9%	100%
Valid	Together	11	7%	100%	
Missing	-1 (Did not answer)	2	1%		
	-2 (Skip (if))	107	64%		
	-3 (Discontinued)	46	28%		
	Together	155	93%		
	TOGETHER	166	100%		

Were the exam dates appropriate? (n = 120)



Why were the exam dates not suitable?

Q41	Why were the exam dates not suitable?				
	Answer	Frequency	Percent	Valid	Cumulative
	incompatibility with other fields of study, overlapping exam dates	1	1%	50%	50%
	during field exercises	1	1%	50%	100%
Valid	Together	2	1%	100%	
Missing	-2 (Skip (if))	118	71%		
	-3 (Discontinued)	46	28%		
	Together	164	99%		

	TOGETHER	166	100%		

ANALYSIS - SUMMARY

Q1	Which study program at FNM did you attend?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Pedagogical study program)	94	57%	57%	57%
	2 (Non-pedagogical study program)	72	43%	43%	100%
Valid	Together	166	100%	100%	

Q2	Which two orientations did you study on the subject teacher study program?							
	Sub questions	Units					Citations	
		Frequencies	Valid	% - Valid	Appropriate	% - Appropriate	Frequencies	%
Q2a	Educational biology	18	94	19%	166	11%	18	100%
Q2b	Educational physics	35	94	37%	166	21%	35	194%
Q2c	Educational chemistry	19	94	20%	166	11%	19	106%
Q2d	Educational mathematics	45	94	48%	166	27%	45	250%
Q2e	Educational computer science	15	94	16%	166	9%	15	83%
Q2f	Educational technique	24	94	26%	166	14%	24	133%
	TOGETHER		94		166		18	100%

Q3	What level of study did you complete at FNM UM?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Level 1)	8	5%	9%	9%
	2 (Level 2)	43	26%	48%	57%
	3 (Level 3)	10	6%	11%	68%
	4 (Other)	29	17%	32%	100%
Valid	Together	90	54%	100%	

Average	2.7	Std. deflection	1.0

Q4	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Biology)	3	2%	38%	38%
	2 (Ecology with nature conservation)	0	0%	0%	38%
	3 (Physics)	2	1%	25%	63%
	4 (Mathematics)	3	2%	38%	100%
Valid	Together	8	5%	100%	

Average	2.6	Std. deflection	1.4

Q5	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Biology and Ecology with nature conservation)	1	1%	2%	2%

	2 (Physics)	10	6%	24%	26%
	3 (Educational technology)	2	1%	5%	31%
	4 (Educational mathematics)	6	4%	14%	45%
	5 (Mathematics)	5	3%	12%	57%
	6 (Subject teacher)	18	11%	43%	100%
Valid	Together	42	25%	100%	

Average	4.4	Std. deflection	1.7

Q6	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Ecological Sciences)	2	1%	20%	20%
	2 (Physics)	5	3%	50%	70%
	3 (Mathematics)	2	1%	20%	90%
	4 (Technology - field education)	1	1%	10%	100%
Valid	Together	10	6%	100%	

Average	2.2	Std. deflection	0.9

Q7	Which study program did you complete?
	old university program mathematics and computer science
	university (old)
	old uni
	pedagogy and chemistry, 2nd level
	double major
	mathematics and ...
	university program
	computer science with mathematics uni
	Level 2 Educational Biology and Educational Chemistry
	university study program / double major mathematics
	professor of biology and chemistry
	uni - double major
	double subject no. mathematics and computer science
	old university program
	double-subject study program mathematics and technology (old)
	double-subject study of mathematics and physics
	university, 7th level
	last generation uni star system
	are you asking before or after the Bologna renovation? so the first pre-bolognese stage, which kind of corresponds to the 2nd bolognese, right? :)
	uni - professor of physics
	fi-pthv
	4 year old
	Phys
	single subject mathematics - uni
	university (before the Bologna system)
	biology and ...
	university

Q8	What level of study have you completed in general?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Level 1)	7	4%	7%	7%
	2 (Level 2)	45	27%	48%	55%
	3 (Level 3)	17	10%	18%	73%
	4 (Other)	25	15%	27%	100%
Valid	Together	94	57%	100%	

Average	2.6	Std. deflection	1.0

Q9	Indicate the faculty and field of study completed
	fnm
	physics and computer science fnm
	fnm professor of biology and computer science
	fnm, educational mathematics and educational technology
	pef/fnm (non-Bologna studies) - the time when pef disbanded
	um faculty of pedagogy, department of physics and mathematics
	mind fnm, isob. mat. and isob. those.

Q10	Indicate the faculty and field of study completed
	mind
	fnm, mat-raÿ
	fnm
	you will probably know
	fnm, single subject mathematics
	natural sciences major physics -pthv
	faculty of pedagogy, mathematics and physics, later one more subject mathematics
	fnm, mat. and rach.
	ghhhh
	fnm
	fnm - physics
	fnm, one-subject pedagogical mathematics
	fnm, educational biology and educational chemistry
	you can probably tell from the previous answers.
	Faculty of Mathematics, Physics and Mathematics
	Faculty of Natural Sciences
	fnm mind
	physics
	fnm, educational mathematics and biology
	faculty of pedagogy (before division), double major chemistry and mathematics
	fnm, biology and chemistry
	fnm, biology and philosophy
	fnm, fi pthv
	educational bio and chemistry
	fnm, prof mat
	Faculty of Science and Mathematics
	pef inclusion in education
	fnm - chemistry and..., - pedagogy and...
	faculty of pedagogy - physics - technology
	Faculty of Pedagogy, Physics and Technology

Q11	Indicate the faculty and field of study completed
	fnm, physics
	Faculty of Science and Mathematics, Physics
	fnm - educational technique
	fnm mathematics
	fnm biology
	fnm mind, ecological sciences
	Faculty of Education; mathematics
	feri um - ass
	Maribor Faculty of Education, Physics and Technology
	Faculty of Science and Mathematics
	ul ntf, chemical education
	fnm physics
	fnm biology, chemistry
	epf um, economic and business sciences

Q12	Indicate the faculty and field of study completed
	fnm and , biology-geography
	single subject mathematics - uni
	fnm, biology and chemistry
	pef mb double subject mathematics
	faculty of natural sciences and mathematics, professor of mathematics
	pedagogy, then fnm, majoring in bio-chem
	feri informatics full-time + fnm educational technology part-time
	fnm, mat and rac
	university study program (before Bologna)
	fnm - old program
	fnm, professor of mathematics (university)
	uni - professor of physics
	fnm, major: mathematics and computer science
	fnm. engineering and mathematics
	the answer is the same as the previous one. fnm.
	fnm chemistry - biology
	Professor of Mathematics and Physics, Old Pedagogical Faculty, Maribor
	fnm, major: chemistry-physics
	faculty of pedagogy, computer science with mathematics
	pef mb - away
	fm koper, master of science
	fnm, mat-raÿ
	fnm and um, professor of mathematics and Slovenian language with literature
	fnm

Q13	What university program did you study?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Biology)	12	7%	17%	17%
	2 (Ecology with nature conservation)	15	9%	21%	38%
	3 (Physics)	12	7%	17%	54%
	4 (Mathematics)	33	20%	46%	100%
Valid	Together	72	43%	100%	

Average	2.9	Std. deflection	1,2

Q14	What level of study did you complete at FNM UM?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Level 1)	26	16%	36%	36%
	2 (Level 2)	35	21%	48%	84%
	3 (Level 3)	6	4%	8%	92%
	4 (Other)	6	4%	8%	100%
Valid	Together	73	44%	100%	

Average	1.9	Std. deflection	0.9

Q15	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Biology)	9	5%	35%	35%
	2 (Ecology with nature conservation)	7	4%	27%	62%
	3 (Physics)	3	2%	12%	73%
	4 (Mathematics)	7	4%	27%	100%
Valid	Together	26	16%	100%	

Average	2,3	Std. deflection	1,2

Q16	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Biology and Ecology with nature conservation)	11	7%	31%	31%
	2 (Physics)	9	5%	26%	57%
	3 (Educational Mathematics)	1	1%	3%	60%
	4 (Educational technology)	0	0%	0%	60%
	5 (Mathematics)	14	8%	40%	100%
	6 (Subject teacher)	0	0%	0%	100%
Valid	Together	35	21%	100%	

Average	2.9	Std. deflection	1.8

Q17	Which study program did you complete?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Ecological Sciences)	0	0%	0%	0%
	2 (Physics)	1	1%	17%	17%
	3 (Mathematics)	5	3%	83%	100%
	4 (Technology - field education)	0	0%	0%	100%
Valid	Together	6	4%	100%	

Average	2.8	Std. deflection	0.4

Q18	Which study program did you complete?
	mathematics - Non-Bolonic

	non-pedagogical mathematics
	single subject non-pedagogical mathematics
	single-subject non-pedagogical study program in mathematics
	pre-Bologna university

Q19	What level of study have you completed in general?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Level 1)	20	12%	27%	27%
	2 (Level 2)	35	21%	48%	75%
	3 (Level 3)	13	8%	18%	93%
	4 (Other)	5	3%	7%	100%
Valid	Together	73	44%	100%	

Average	2.0	Std. deflection	0.9

Q20	Indicate the faculty and field of study completed
	fnm, ecology with nature conservation
	fnm physics
	fnm biology
	Faculty of Education ; single subject mathematics
	biology, fnm mb
	fnm, general mathematics
	faculty of natural sciences and mathematics, majoring in biology
	fnm, physics
	fnm, mathematics (single subject)
	fnm ecology with nature conservation
	fnm mathematics
	fnm, 2021
	Faculty of Science and Mathematics, Biology
	fnm mind math
	fnm - ecology with nature conservation
	fnm
	faculty of natural sciences and mathematics, major in mathematics

Q21	Indicate the faculty and field of study completed
	fnm, educational mathematics
	single subject non-pedagogical mathematics
	Faculty of Science and Mathematics, Physics
	fnm, mathematics
	fnm, biology and ecology with nature conservation
	Faculty of Biotechnology, Molecular and Functional Biology
	fnm mb biology and ecology with nature conservation
	faculty of natural sciences and mathematics - biology and ecology with nature conservation
	fnm mathematics (financial/computing)
	fnm um, majoring in biology and ecology with nature conservation
	faculty of natural sciences and mathematics, biology and ecology with nature conservation
	fnm
	biotechnical faculty, university of lj, microbiology
	non-pedagogical mathematics
	biotechnical, ecology and biodiversity

	fnm mathematics
	fnm, major: biology and ecology with nature conservation
	Faculty of Science and Mathematics, Maribor, Physics, 2nd level
	faculty of natural sciences and mathematics mind, physics, 2nd level
	fnm, financial mathematics
	biotechnical faculty, functional and molecular biology
	fs, technical environmental protection
	Faculty of Science and Mathematics
	fnm, mathematics, financial mathematics
	fnm mind

Q22	Indicate the faculty and field of study completed
	fachbereich physik, philipps-universität marburg, physics
	mps
	Jožef Stefan International Postgraduate School
	ferries, electrical engineering
	fnm, mathematics
	Faculty of Mathematics, University of Vienna, Mathematics
	fnm mind
	Faculty of Electrical Engineering
	fnm mind, mathematics
	fmf, ul, mathematics

Q23	Indicate the faculty and field of study completed
	fnm mb
	fnm
	fnm, non-pedagogical mathematics
	fnm, non-pedagogical mathematics, level 7
	fnm uni. B.Sc. a mathematician

Q24 Year of enrollment in the first year

Answer	Frequency	Percent	Valid	Cumulative
1 (2023)	1	1%	1%	1%
2 (2022)	0	0%	0%	1%
3 (2021)	0	0%	0%	1%
4 (2020)	4	2%	3%	3%
5 (2019)	4	2%	3%	6%
6 (2018)	4	2%	3%	9%
7 (2017)	3	2%	2%	11%
8 (2016)	5	3%	3%	14%
9 (2015)	2	1%	1%	16%
10 (2014)	4	2%	3%	19%
11 (2013)	1	1%	1%	19%
12 (2012)	4	2%	3%	22%
13 (2011)	5	3%	3%	26%
14 (2010)	10	6%	7%	32%
15 (2009)	8	5%	6%	38%
16 (2008)	17	10%	12%	50%
17 (2007)	8	5%	6%	55%
18 (2006)	9	5%	6%	61%
19 (2005)	10	6%	7%	68%

	20 (2004)	9	5%	6%	74%
	21 (2003)	7	4%	5%	79%
	22 (2002)	2	1%	1%	81%
	23 (2001)	2	1%	1%	82%
	24 (2000)	3	2%	2%	84%
	25 (1999)	3	2%	2%	86%
	26 (1998)	2	1%	1%	88%
	27 (1997)	1	1%	1%	88%
	28 (1996)	2	1%	1%	90%
	29 (1995)	2	1%	1%	91%
	30 (1994)	2	1%	1%	92%
Valid	Together	145	87%	100%	

Q25	Year of completion of studies				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (2023)	6	4%	4%	4%
	2 (2022)	16	10%	11%	15%
	3 (2021)	6	4%	4%	19%
	4 (2020)	3	2%	2%	21%
	5 (2019)	7	4%	5%	26%
	6 (2018)	5	3%	3%	30%
	7 (2017)	6	4%	4%	34%
	8 (2016)	10	6%	7%	41%
	9 (2015)	7	4%	5%	46%
	10 (2014)	11	7%	8%	53%
	11 (2013)	12	7%	8%	61%
	12 (2012)	8	5%	6%	67%
	13 (2011)	10	6%	7%	74%
	14 (2010)	6	4%	4%	78%
	15 (2009)	4	2%	3%	81%
	16 (2008)	4	2%	3%	83%
	17 (2007)	2	1%	1%	85%
	18 (2006)	2	1%	1%	86%
	19 (2005)	5	3%	3%	90%
	20 (2004)	2	1%	1%	91%
	21 (2003)	1	1%	1%	92%
	22 (2002)	2	1%	1%	93%
	23 (2001)	0	0%	0%	93%
	24 (2000)	1	1%	1%	94%
	25 (1999)	2	1%	1%	95%
	26 (1998)	0	0%	0%	95%
	27 (1997)	1	1%	1%	96%
	28 (1996)	1	1%	1%	97%
	29 (1995)	3	2%	2%	99%
	30 (1994)	0	0%	0%	99%
Valid	Together	145	87%	100%	

Q26	Do you think that the learning material that was given to you during school was adequate?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	126	76%	87%	87%
	2 (No)	19	11%	13%	100%
Valid	Together	145	87%	100%	

Average	1.1	Std. deflection	0.3

Q27	If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?
	more knowledge you need as a classroom teacher
	from the field, the real school market, but not from doctor's offices
	too much of a mathematical view, not enough of a practical one from a teaching point of view
	more practice, practical examples. although I appreciate the knowledge of analysis, I will never use it in mat lessons. and in the technique, it would be good to make more practical products for later teaching
	e.g. computer science, is not keeping up with the times
	for a teacher, the emphasis in physics was too much on the mob, the modern. in technology, but not enough in mechanical engineering, drawing, work in the workshop, practical skills. otherwise, everything was within the limits of the coast. no urgent modification is required. but it is necessary to go to school lessons several times. in didatkiki, they should start introducing students to children with special needs. is no longer alone adhd.we would also need a legal...
	more didactics, practice, regular visits by teachers at schools, performances, newer methods or teaching methods (e.g. formative monitoring), discipline - concrete examples of solutions situations; students with pp- how to work with them, not just knowledge of theory... in short, more practice
	certain subjects should be more challenging, e.g. biochemistry; I can only praise the field work - here it was really pleasant and useful
	eliminate - modern physics, mathematical methods in physics,
	too much moodl.
	more didactics and teaching practice, less in-depth analysis ii tasks and more up-to-date multimedia. less mathematical physics.
	more content about nature conservation also for biologists
	pedagogical, didactic, communication with parents, stress management
	more practice
	more practice, exclude modern physics, mathematical methods in physics
	as for physics, she was up to par. in terms of technology, we did not get enough ideas and knowledge of how to work with machines (3d printer, laser cutter, etc.) and enough ideas for products.
	it would need more content related to educational work and more emphasis on interdisciplinary integration. different types of chemistry (e.g. physical and analytical) use different labels in equations and different emphases and it is difficult to understand it holistically, to connect it meaningfully in the same brain.
	I don't remember, because I don't work in the field of mathematics... but in the analysis there were quite a few abstract things that I found a little more difficult to understand
	in computer science, more up-to-date and useful content should be included, to which more attention should be paid.

Q28	In practice, did you need the learning content that was given to you during your schooling?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (YES)	111	67%	77%	77%
	2 (No)	34	20%	23%	100%
Valid	Together	145	87%	100%	

Average	1,2	Std. deflection	0.4

Q29	COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING Which competencies from the table below did you as a listener perceive in the pedagogical process?							
	Sub questions	Answer			Valid	No. units	Average	Std. deflection
		Yes	No	Together				
Q29a	Problem solving.	121 (90%)	13 (10%)	134 (100%)	134	166	1.1	0.3
Q29b	Modeling.	81 (60%)	53 (40%)	134 (100%)	134	166	1.4	0.5
Q29c	Systems thinking thinking that focuses as a whole and mutually connection of elements in system).	103 (77%)	31 (23%)	134 (100%)	134	166	1,2	0.4
Q29d	Programming, coding.	69 (51%)	65 (49%)	134 (100%)	134	166	1.5	0.5
Q29e	Algorithms, logical operators.	77 (57%)	57 (43%)	134 (100%)	134	166	1.4	0.5
Q29f	Data analysis.	109 (81%)	25 (19%)	134 (100%)	134	166	1,2	0.4
Q29g	Optimization, decisive trees.	52 (39%)	82 (61%)	134 (100%)	134	166	1.6	0.5
Q29h	Artificial intelligence.	10 (7%)	124 (93%)	134 (100%)	134	166	1.9	0.3

Q29i	Machine learning studies and development algorithms and techniques with which computers acquire the ability to learn and improve performance based on experience and data).	25 (19%)	109 (81%)	134 (100%)	134	166	1.8	0.4

Q30	SCIENCE COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process?							
	Sub questions	Answer			Valid	No. units	Average	Std. deflection
		Yes	No	Together				
Q30a	Collecting, analyzing and interpreting data.	115 (89%)	14 (11%)	129 (100%)	129	166	1.1	0.3
Q30b	Synthesis of conclusions.	99 (77%)	30 (23%)	129 (100%)	129	166	1,2	0.4
Q30c	Problem solving.	119 (92%)	10 (8%)	129 (100%)	129	166	1.1	0.3
Q30d	Transferring theory into practice.	93 (72%)	36 (28%)	129 (100%)	129	166	1.3	0.5
Q30e	Using mathematical tools.	109 (84%)	20 (16%)	129 (100%)	129	166	1,2	0.4
Q30f	Researching.	111 (86%)	18 (14%)	129 (100%)	129	166	1.1	0.3
Q30g	Design of experiments.	88 (68%)	41 (32%)	129 (100%)	129	166	1.3	0.5
Q30h	Critical thinking.	118 (91%)	11 (9%)	129 (100%)	129	166	1.1	0.3
Q30i	Environmental sustainability.	59 (46%)	70 (54%)	129 (100%)	129	166	1.5	0.5
Q30j	Safety at Work.	77 (60%)	52 (40%)	129 (100%)	129	166	1.4	0.5

Q31	DIGITAL COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process?							
	Sub questions	Answer			Valid	No. units	Average	Std. deflection
		Yes	No	Together				
Q31a	Use of ICT (information communication technology) for presentations, animations, simulations, creation,... (lecturer).	92 (73%)	34 (27%)	126 (100%)	126	166	1.3	0.4
Q31b	Use of ICT for the preparation of seminars assignments, project assignments, presentations (student).	98 (78%)	28 (22%)	126 (100%)	126	166	1,2	0.4
Q31c	Using the online classroom (materials, assignments, quizzes).	66 (52%)	60 (48%)	126 (100%)	126	166	1.5	0.5
Q31d	Using an interactive whiteboard.	52 (41%)	74 (59%)	126 (100%)	126	166	1.6	0.5
Q31e	Programming (student).	73 (58%)	53 (42%)	126 (100%)	126	166	1.4	0.5
Q31f	Use of software tools for data processing and analysis, drawing of graphs (student).	95 (75%)	31 (25%)	126 (100%)	126	166	1,2	0.4
Q31g	Searching, editing information in databases data (student).	78 (62%)	48 (38%)	126 (100%)	126	166	1.4	0.5
Q31h	Safety online.	34 (27%)	92 (73%)	126 (100%)	126	166	1.7	0.4
Q31i	Information literacy (understanding and use of information in a digital environment).	73 (58%)	53 (42%)	126 (100%)	126	166	1.4	0.5
Q31j	Digital communication (use e-mail, messaging applications, social networks, video calls, forums).	82 (65%)	44 (35%)	126 (100%)	126	166	1.3	0.5
Q31k	Media literacy (understanding and critical evaluation of media all-bin).	60 (48%)	66 (52%)	126 (100%)	126	166	1.5	0.5
Q31l	Cyber security technology and (practices, measures aimed at protection of computer systems, networks, data).	34 (27%)	92 (73%)	126 (100%)	126	166	1.7	0.4

Q32	ENERGY LITERACY Which competences from the table below did you as a listener perceive in the pedagogical process?							
	Sub questions	Answer			Valid	No. units	Average	Std. deflection
		Yes	No	Together				

Q32a	Energy saving.	63 (51%)	61 (49%)	124 (100%)	124	166	1.5	0.5
Q32b	Energy resources.	66 (53%)	58 (47%)	124 (100%)	124	166	1.5	0.5
Q32c	Energy policy.	33 (27%)	91 (73%)	124 (100%)	124	166	1.7	0.4
Q32d	Climate change.	62 (50%)	62 (50%)	124 (100%)	124	166	1.5	0.5
Q32e	Durability.	54 (44%)	70 (56%)	124 (100%)	124	166	1.6	0.5
Q32f	Environmental impact.	68 (55%)	56 (45%)	124 (100%)	124	166	1.5	0.5
Q32g	Circular economy.	28 (23%)	96 (77%)	124 (100%)	124	166	1.8	0.4
Q32h	Energy efficiency.	52 (42%)	72 (58%)	124 (100%)	124	166	1.6	0.5

Q33	Do you think that the competences were sufficiently included in the teaching?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	93	56%	76%	76%
	2 (No)	29	17%	24%	100%
Valid	Together	122	73%	100%	

Average	1,2	Std. deflection	0.4

Q34	If not, which competences would you like or would like to be included to an even greater extent?
	independent research
	everyone
	transfer of knowledge into practice
	we should do more programming, modeling.
	modeling
	digital literacy
	preparation of teacher documentation, rhetoric, solving educational situations, working with students with special needs
	everything
	dealing with actual situations rather than with something that is expected but does not exist or does not happen
	evaluation of students' knowledge, cooperation with difficult parents, overcoming marital nebulae in education parents
	practical work
	all of the above, in 2003 it was not talked about yet
	problem solving
	artificial intelligence
	at the time of his studies there was no Internet and no development of digital competences
	linking content
	design of experiments in the environment
	lectures by a didacticist who actually taught at the school himself
	design and execution of experiments
	competences of the 21st century. teaching with the help of digital technology. presentation of the Danish model.
	digital
	mentioned in the survey. they are probably already more involved in the program now.
	digital (not yet possible at the time)
	work on projects, from the beginning (planning) to the end (implementation, evaluation and reporting)
	digital, ui
	it was not in use at the time. all digital competences.
	practice
	in view of the above, at least in your awareness you include current competences in your studies. the process of this time. then I would like more time for critical discussion and exchange of opinions, for comparison experimental results. the done check mark is not relevant if I don't know why, if I can't clearly see the attempts and results of the others. there could be much less varied content.
	connection with practice, professions.

Q35	Do the acquired competences benefit you in practice?				
	Answer	Frequency	Percent	Valid	Cumulative

	1 (Yes)	102	61%	84%	84%
	2 (No)	20	12%	16%	100%
Valid	Together	122	73%	100%	

Average	1,2	Std. deflection	0.4

Q36	Do you think that the content was given to you in such a way that you were able to absorb the material?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	115	69%	96%	96%
	2 (No)	5	3%	4%	100%
Valid	Together	120	72%	100%	

Average	1.0	Std. deflection	0.2

Q37	If not, how do you think the delivery method could be improved?
	as little frontal lecture as possible
	especially at the undergraduate level, there was too much theoretical work.
	the exercises were a disaster - expecting the student to solve the task by himself, while there was no explanation
	less content, more connecting, developing debate and solving problems. I was impressed by the project work of my fellow physicists, who received a travel card that would be very useful for my professional work.
	with talented educators who are not necessarily talented professionals

Q38	Were you satisfied with the assessment method during your studies?							
	Sub questions	Answer			Valid	No. units	Average	Std. deflection
		Yes	No	Together				
Q38a	The relationship between the theoretical and practical part.	110 (92%)	10 (8%)	120 (100%)	120	166	1.1	0.3
Q38b	Oral exam.	116 (97%)	4 (3%)	120 (100%)	120	166	1.0	0.2
Q38c	Written assessment	114 (95%)	6 (5%)	120 (100%)	120	166	1.1	0.2

Q39	If not, how do you think you would be assessed more correctly (more objectively and fairly)?
	the criteria for oral assessment are not clear enough (also in other educational institutions).
	so that Mateja wouldn't sit on my head.
	in some subjects, quite a lot was evaluated, the content of what was written was not even looked at.
	practical work was not assessed
	there could be more practical work
	/
	certain professors did not have appropriate evaluation.
	assessment could also include innovative solutions to practical problems
	more objectively
	using pre-determined criteria, preferably known to the student
	part of the written assessment was obtained in some other way than with a written exam (say with ongoing obligations)

Q40	Were the exam dates appropriate?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	118	71%	98%	98%
	2 (No)	2	1%	2%	100%
Valid	Together	120	72%	100%	

Average	1.0	Std. deflection	0.1

Q41	Why were the exam dates not suitable?
	inconsistency with other fields of study, overlap of exam dates
	during field exercises

APPENDIX 6: RESULTS OF THE SURVEY QUESTIONNAIRE FOR FGPA UM GRADUATES - summary with graphs

ANALYSIS - FREQUENCY

Q1	In which study program did you study?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (construction UN program)	3	50%	50%	50%
	2 (construction VS program)	3	50%	50%	100%
Valid	Together	6	100%	100%	

Q2	Year of enrollment in the first year				
	Answer	Frequency	Percent	Valid	Cumulative
	2010	1	17%	17%	17%
	2011	2	33%	33%	50%
	2013	1	17%	17%	67%
	2008	1	17%	17%	83%
	2009	1	17%	17%	100%
Valid	Together	6	100%	100%	

Q3	Year of completion of studies (graduation):				
	Answer	Frequency	Percent	Valid	Cumulative
	2015	2	33%	33%	33%
	2016	4	67%	67%	100%
Valid	Together	6	100%	100%	

Q4	Do you think that the learning material that was given to you during school was adequate? Was the content that you needed during your studies or later in practice provided?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	

Q5	If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?				
	Answer	Frequency	Percent	Valid	Cumulative
	no construction history required, geometric modeling (prefer what program). otherwise everything useful	1	17%	33%	33%
	not enough concrete things, v overall ok	1	17%	33%	67%
	it was not suitable for the practical part in employment, it is expected knowledge of using programs	1	17%	33%	100%
Valid	Together	3	50%	100%	

Q6	DIGITAL COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process?				
	Answer	Frequency	Percent	Valid	Cumulative
Q6a	Use of ICT (information communication technologies) for presentations, animations, simulations, creation,... (lecturer).				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%

Valid	Together	6	100%	100%	
Q6b	Use of ICT for preparation seminar assignments, projects assignment, presentation (student).				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q6c	Using the online classroom (material, assignments, quizzes).				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q6d	Using an interactive whiteboard.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	
Q6e	Programming (student).				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q6f	Using software tools for data processing and analysis, drawing graphs (student).				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q6g	Searching, editing information in databases (student).				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q6h	Safety online.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	
Q6i	Information literacy (understanding and application information in the digital environment).				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q6j	Digital communication (use of e-mail, messaging apps, social networks, video calls, forums).				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q6k	Media literacy (understanding and critical media evaluation contents).				
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	
Q6l	Cyber security (practices, technologies and measures, intended for computer protection systems, networks, data).				
	1 (Yes)	2	33%	33%	33%

	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	

Q7	COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING Which competencies from the table below did you as a listener perceive in the pedagogical process?				
	Answer	Frequency	Percent	Valid	Cumulative
Q7a	Problem solving.				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q7b	Modeling.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q7c	Systems thinking thinking that focuses as a whole and mutually connection of elements in system).				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q7d	Programming, coding.				
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	
Q7e	Algorithms, logical operators.				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q7f	Data analysis.				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q7g	Optimization, decision-making trees.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	
Q7h	Artificial intelligence.				
	1 (Yes)	0	0%	0%	0%
	2 (No)	6	100%	100%	100%
Valid	Together	6	100%	100%	
Q7i	Machine learning studies and development algorithms and techniques, s which computers they acquire the ability to learn and performance improvements on based on experience and data).				
	1 (Yes)	0	0%	0%	0%
	2 (No)	6	100%	100%	100%
Valid	Together	6	100%	100%	

Q8	SCIENCE COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process?				
	Answer	Frequency	Percent	Valid	Cumulative
Q8a	Collecting, analyzing and interpreting the data.				

	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q8b	Synthesis of conclusions.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q8c	Problem solving.				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q8d	Transferring theory into practice.				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q8e	Using mathematical tools.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q8f	Researching.				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q8 Mr	Design of experiments.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q8h	Critical thinking.				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q8i	Environmental sustainability.				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q8j	Safety at Work.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	

Q9	ENERGY LITERACY Which competences from the table below did you as a listener perceive in the pedagogical process?				
	Answer	Frequency	Percent	Valid	Cumulative
Q9a	Energy saving.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	
Q9b	Energy resources.				
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	
Q9c	Energy policy.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%

Valid	Together	6	100%	100%	
Q9d	Climate change.				
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	
Q9e	Durability.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q9f	Environmental impact.				
	1 (Yes)	4	67%	67%	67%
	2 (No)	2	33%	33%	100%
Valid	Together	6	100%	100%	
Q9g	Circular economy.				
	1 (Yes)	2	33%	33%	33%
	2 (No)	4	67%	67%	100%
Valid	Together	6	100%	100%	
Q9h	Energy efficiency.				
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	

Q10	Do you think that the competences were sufficiently included in the teaching?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	3	50%	50%	50%
	2 (No)	3	50%	50%	100%
Valid	Together	6	100%	100%	

Q11	If not, which competences would you like or would like to be included to an even greater extent?				
	Answer	Frequency	Percent	Valid	Cumulative
	more use of software environments in practice, yes then in the company already you know how to use programs	1	17%	33%	33%
	digital competences: application specific programs for construction recalculation	1	17%	33%	67%
	more content from renewable sources, understanding the construction process from beginning to end	1	17%	33%	100%
Valid	Together	3	50%	100%	

Q12	Do the acquired competences benefit you in practice?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	

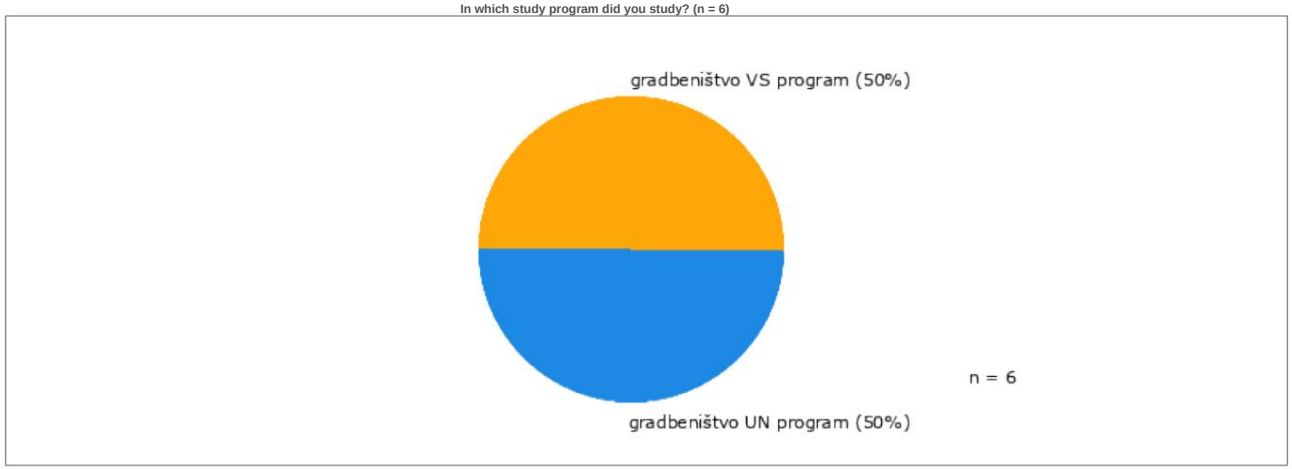
Q13	Do you think that the content was given to you in such a way that you were able to absorb the material?				
	Answer	Frequency	Percent	Valid	Cumulative
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	

Q14	If not, how do you think the delivery method could be improved?				
	Answer	Frequency	Percent	Valid	Cumulative
	could be better: simulations, animations, movies (no need for all on an excursion)	1	17%	100%	100%
Valid	Together	1	17%	100%	

Q15	Were you satisfied with the assessment method during your studies?				
	Answer	Frequency	Percent	Valid	Cumulative
Q15a	The relationship between theoretical and practical part.				
	1 (Yes)	5	83%	83%	83%
	2 (No)	1	17%	17%	100%
Valid	Together	6	100%	100%	
Q15b	Oral exam.				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	
Q15c	Written assessment				
	1 (Yes)	6	100%	100%	100%
	2 (No)	0	0%	0%	100%
Valid	Together	6	100%	100%	

Q16	If not, how do you think you would be assessed more correctly (more objectively and fairly)?				
	Answer	Frequency	Percent	Valid	Cumulative
	too much emphasis on theoretical work	1	17%	100%	100%
Valid	Together	1	17%	100%	

ANALYSIS - GRAPHS



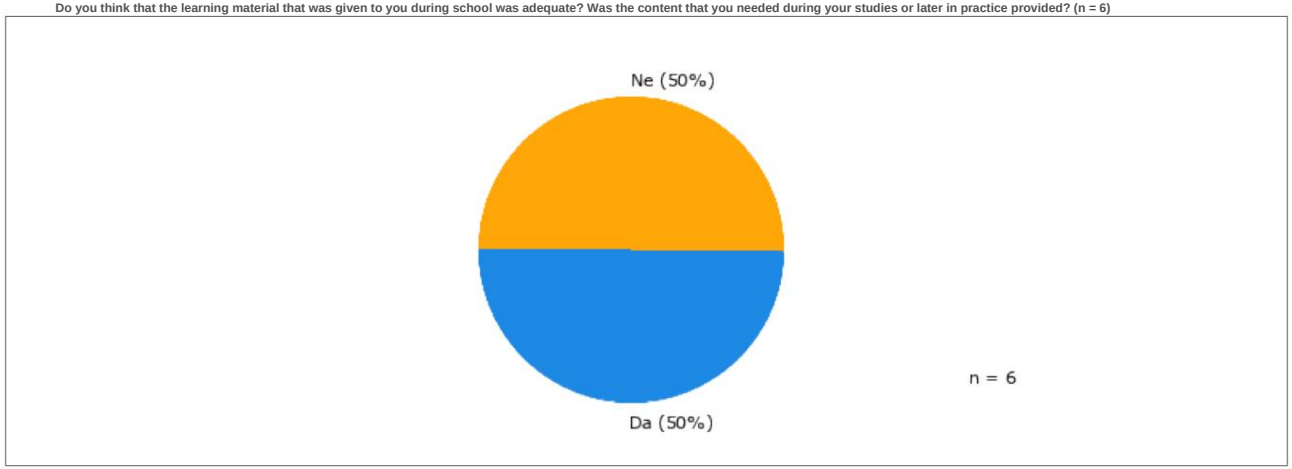
Q2	Year of enrollment in the first year				
	Answer	Frequency	Percent	Valid	Cumulative
	2010	1	17%	17%	17%
	2011	2	33%	33%	50%
	2013	1	17%	17%	67%
	2008	1	17%	17%	83%

	2009	1	17%	17%	100%
Valid	Together	6	100%	100%	
Missing	Together		0%		
	TOGETHER	6	100%		

Year of completion of studies (graduation):

Q3	Year of completion of studies (graduation):				
	Answer	Frequency	Percent	Valid	Cumulative
	2015	2	33%	33%	33%
	2016	4	67%	67%	100%
Valid	Together	6	100%	100%	
Missing	Together		0%		
	TOGETHER	6	100%		

Do you think that the learning material that was given to you during school was adequate? Was the content that you needed during your studies or later in practice provided? (n = 6)

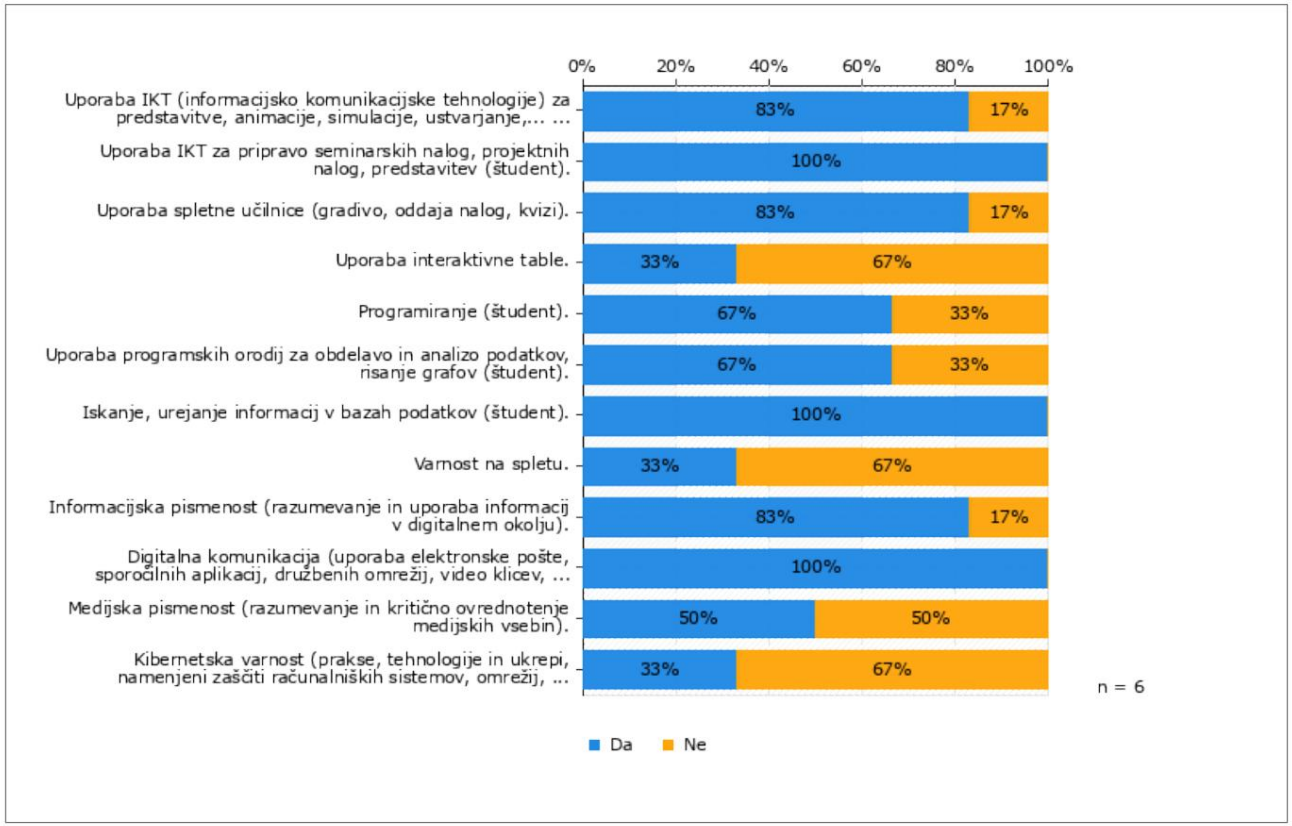


If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?

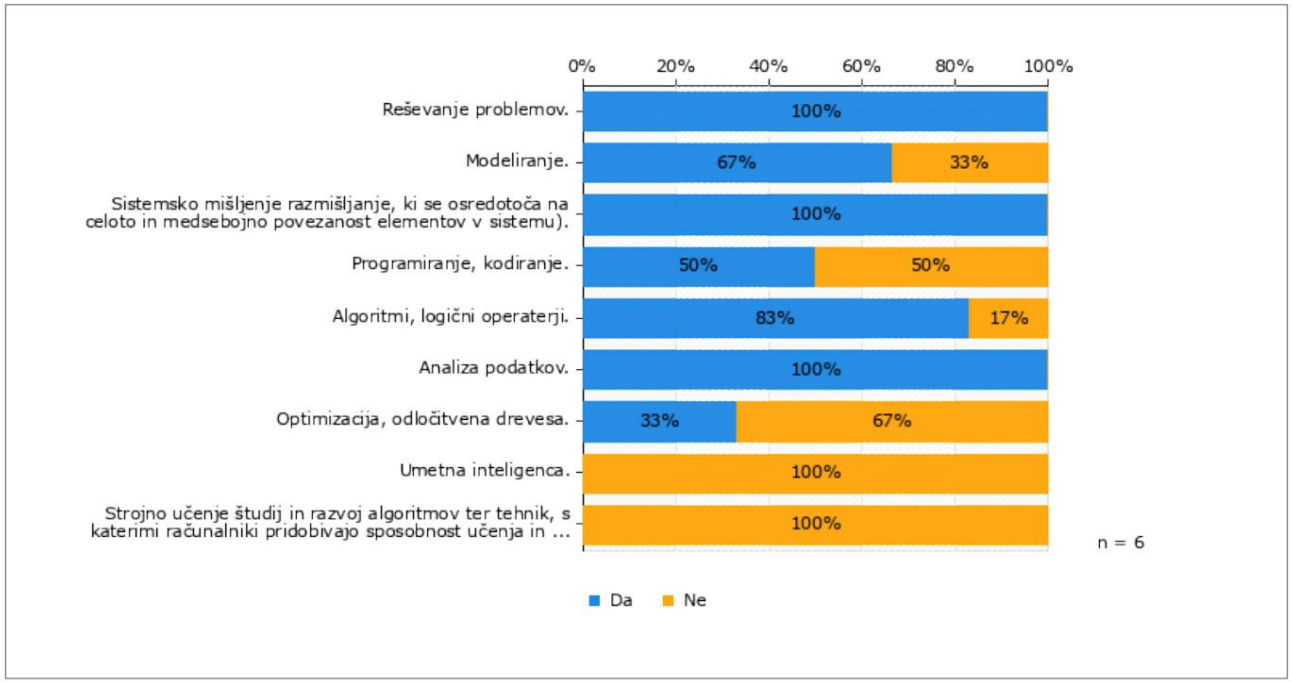
Q5	If NO, in your opinion, what content should be included or excluded in order to acquire relevant knowledge?				
	Answer	Frequency	Percent	Valid	Cumulative
	no construction history required, geometrically modeling (preferably some program). otherwise everything useful	1	17%	33%	33%
	not enough concrete things, but overall ok	1	17%	33%	67%
	was not suitable for the practical part of employment, knowledge of using programs is expected	1	17%	33%	100%
Valid	Together	3	50%	100%	

Missing	-2 (Skip (if))	3	50%		
	Together	3	50%		
	TOGETHER	6	100%		

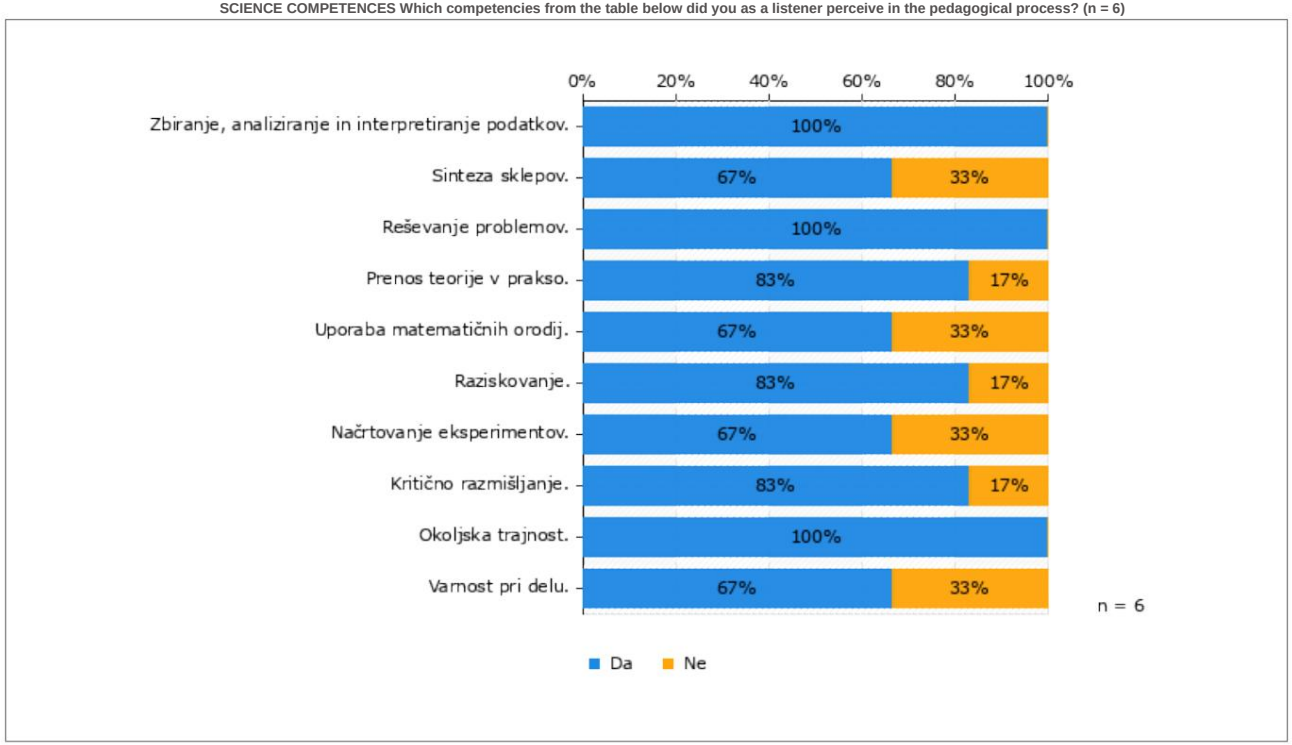
DIGITAL COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 6)



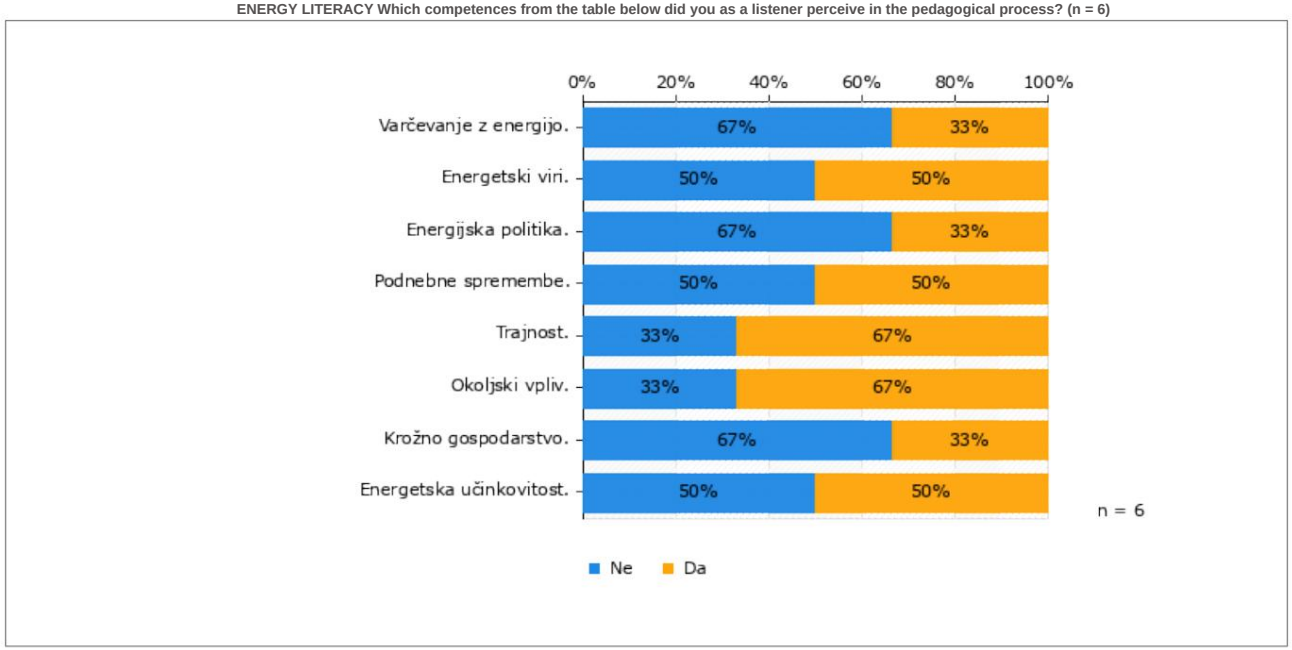
COMPETENCES OF ALGORITHMIC, LOGICAL AND ABSTRACT THINKING Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 6)



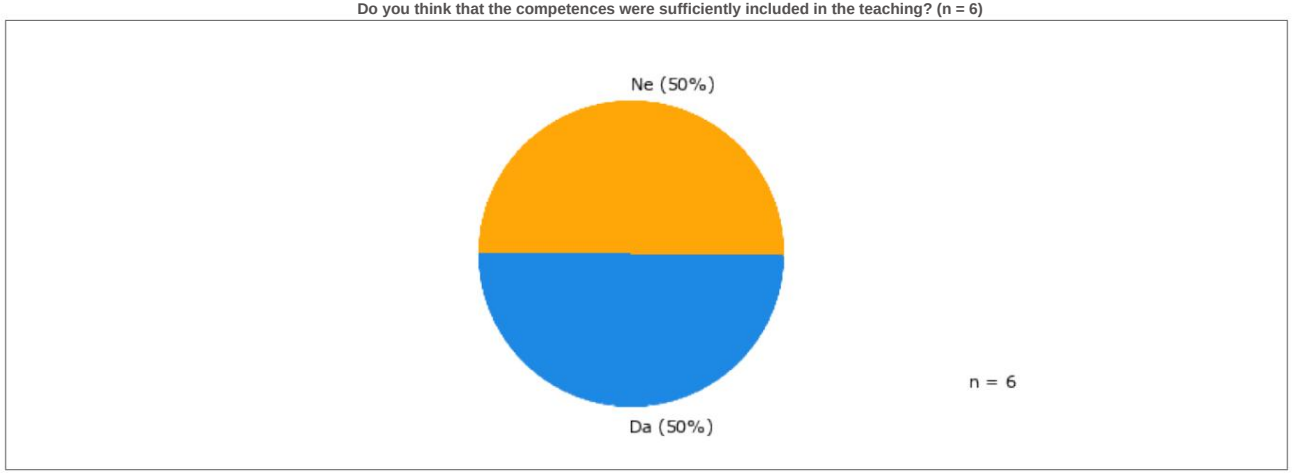
SCIENCE COMPETENCES Which competencies from the table below did you as a listener perceive in the pedagogical process? (n = 6)



ENERGY LITERACY Which competences from the table below did you as a listener perceive in the pedagogical process? (n = 6)



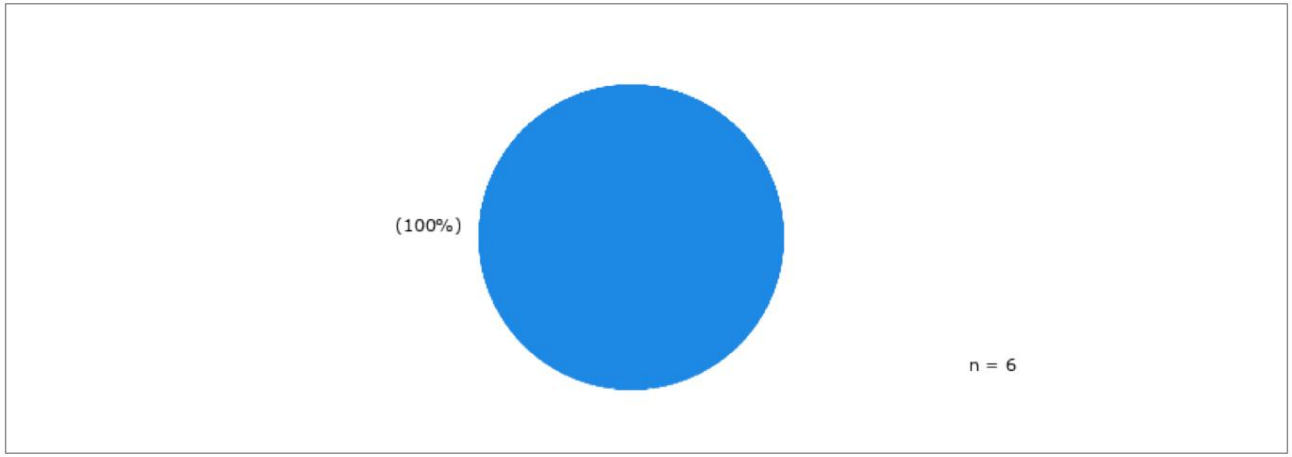
Do you think that the competences were sufficiently included in the teaching? (n = 6)



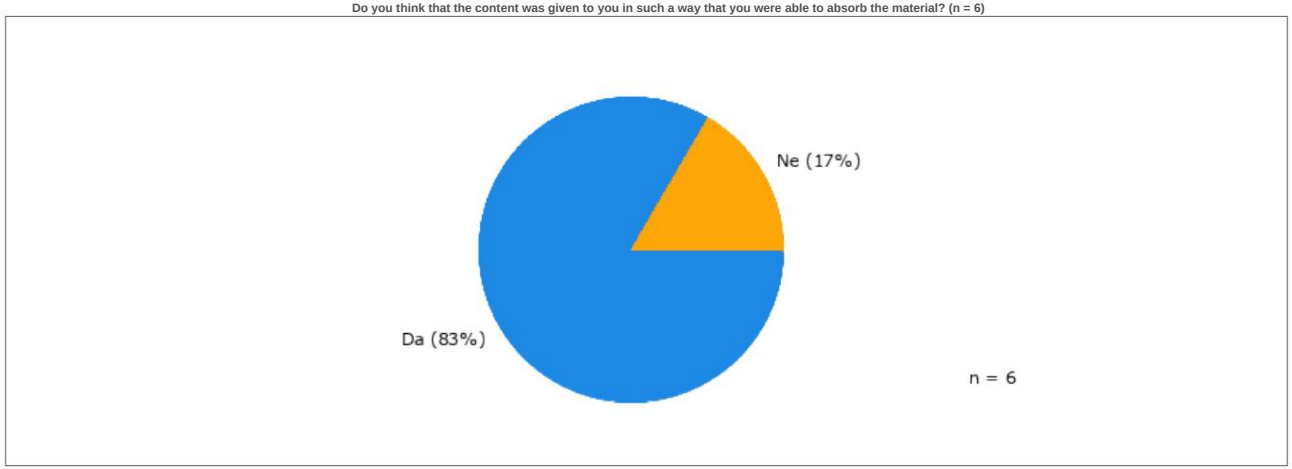
If not, which competences would you like or would like to be included to an even greater extent?

Q11	If not, which competences would you like or would like to be included to an even greater extent?				
	Answer	Frequency	Percent	Valid	Cumulative
	more use of software environments in practice, yes then you already know how to use it in the company programs	1	17%	33%	33%
	digital competences: use of specific programs for construction recalculation	1	17%	33%	67%
	more renewable content, understanding of the construction process from start to finish	1	17%	33%	100%
Valid	Together	3	50%	100%	
Missing	-2 (Skip (if))	3	50%		
	Together	3	50%		
	TOGETHER	6	100%		

Do the acquired competences benefit you in practice? (n = 6)



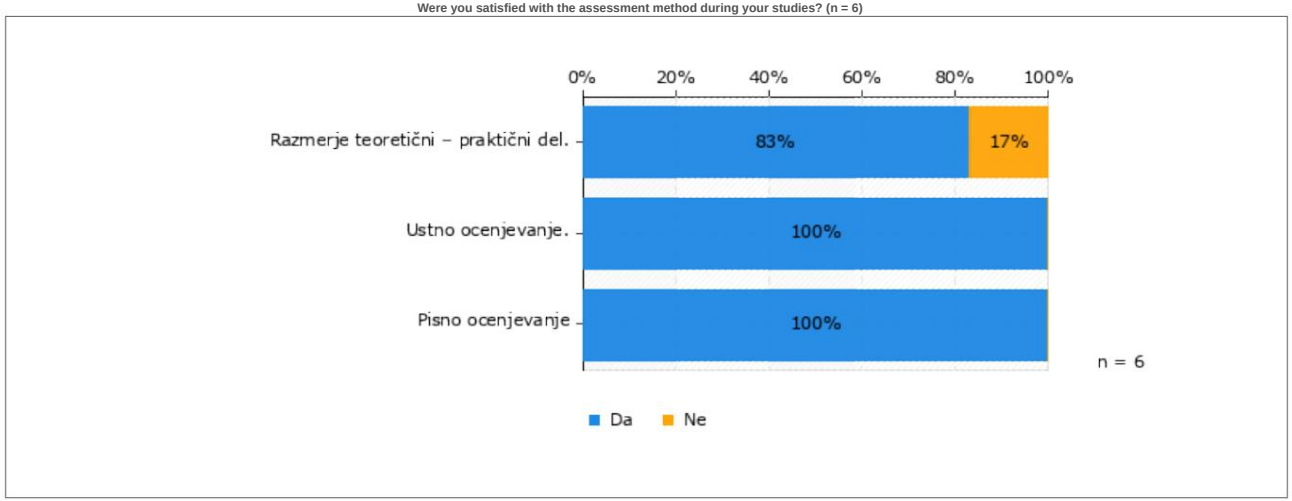
Do you think that the content was given to you in such a way that you were able to absorb the material? (n = 6)



If not, how do you think the delivery method could be improved?

Q14	If not, how do you think the delivery method could be improved?				
	Answer	Frequency	Percent	Valid	Cumulative
	could be better: simulations, animations, movies (so that not everyone has to go on an excursion)	1	17%	100%	100%
Valid	Together	1	17%	100%	
Missing	-2 (Skip (if))	5	83%		
	Together	5	83%		
	TOGETHER	6	100%		

Were you satisfied with the assessment method during your studies? (n = 6)



If not, how do you think you would be assessed more correctly (more objectively and fairly)?

Q16	If not, how do you think you would be assessed more correctly (more objectively and fairly)?				
	Answer	Frequency	Percent	Valid	Cumulative
	too much emphasis on theoretical work	1	17%	100%	100%
Valid	Together	1	17%	100%	
Missing	-2 (Skip (if))	5	83%		
	Together	5	83%		
	TOGETHER	6	100%		