GENERATION DATA

USING DATA FOR PROFIT

GENERATION DATA TOOLKIT

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Szczecin, 2019

GENERATION DATA TOOLKIT

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ABBREVIATIONS

Institution Abbreviation	Name of Institution	Logo of Institution	Country
US	University of Szczecin		Poland
LYIT	Letterkenny Institute of Technology		Ireland
VGTU	Vilnius Gediminas Technical University		Lithuania
EUCEN	European University Continuing Education Network		Belgium, Croatia, Finland, Greece, Germany, Hungary, Lithuania, Portugal, Romania, Spain, Switzerland, UK, Norway, Italy, Poland
EUEI	European E-learning Institute		Denmark
FELTECH	Feltech Software Innovations Ltd		Ireland

Table 1: Partner Institutions

RESEARCH OUTLINE

The process of research is composed of certain phases, which demonstrates the characteristics of methodological correctness. The order of the strategies presented below in Table 2: Research concept and implementation of research:

A.   Research concept
1.   Formulating a research problem
2.   Defining variables and indicators
3.   Selection of methods and tools
4.   Adoption of research procedures

B.   Implementation of Research
1.   Conducting research
2.   Organizing data and analysis
3.   Development of results

Table 2: Research concept and implementation of research

In the face of a rapidly growing economy, we need to develop our digital skills to stay competitive and be part of modern society. In all areas of life, we note the growing role of digitization. Therefore, the competences related to data management and the creation of appropriate IT tools are becoming very desirable.

RESEARCH PROBLEMS

In connection with the development of digitization, we encounter the following problems affecting higher education:

- too low importance of digitalization in personal development among students and academic staff,
- insufficient data skills by the academic staff and students who are potential representatives of the future entrepreneurial community,
- little knowledge about digitization processes among students translates into lowering the competitiveness of the national economy in the future,
- lack of defined key data skills is an obstacle to further professional development of both academic staff and students,
- due to large information amount available there is a lack of time to search for important / selected information that would allow the training of data skills and professional development.

SUBJECT AND PURPOSE OF RESEARCH

The subject of research is the importance of skillful handling of data. The main goal of the project is to create a Generation Data Toolkit that will allow the current and future students, as well as the academic staff to increase the knowledge of what contemporary data skills are. The project will provide an introduction data skills that is both rigorous and congruent with academic and proprietary research, but also accessible and practical in nature, so that

the stakeholder organization and HE organizations can find it directly relevant to the opportunities and challenges faced.

The project will allow achieving the following intermediate research goals:

-   defining the data management branches,
-   defining current skills and skills deficits of HE teachers/lectures and students in participating countries,
-   defining main components of the policy environment regarding data skills at EU and national and regional level,
-   defining the effective strategies for teaching data skills to students and early stage entrepreneurs,
-   defining the demand for training among academic staff, strengthening their data skills,
-   create a smart data skills teaching model, including a curriculum, teachers guide, lesson plans & suggested content and learning exercise

The project responds to the needs of the following actors:

-   Entrepreneurship education providers, who recognize big data is an important trend, but lack understanding of its relevance to their daily work, as well as the pedagogical strategies to teach it to others.
-   Early stage entrepreneurs and management studies students (future entrepreneurs) who need to know how to build data skills into their business plans from the get go, to help capitalize on market opportunities.
-   SME managers (current entrepreneurs), who need to learn how to grow their smart data capacity even with limited resources.
-   Economic development stakeholders who need scalable strategies for upskilling our populations in data skills and digital competencies in general, in order to ensure economies stay competitive and they stay ahead of the curve.

I .   RESEARCH DESIGN AND DATA COLLECTION

According to the methodological structure, the methods of collecting information presented in the Table 3 below have been assumed in the project.

Methods of collecting knowledge	Research Areas	Purpose
• academic research (journals and publications) • online research (policy and practice documents) • direct data collection with target groups via survey • in depth interviews with project partners and/or case study candidates	• skills' survey • policy context • best practice	Analyzes will be necessary to determine the state of current research, available information, exchange of experience. The concepts, terms, assumptions, and detailed descriptions will be analyzed. They will also be the basis for comparing the obtained results and observations and comments.

Table 3: Methods of collecting data

The methodology includes means to gather up-to-date information on all three content sections: skills' survey, policy context and best practice

- information collection will be carried out on the basis of assumptions,
- the recipient of the data will be defined,
- specific questions will be defined, for which we intend to get an answer.

The scope of activities to perform the tasks of gathering information are:

- the research area to be defined,
- tools and materials needed to carry out the study will be defined,
- details of research materials, such as accessibility, language, location, to be examined.

Regarding data collection tools:

- the software and its structure for gathering information will be defined,
- data selection and detail rules will be defined.

After conducting the research, the information will be collected and analyzed using selected methods of knowledge processing, such as: Inductive and deductive reasoning methods[1], Analysis and comparison methods[2], and Creative thinking methods[3].

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[1] Inductive and deductive reasoning methods described in article (G. Nandasenaa, L. N. K. de Silvab , K. K. W. A. S. Kumara, 2018, "Methods of Reasoning in Scientific Discovery, URL: http://asrjetsjournal.org/index.php/American_Scientific_Journal/article/download/3500/1360)

[2] Analysis and comparison methods (Sandra K. Hanneman, 2010," Design, Analysis and Interpretation of Method-Comparison Studies", URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2944826/)

[3] Creative thinking methods (Christian Kohls 2014, "COLLABORATION TOOLS AND PATTERNS FOR CREATIVE THINKING", URL: https://arxiv.org/ftp/arxiv/papers/1503/1503.01065.pdf)

II . ANALYSIS OF THE TEST RESULTS

SUBJECT OF STUDY

The subject of the research is the analysis of data skills among academic staff and students from those countries which are participating in the project. For the needs of empirical research, a research hypothesis was formulated: There is a lack of data skills among the academic staff and students. An important determinant affecting the improvement of data skills among the academic staff is to set down their deficiencies and needs. The skills of the academic staff related to effective data management have an impact on the quality of students' education and, hence, future entrepreneurs. Improving the data skills among the academic staff is determined by training, their personal and scientific development. The presented problem related to lack of data skills was examined with the help of a set of surveys, which are divided in two questionnaires, one for the academic staff and the other for students.

The research was started with a number of basic descriptive research questions, which in the case of the academic staff allowed us to define whether the examined person works as an academic teacher, based on experiences (seniority of teachers) and whether he/she deals with issues related to the management of data and from which partner country he/she came from. In the case of students, the first questions allowed to define whether the questioned person is a student or a beginning entrepreneur and if they had to deal with any data structures and if he/she already had any subjects related to data management.

The main purposes of the survey were:

- Identification of the current state of knowledge of the academic staff and students with the emphasis on the topics according to data skills;

- Evaluation of the teaching system and the need to improve the skills related to data management.

In order to identify the current state of knowledge among the academic staff and students, questions have been asked to examine the respondents' skills related to such categories as smart data, data governance, data security, information retrieval, programming skills, online software usability, Software usability for learning or teaching purpose. It also checked how many respondents spend their time using devices that are a tool for generating and processing data.

In order to assess the teaching system related to data management, respondents expressed their views on the current teaching system of subjects related to data management, pointed out topics to keep them interested to several issues, and proposed their ideas for improving data-related learning.

RESEARCH METHOD

Between February and April 2019, an empirical research was carried out among academic staff and students from countries and institutions participating in the project (Letterkenny Institute of Technology (LYIT), University of Szczecin (US), Vilnius Gediminas Technical University (VGTU), European University Continuing Education Network (EUCEN), European E-learning Institute (EUEI), Feltech Software Innovations Ltd (FELTECH)). The assumptions of the study have been discussed above. The institutions participating in the project distributed the questionnaire electronically among the academic staff and students. The research was aimed at establishing the level of the data skills among the academic staff and students, assessment and determination of gaps in current teaching systems, and proposing solutions that would improve the skills related to data management.

The way of constructing the questions allowed to a significant extent to answer on the basis of your beliefs and instances of the current knowledge of respondents. In the survey, in which there were questions with bipolar answers, it means that on the opposite edges of the scale there are contradictory beliefs, the use of a 4-element scale without a neutral point, the so-called scale of forced choice.

The study was attended by academic staff and students from partner countries of institutions participating in the LYIT, US, VGTU, EUCEN, EUEI and FELTECH projects from Ireland, Northern Ireland and Lithuania. The criterion for participation in the study was to have a status of: academic staff, or student and/or being a young entrepreneur.

RESEARCH SAMPLE

A total of 469 people participated in the research conducted among the academic staff and students from the partner countries of the project, of which 276 were students and among them were also some young entrepreneurs examined, and 193 representatives of the academic staff.

ACADEMIC STAFF

The 193 questionnaires completed by the academic staff consist of 46 questionnaires made available by the US, 40 by VGTU, 33 by EUCEN, 32 by LYIT, 1 by EUEI and 41 by FELTECH. Most people from the academic staff participating in the survey have ten to twenty years of seniority, see Chart 1.

How long have you been working as an academic teacher?

	10-19 years	20 years or more	2-3 years	4-9 years	up to 1 year
Total	45	57	29	48	14
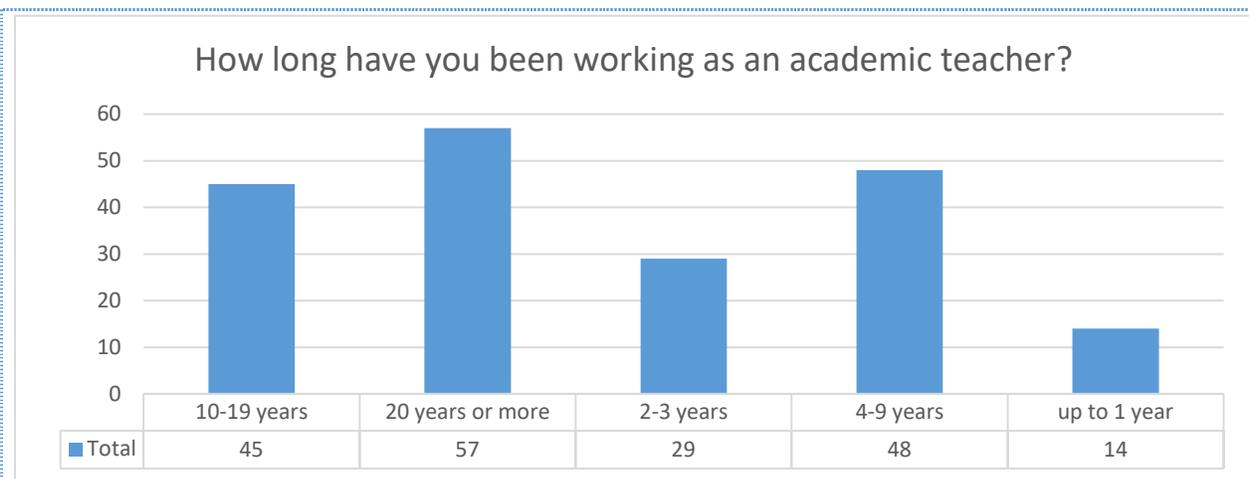
Chart 1: How long have you been working as an academic teacher?

Among the respondents of the academic staff, 19 nationalities could be distinguished, the most numerous group being the Irish, Poles and Lithuanians, see Chart 2.

Where are you from (country)?

	Belgium	Croatia	Denmark	Finland	Germany	Greece	Hungary	Ireand	Ireland	Italy	Lithuania	Northern Ireland	Poland	Poland	Portugal	Romania	Spain	Switzerland	UK
Total	1	6	1	3	1	2	1	1	69	1	41	2	44	3	5	1	4	4	3
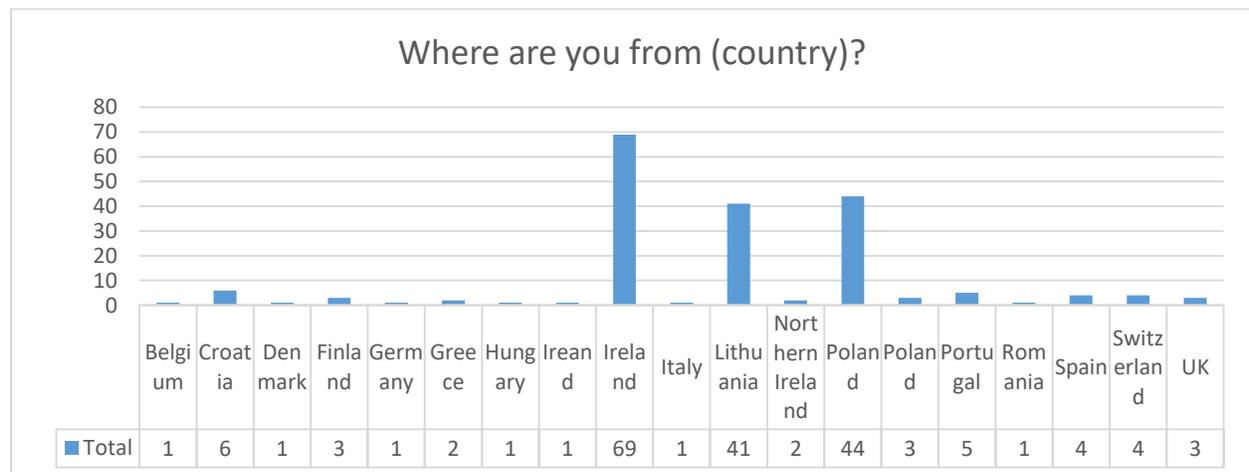
Chart 2: Where are you from (country)?

The third question was to check how many respondents ran classes related to data management. Over half did not conduct this type of activities, see Chart 3.
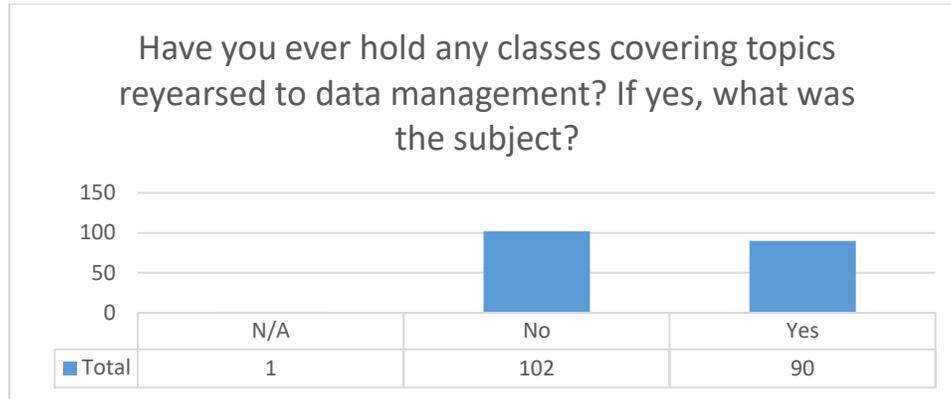
Chart 3: Have you ever hold any classes covering topics related to data management? If yes, what was the subject?

From among the items presented in Table 4, by ninety representatives of the academic staff, there are subjects such as:

- Data warehouses
- IT systems of management
- Database
- Mathematical statistics
- Information technology
- Computer programming
- Designing information systems
- Visualization and graphics for the manager
- Data visualization and reporting
- Geographical information systems
- HR and payroll systems
- Introduction to computer science in business
- Business Intelligence
- Analysis and Design of Information Systems

- Financial management
- Research Methods, Research Projects
- GDPR
- Data strategy, and Data quality
- Data Integration, Data Storage
- Excel, Facebook,
- Google home, downloading software
- CRM Systems, Project Management Systems
- Data management and data quality
- Data protection, security and data access
- Data storage
- Data and communications management plan
- Data integration, data governance

• Architecture of computer systems, ERP business support systems, CRM.	• Company data, employee data management
• Facilities Management, BIM	• Google Drive
• Information management systems	• Data sharing
• Company data management	• Data permission, posting, enforcement
• Data analytics	• Customer collection data, tracking online data
• Quantitative decision making methods	• Recording customer contact information
• E-business	• Customer journey management data
• Information security management	• Customer data for buying behavior, Online data social media analytics
• Social Network Analysis.	• Keeping track of marketing campaigns, online trading data, Subscription data management
• Relational Databases and NoSQL Data Bases	
• Big Data analysis	• Different data management systems
• Scientific programming	• Quality management
• Physics contents	• Accounting data, HR data, collection and storage
• Management in Education	• Private cloud technologies
• Machine learning, data analysis, statistics	• Photography
• Biotechnology	• Business tools and software
• Participation in education	
• Marketing	

Table 4: Teachers, Data- Subjects

In the next section, the knowledge and skills of the academic staff in the field of data management have been checked. The charts below (Chart 4 to Chart 9) present the results of the Smart Data section.

Do you know: [what Smart Data is?]

	No	Rather no	Rather yes	Yes
Total	24	42	68	59

Chart 4: Smart Data

Do you know: [what are the benefits of effective data management?]

	No	Rather no	Rather yes	Yes
Total	14	34	72	73
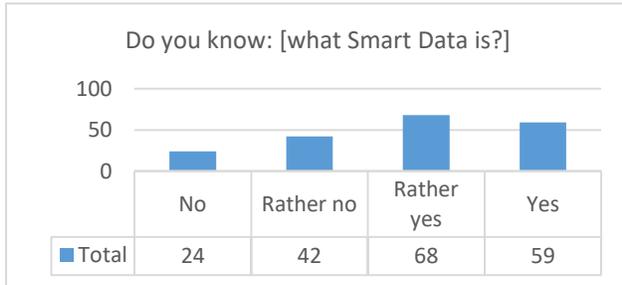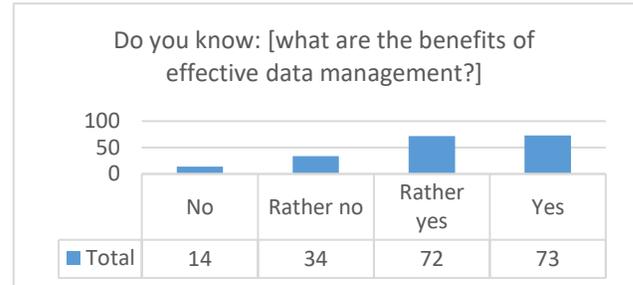
Chart 5: Smart Data-effective data management

Do you know: [the types of databases and their purposes? (e.g. Hadoop HDFS, NoSQL, In-Memory, Analytical, Transaction, etc.)]

	No	Rather no	Rather yes	Yes
Total	52	58	49	34
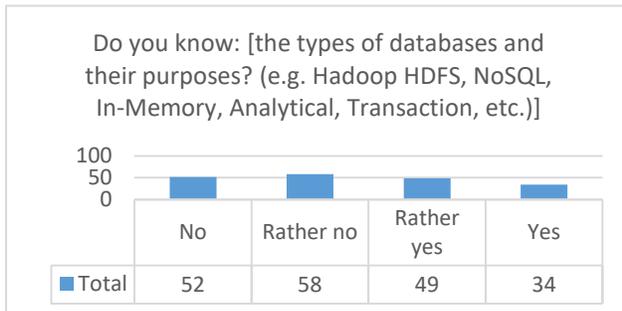
Chart 6: Smart Data-effective data management

Do you know: [data access types and their purposes? (e.g. Batch Processing, Streaming, Search and Discovery, Query, etc.)]

	No	Rather no	Rather yes	Yes
Total	54	55	50	34
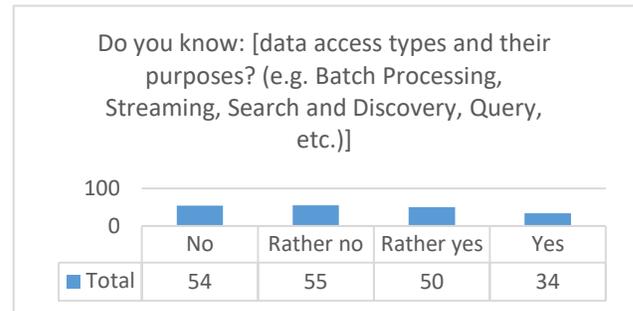
Chart 7: Smart Data-data access types

Do you know: [the forms of data integration and their purpose (e.g. Data connectivity, Data Ingestion (ETL, ELT), etc.)]

	No	Rather no	Rather yes	Yes
Total	57	62	45	29
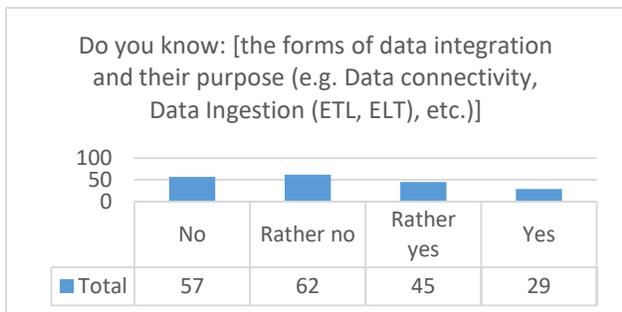
Chart 8: Smart Data-forms of data integration

Do you know: [the forms of data visualization and their purpose (e.g. Dashboards, advanced visualization, real-time intelligence), etc.)]

	No	Rather no	Rather yes	Yes
Total	48	48	62	35
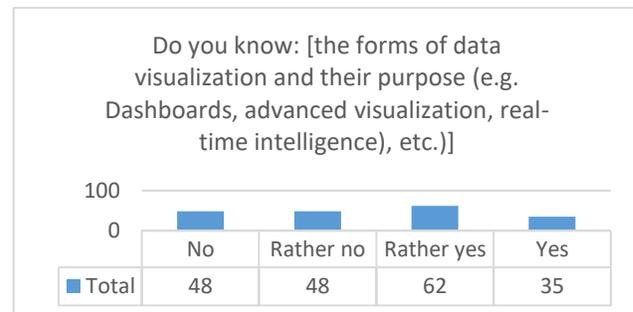
Chart 9: Smart Data- forms of data visualization

Chart 10 presents the average of results of the Smart Data section. The academic staff know their knowledge in this area in 30% as good, while 26% of correspondents consider their knowledge insufficient.
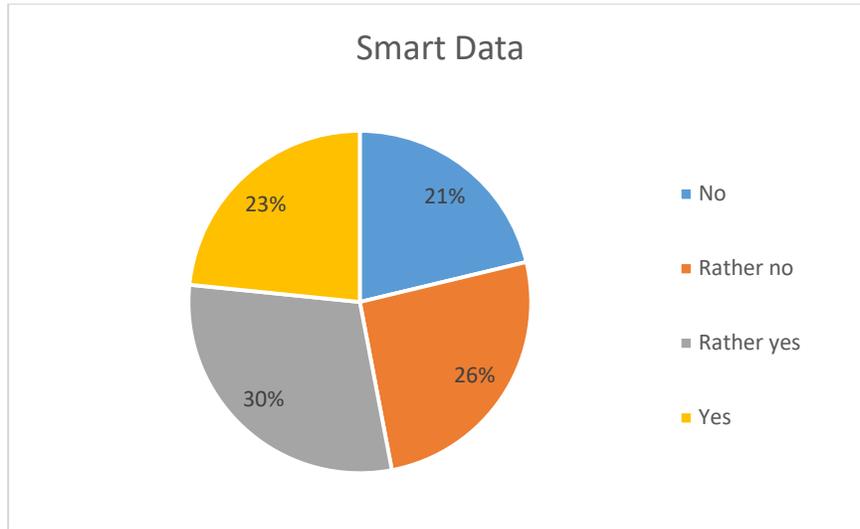
Chart 10: Smart Data section average

In the next section, the knowledge and skills of the academic staff in the field of data governance have been checked. Chart 11 to Chart 21 present the results of the data governance section.

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	56	30	54	53
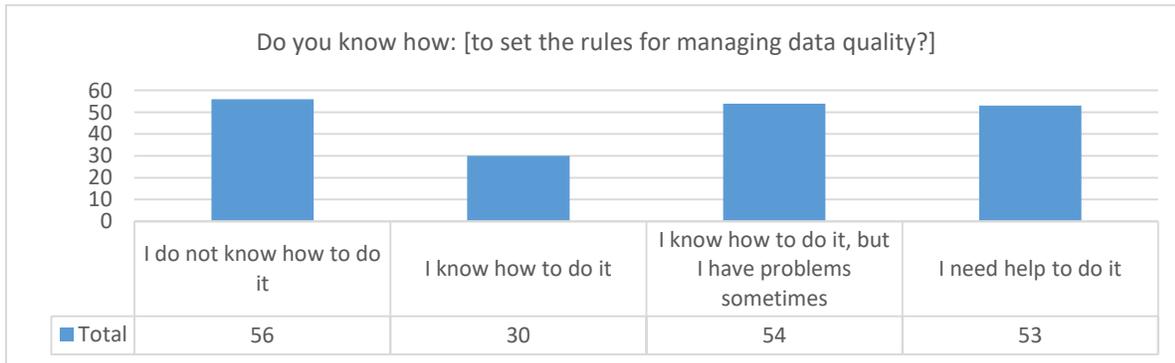
Chart 11: Results of the data governance- managing data quality

Do you know how: [to set the rules for maintaining and monitoring the quality of data?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	62	37	46	48
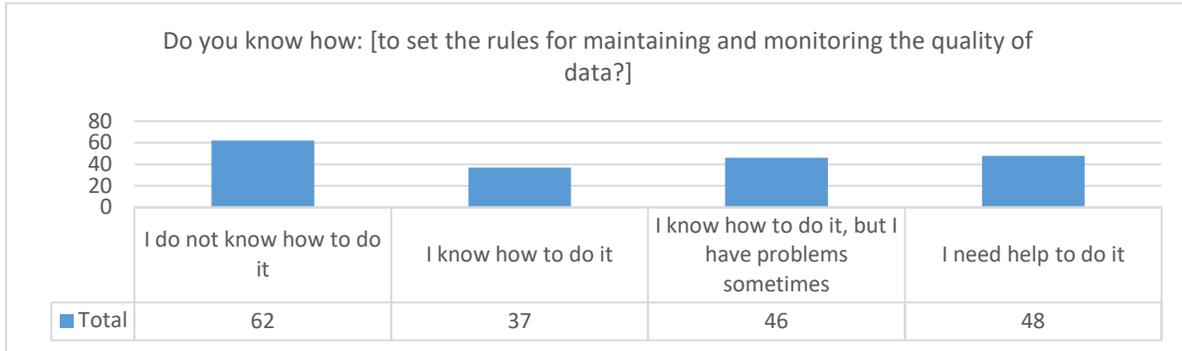
Chart 12: Results of the data governance- maintaining and monitoring the quality of data

Do you know how: [to set criteria and classes of data security (privacy)?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	72	26	45	50
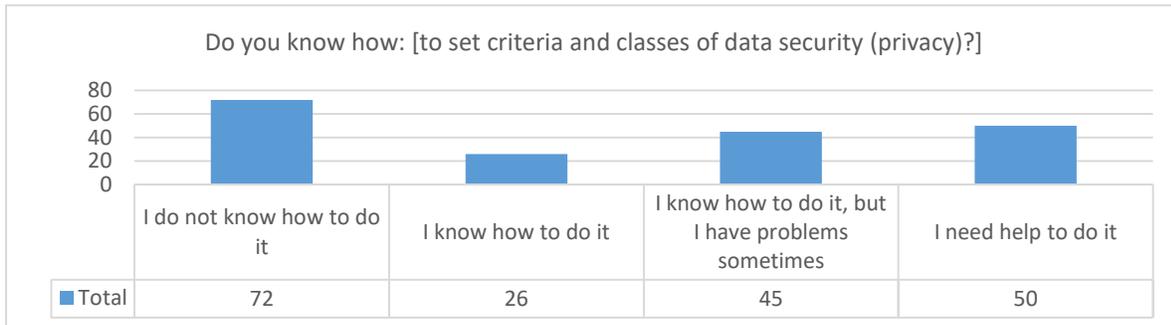
Chart 13: Results of the data governance- data security (privacy

Do you know how: [to manage data processing?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	65	34	45	49
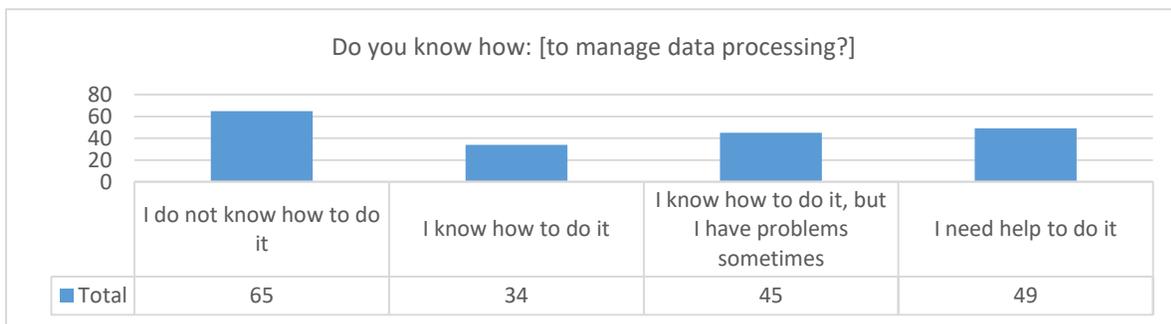
Chart 14: Results of the data governance- data processing

Do you know how: [to set up and class data main stages of data processing - life cycle?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	76	29	39	49
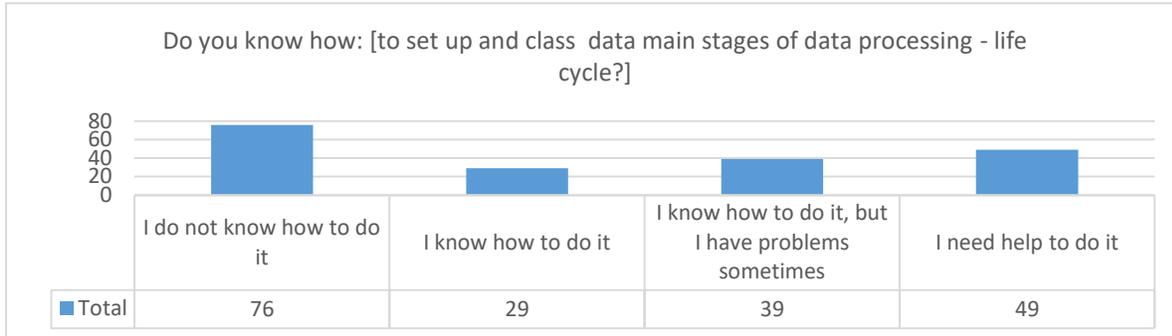
Chart 15: Results of the data governance- data processing - life cycle

Do you know how: [to use information to help it improve your business?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	51	37	55	50
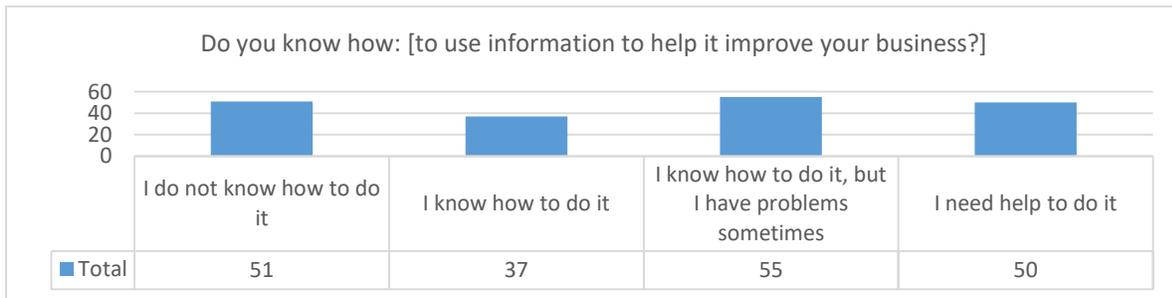
Chart 16: Results of the data governance-improving business

Do you know how: [to set criteria and measures of data quality?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	54	35	47	57
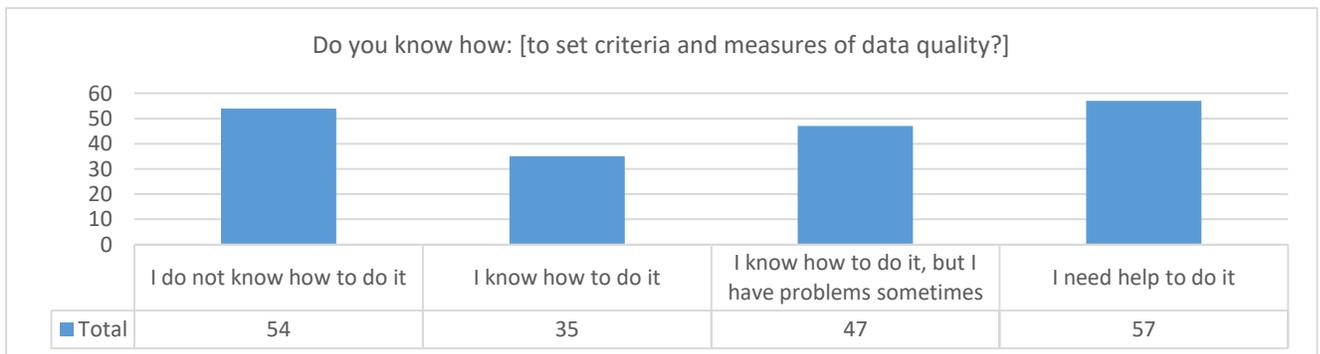
Chart 17: Results of the data governance –data quality
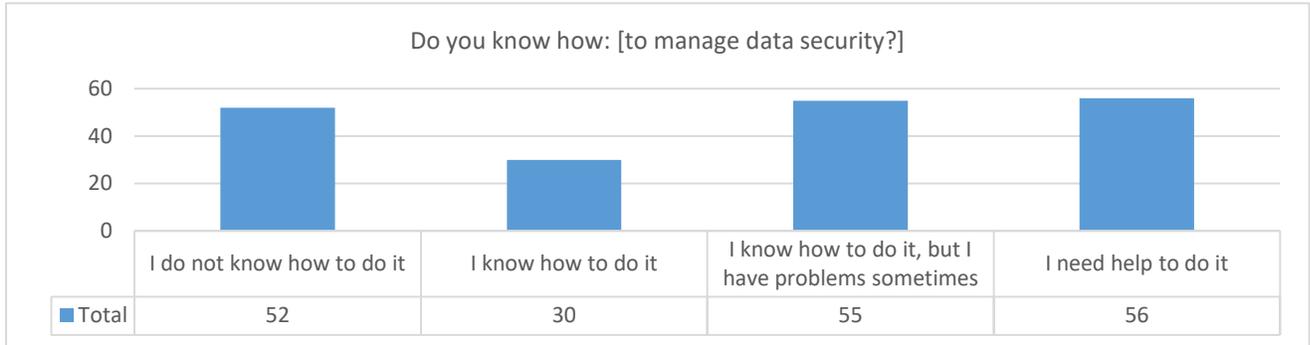
Do you know how: [to manage data security?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	52	30	55	56

Chart 18: Results of the data governance-data security

Do you know how: [to set the rules for access, review and modification, deletion of data?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	65	32	47	49
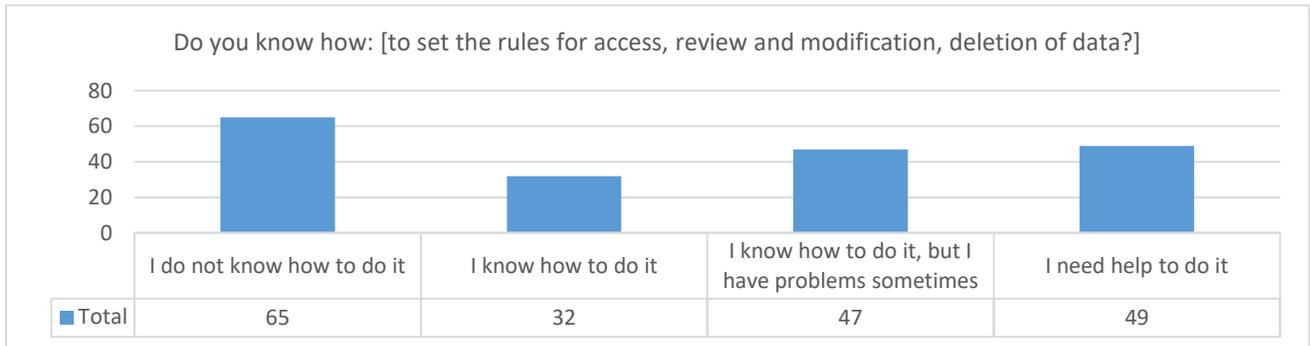
Chart 18: Results of the data governance- for access, review and modification, deletion of data

Do you know how: [to determine the types and classes of data processed, their origin and ownership?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	73	25	43	52
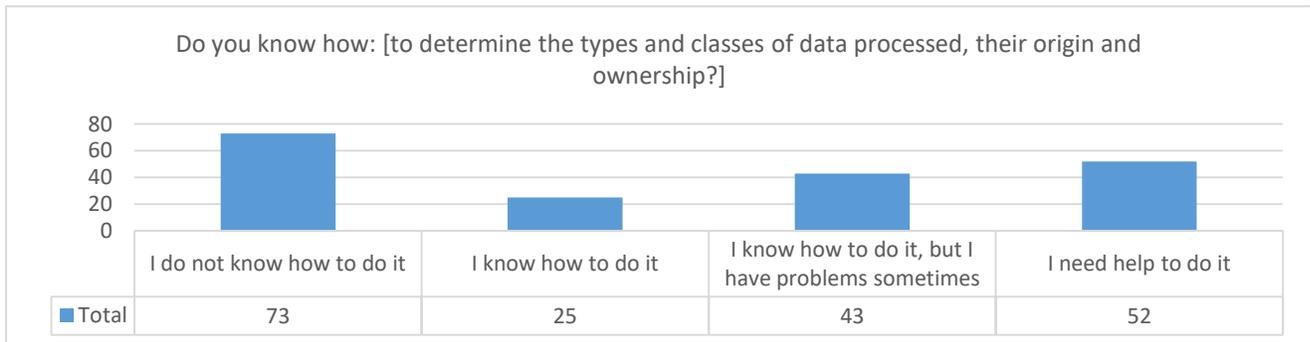
Chart 19: Results of the data governance- types and classes of data processed, their origin and ownership

Do you know how: [to set up rules for the collection, storing, processing and deletion of data?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	68	31	40	54
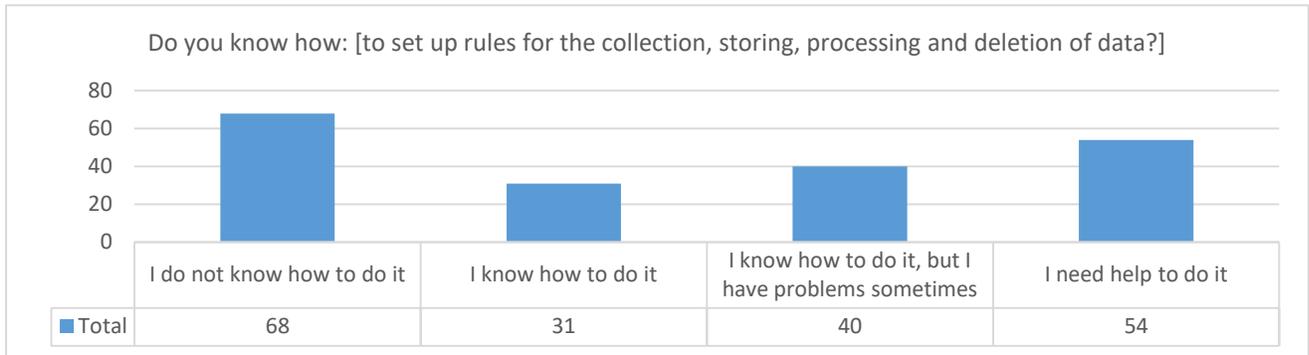
Chart 20: Results of the data governance- collection, storing, processing and deletion of data?]

Do you know how: [to measure the effectiveness of the business processes?]

	I do not know how to do it	I know how to do it	I know how to do it, but I have problems sometimes	I need help to do it
Total	60	28	47	58
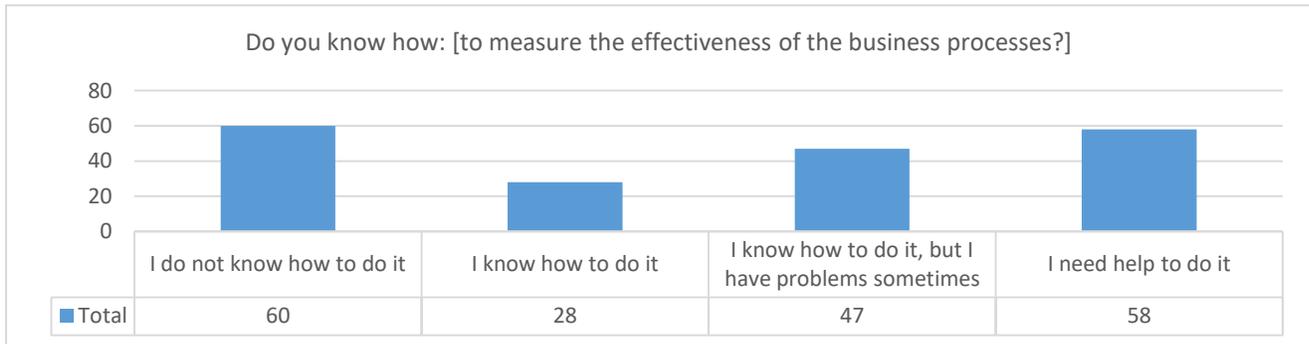
Chart 21: Results of the data governance- measure the effectiveness of the business processes

Chart 22 presents the average of the results of the Data governance section. Academic staff in 33% indicate lack of skills in this area, and 27% for lack of skills.

Data governance

- 33% — I do not know how to do it
- 16% — I know how to do it
- 24% — I know how to do it, but I have problems sometimes
- 27% — I need help to do it
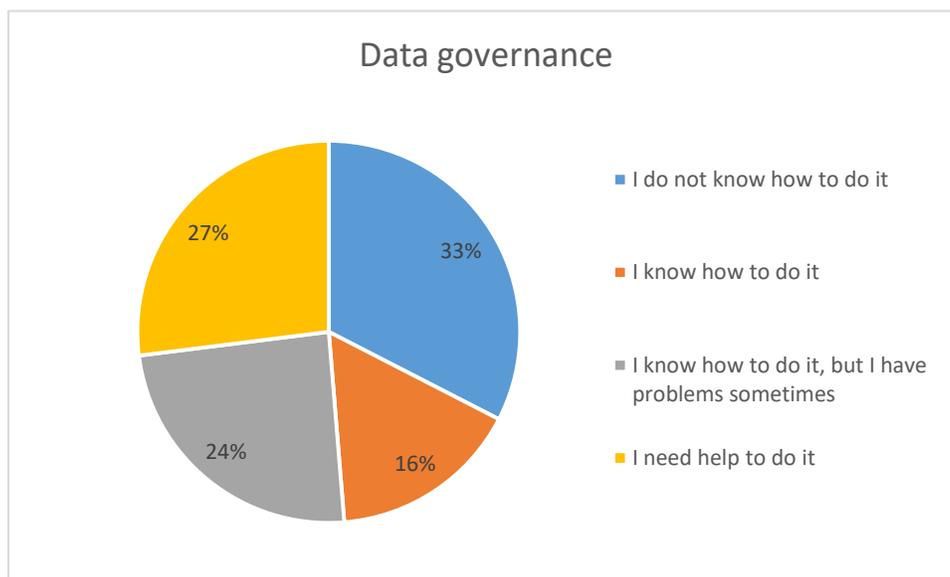
Chart 22: Average - Data governance

Chart 23 presents the average of the results of the Data security section. The academic staff in 31% indicates good skills in this area, and 27% for lack of skills

Data Security

- 18% — I do not know how to do it
- 24% — I know how to do it
- 31% — I know how to do it, but I have problems sometimes
- 27% — I need help to do it
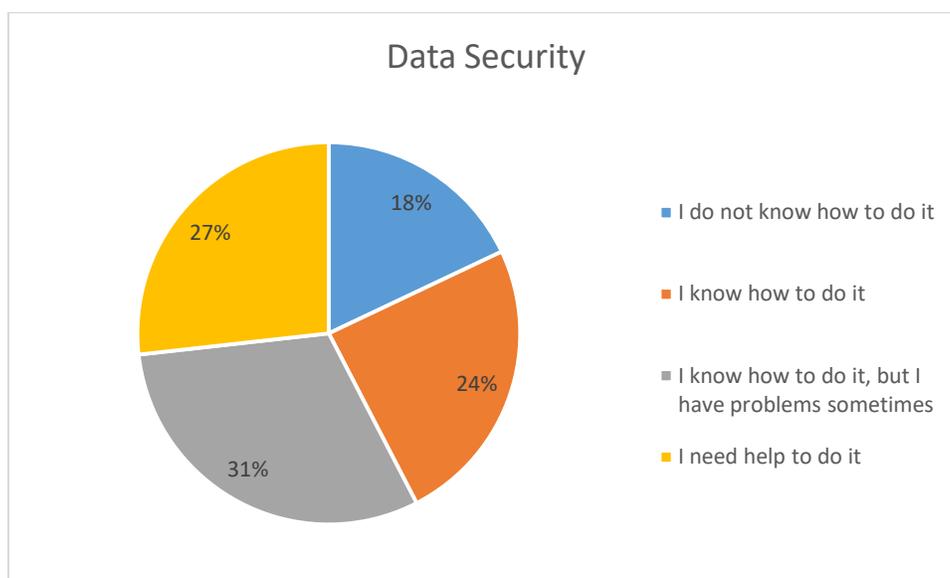
Chart 23: Average - Data security

Chart 24 presents the average of the results of the Searching for information section. The academic staff in 51% indicates very good skills in this area.

Searching for information

- I do not know how to do it
- I know how to do it
- I know how to do it, but I have problems sometimes
- I need help to do it
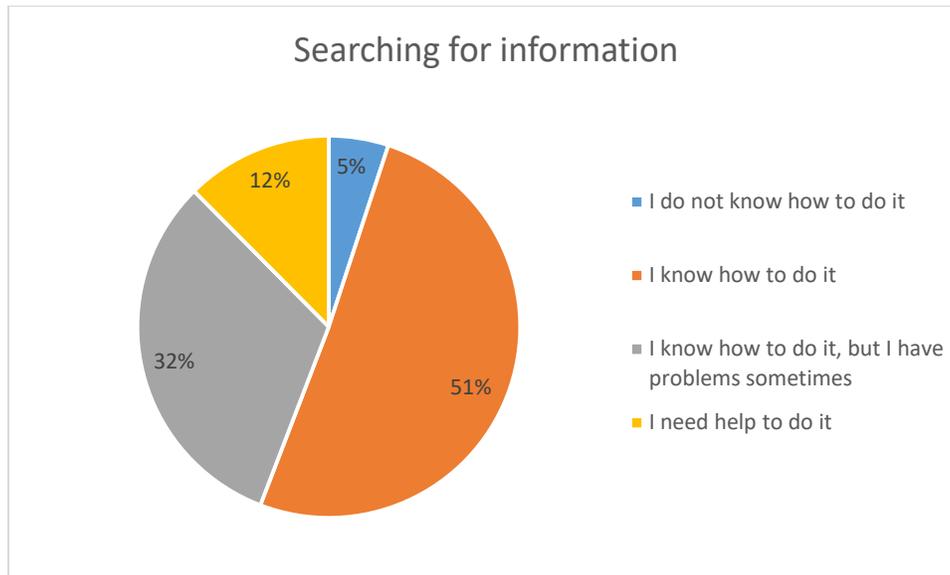
Chart 24: Average - Searching for information

Chart 25 presents the average of the results of the Software skills section. Academic staff in 34% indicate good skills in this area, 25% of respondents have problems with software activities.

Software skills

- I do not know how to do it
- I know how to do it
- I know how to do it, but I have problems sometimes
- I need help to do it
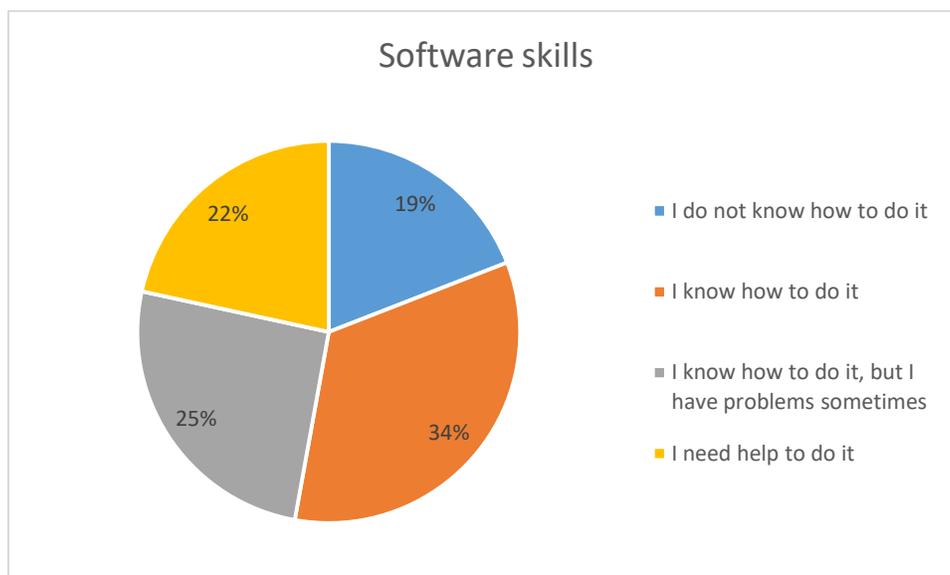
Chart 25: Average - Software skills

Chart 26 presents the average of the results of the online software usability section. Academic staff in 42% indicate very good skills in this area and 31% of respondents got good skills with online software activities.
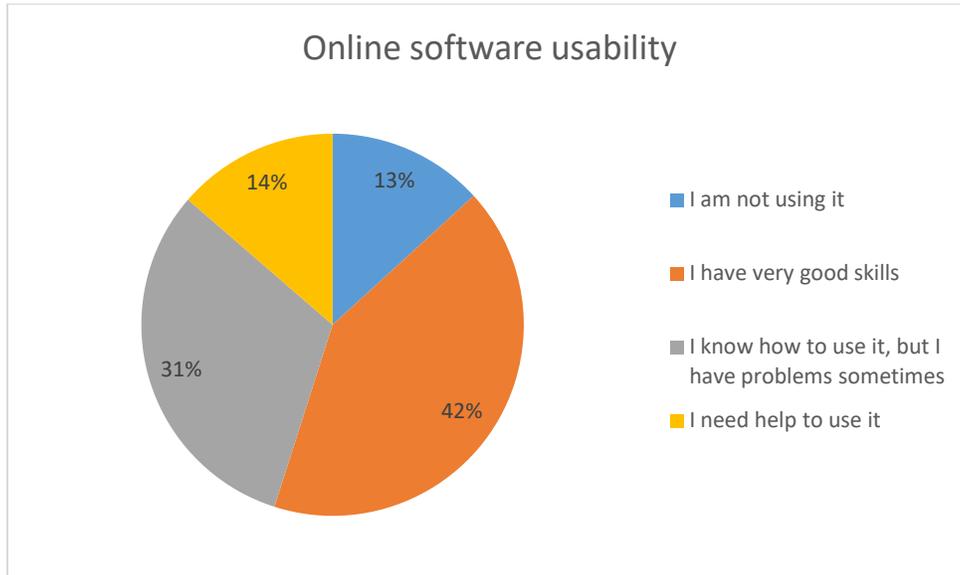
Chart 27 presents the average of the results of the Software usability for learning or teaching purpose section. Academic staff in 35% indicate problems using software for teaching purposes, while 23% think that they have very good skills.
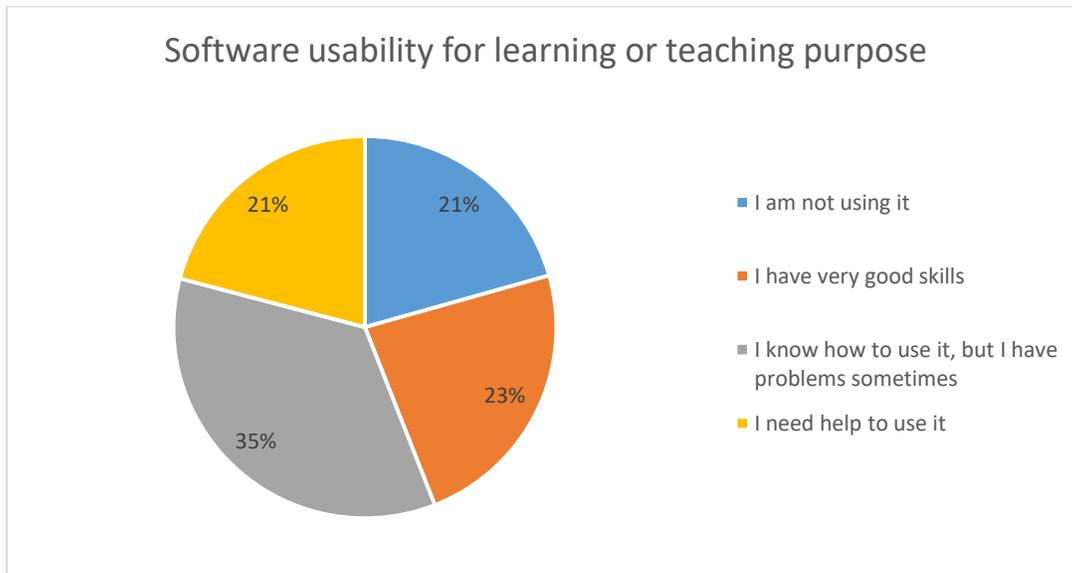
Chart 27: Average - Software usability for learning or teaching purpose

Chart 28 presents the average of the results of Time Spent with digital devices section. Over 49% of the academic staff declare using electronic devices of various types less than one hour a day, 22% of respondents use electronic devices more than 4 hours a day.
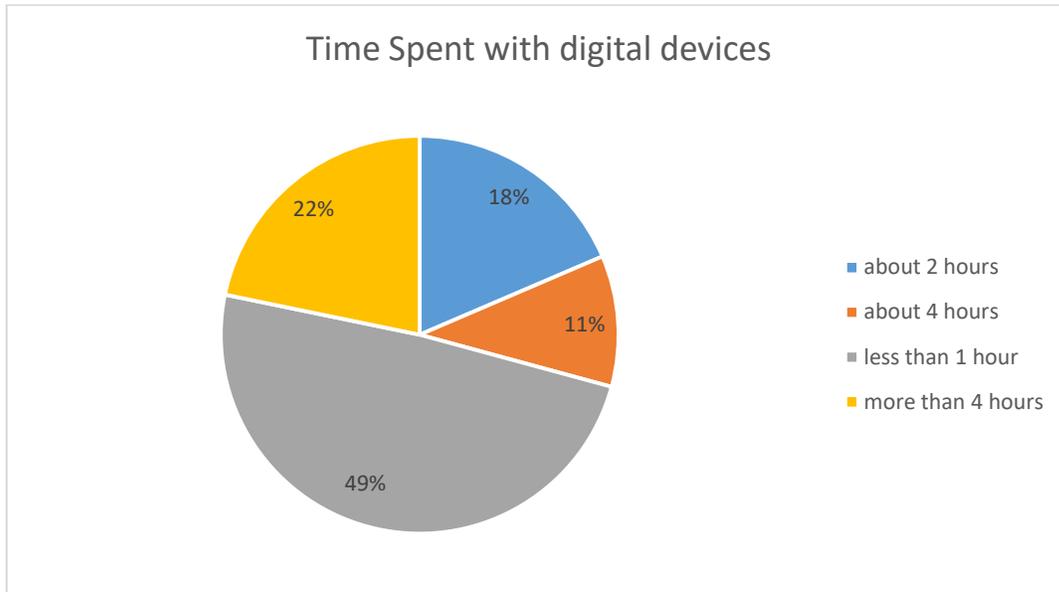
Chart 28: Average - Time Spent with digital devices

Chart 29 presents the average of the results of the Teaching section. Over 29% of respondents declare problems related to the development of teaching processes related to the management of data, another 29% indicate that they need help in this area.
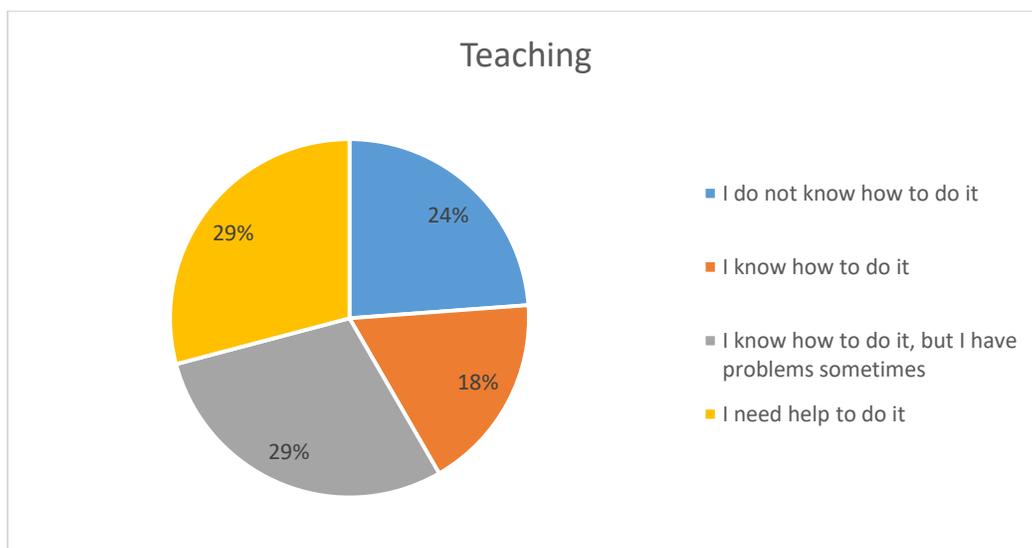
Chart 29: Average – Teaching

Chart 30 presents the results of the question: How would you rate the current curriculum in terms of data management issues? 101 respondents declared weaknesses in syllabuses related to the subject of data management, and 25 people stated that there is no need for interference in current curriculum.

	How would you rate the current curriculum in terms of data management issues?				
	Answer not applicable	In the curriculum there are deficiencies	N/A	No idea	The curriculum does not lack any topics reyearsed to data management
■ Total	31	101	15	21	25
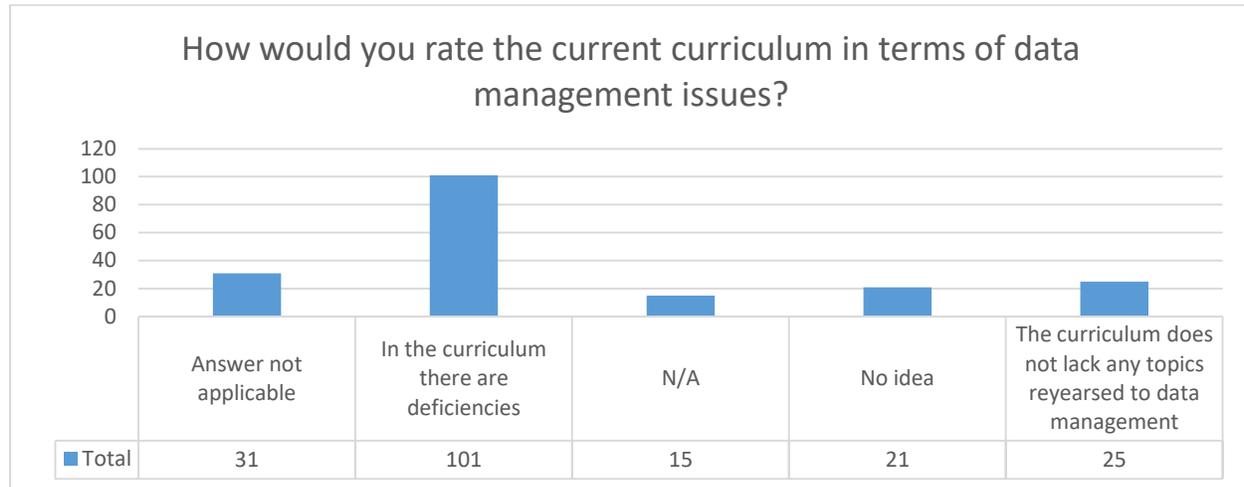
Chart 30: How would you rate the current curriculum in terms of data management issues?

Respondents who declared deficiencies in the syllabus proposed adding the following topics to the curriculum:

- *Theoretical basis of data storage and processing*
- *Topics related to building awareness of the consequences of process automation*
- *More practical activities for students*
- *More practical information*
- *E-learning tools, more digital usage and online courses for promotion of students mobility*
- *Related topics*
- *Data management topics*
- *Big data management, Cloud computing topics*
- *Additional data management topics for non-IT study programmes*
- *Data analytics, Data search*
- *Cloud computing, data analytics*
- *Data security topics*
- *Topics on data management issues*
- *Cloud computing*
- *Integration of data management in business management*
- *Topics on privacy protection and security*
- *Big data (business management)*
- *How to make business more efficient*
- *Data Governance and Ludoliteracy*
- *BI, Semantic Web*
- *Data security and data government*
- *SQL Script*
- *Blended learning*
- *Digital and data management competences offered by the School as a complement of initial or updating training*
- *Digital competencies*
- *Managing and storing data*
- *Information on data management*
- *Data Security and basic IT skills*
- *Practical training*
- *Security, meta data management, data storage, data cleaning*
- *Major need in terms of data management and how to integrate it into curriculum*
- *address excessive culture of data collection, refining and updating data management practices*
- *Mainly data sharing, distribution and*

31

- *How to integrate data management in business processes?*
- *Data security, processing and data rules and regulations*
- *Meta Data, data strategies, Content management, analytics and protection*
- *Copyright and licenses*
- *Data needs for different types of businesses and for entrepreneurs*
- *Data needed and suggested when setting up a business e.g. backing up your data, data storage, data relations*
- *Technology and future devices and software needed for data management*
- *Data management implications, security and policy in Europe*
- *Software management, analytics and integration*
- *Data mining, cleaning and data storage*
- *Data management strategies different examples and how each work*
- *Data software, teaching, recording, public rights and GDPR*
- *Different technologies needed to deliver different data topics*
- *Data quality and control measures, systems on how to keep on top of your data and data management practices*
- *Data excellence and technologies*
- *security management*
- *More varied subjects specific to entrepreneurs*
- *Curriculum is not up to date and not enough case studies from real businesses*
- *Customer relations management, best software tools, software implementation*
- *Different data management practices for different types of entrepreneurial businesses*
- *Data strategy management, quality control, data management roadmaps,*
- *Data strategies development*
- *Governance and data quality management*
- *Data architecture, life cycle and applications*
- *Data improvement practices*
- *Data software and what is best, why and why it is best practice*
- *Data applications*
- *Data mining, semantics, reporting*
- *Batch reporting, visualizations, meta data, managing data quality*
- *How to use excel in advanced stages and data ingestion*

Table 5: Deficiencies in the syllabus-proposed topics

In the next question, the respondents were asked what problem they see in the current system of education related to, presented in Chart 31 to Chart 37:

Lack of specialist knowledge, e.g. support from a data expert]

	No	Rather no	Rather yes	Yes
Total	10	21	101	59

No regulations on the use of data

	No	Rather no	Rather yes	Yes
Total	24	46	79	42
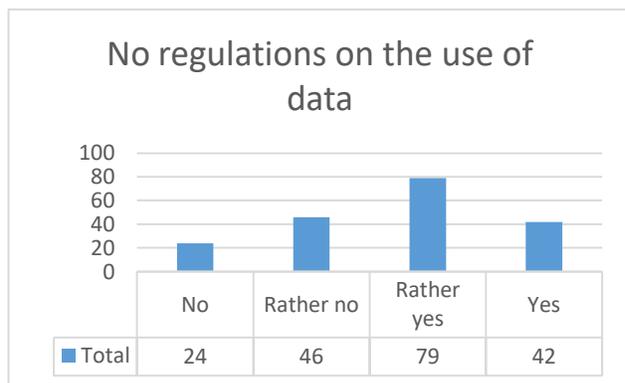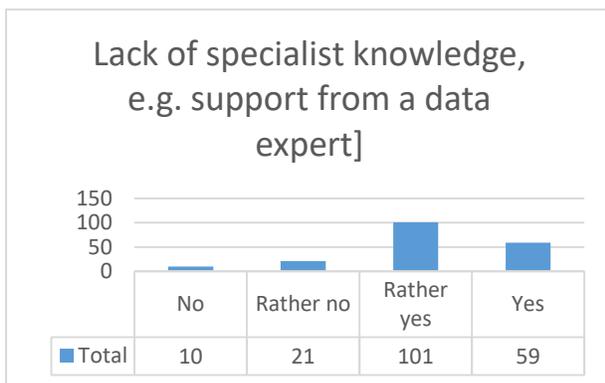
Chart 31: Lack of specialist knowledge

Lack of training in the use of data systems and improving data skills

	No	Rather no	Rather yes	Yes
Total	9	21	80	80
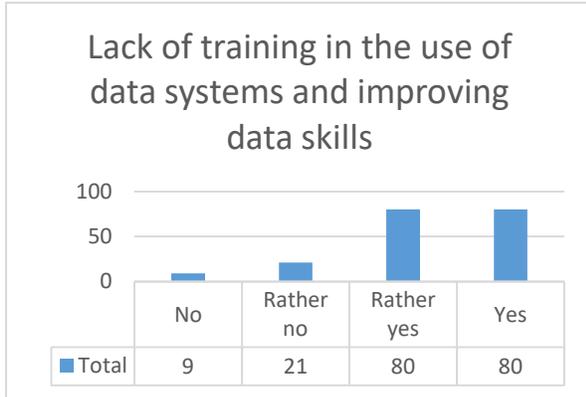
Chart 32: No regulations on the use of data

Lack of time

	No	Rather no	Rather yes	Yes
Total	11	24	68	88
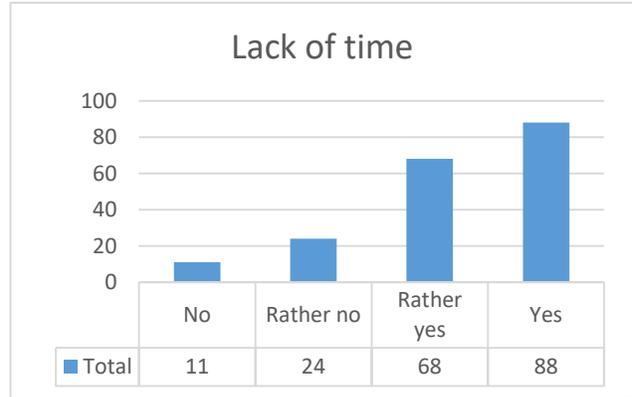
Chart 33: Lack of training

Negative attitude of the academic staff (belief in the low significance of data skills)

	No	Rather no	Rather yes	Yes
Total	32	50	62	43

Chart 34: Lack of time

Lack of collaboration in data use

	No	Rather no	Rather yes	Yes
Total	26	38	79	47
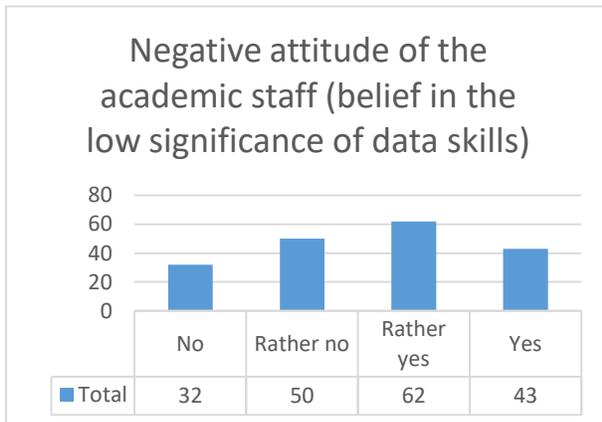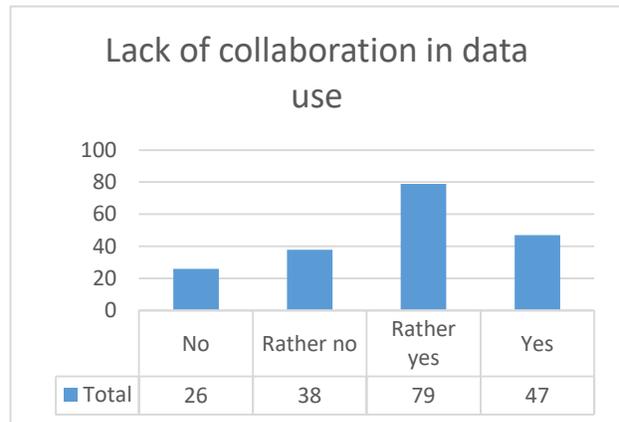
Chart 35: Negative attitude of the academic staff
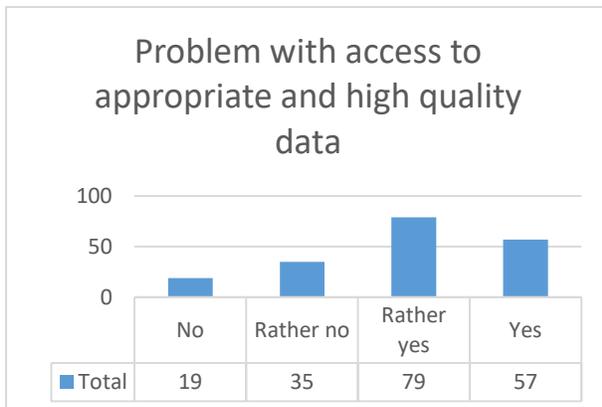
Chart 36: Lack of collaboration in data use

Problem with access to appropriate and high quality data

	No	Rather no	Rather yes	Yes
Total	19	35	79	57

Chart 37: Problem with access to appropriate and high quality data

The Chart 38 indicates where academic staff would apply the knowledge about data.

Where would you apply the knowledge about data?

	for business purpose	for educational purpose	in everyday situation
Total	46	129	18
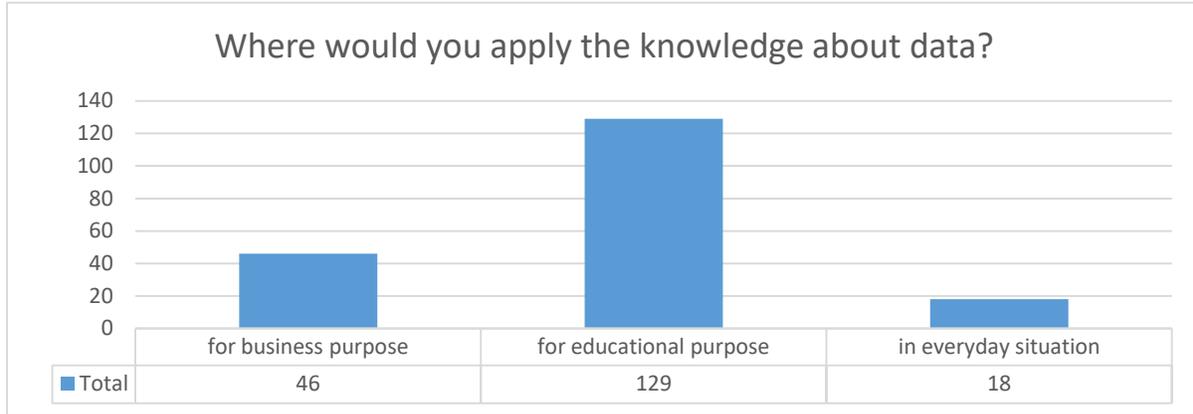
Chart 38: Application of the knowledge about data

In the next section, the academic staff answered the question: Which topics related to data management are important and/or should be subject to compulsory education? (1 – least significant, 6 – most significant), see Chart 39 to Chart 44.

Database & Storage Management

	1.	2.	3.	4.	5.	6.
Total	26	29	19	40	42	37
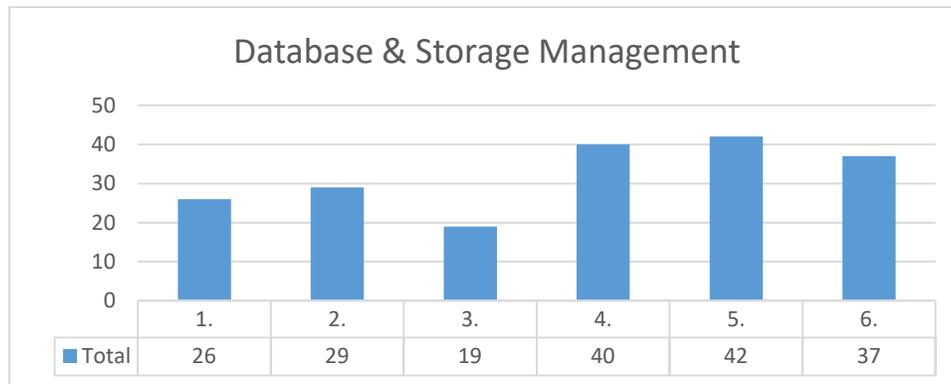
Chart 39: Database & Storage Management

Data modeling and Design

	1.	2.	3.	4.	5.	6.
■ Total	18	33	31	52	31	28

Chart 40: Data modeling and Design

Data Security

	1.	2.	3.	4.	5.	6.
■ Total	18	29	19	22	37	68

Chart 41: Data Security

Data Quality

	1.	2.	3.	4.	5.	6.
■ Total	21	18	23	26	42	63

Chart 42: Data Quality

Documents and Content management

	1.	2.	3.	4.	5.	6.
Total	20	22	22	33	47	49
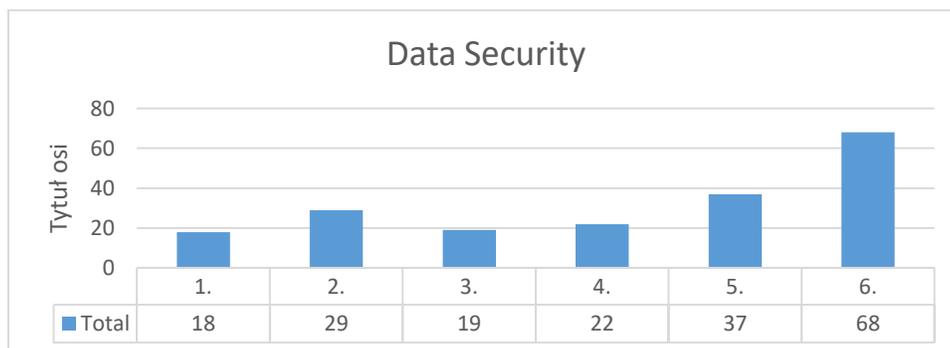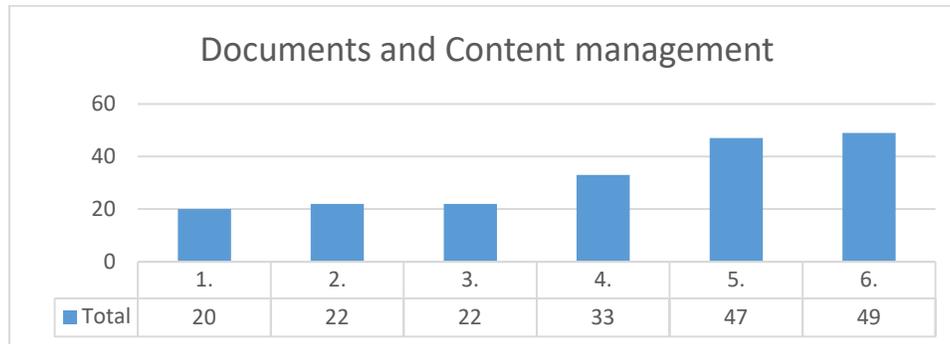
Chart 43: Documents and Content management

Data Integration and Inter-operability

	1.	2.	3.	4.	5.	6.
Total	16	26	41	43	40	27
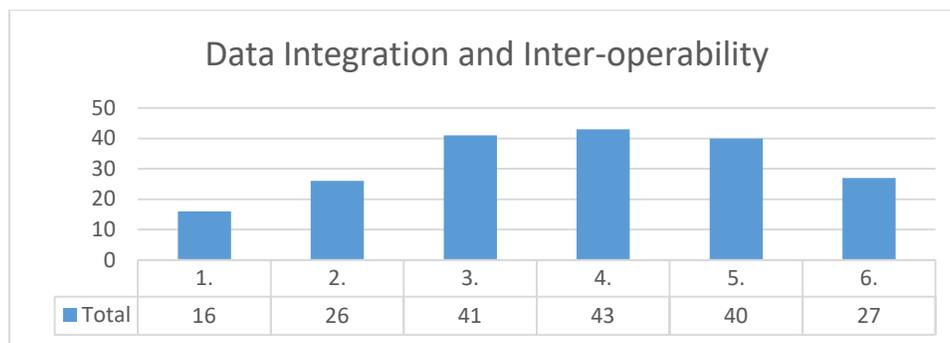
Chart 44: Data Integration and Inter-operability

In the next section, the academic staff answered the question: What in your opinion could be improved in teaching about data?, see Table 6.

- *More time*
- *Introduce appropriate subjects at the level of high school and university education*
- *Clear language*
- *Methods of obtaining various data*
- *Increase the integrity and uniformity of teaching content associated with data within different subjects, treating data-related learning as one comprehensive but fragmented process*
- *more free trainings*
- *Case study*
- *Put words into action*
- *Developing competences in the area of critical thinking in the process of searching information*
- *More practical exercises*

- *Give us the right tools and up to date information that will be able to used globally for entrepreneurs in the working world*
- *What are the current data management topics and what do I need to teach there is so much information, making sure it is applicable to Ireland and entrepreneurs in Ireland*
- *Make sure we provide the right content for entrepreneurs suitable to our country needs and the types of businesses we have e.g. agriculture and food is very strong in Ireland*
- *We need to organize the data*

- *Creating tutorials, meetings with experts, websites with data from which you could benefit from the classes*
- *Analysis and inference - case studies*
- *More practical exercises in the field of data mining*
- *Show and use modern pattern search tools or data storage and indicate their application may be useful in the professional career of students.*
- *A large number of examples on real data*
- *More practical examples and possibilities of use*
- *Increase the number of teaching hours of modeling and data management*
- *By training lecturers (researchers) and students*
- *There is no unambiguous answer*
- *Introduce more assessment projects*
- *Recognition and acquisition of data*
- *Additional courses needed*
- *To devote more time on this topic.*
- *To share more information with other universities/companies.*
- *Skills of teaching staff and the students*
- *To add teaching for lecturers to improve their knowledge (especially data security)*
- *To organize more lectures for teaching and administrative staff.*
- *Basic information for everyone*
- *To provide information about data management to other study programmes*
- *More education on data security*
- *There should be given more practical information from business to make these studies more attractive for students*
- *Invite lecturers from other study programmes.*
- *To add more topics in different (also social) study programmes*
- *To add new study modules, that each student could choose and study them.*
- *To use the new tools in university's everyday situation.*
- *The quality of data management study programmes*
- *We are talking too little about big data meaning and its importance to a better quality of business management processes.*
- *Maybe more related topics to be added to existing study programs?*

- *management topics in our teaching better and make them more relevant to entrepreneurs*
- *Our content still is not covering enough of the topics needed and in enough dept especially for entrepreneurs who may not receive incubation support*
- *Give us the best tools that are easy to use for data teaching that are up to date specific to entrepreneur needs*
- *I have not been trained to teach in an application modality and every entrepreneur is different with different skills and backgrounds, if I could be more flexible to their needs*
- *I get lost in all the data management topics I think there needs to be a balance between data management for the entrepreneur and the entrepreneurs business needs*
- *A lot of data management is not needed, such as the technical aspects, I would like to see more with more of an entrepreneurial content focus*
- *Bring in more project based learning so entrepreneurs can lead their own learning, get to think more and use data practices better that works for their business*
- *Need to include game based learning for memory benefits when needed, good to get a few entrepreneurs working together in quizzes, polls etc.*
- *How to make sure data is leveraged properly, how to upskill and teach entrepreneurs to upskill as needed like continuous improvement*
- *Follow best practice around the world, what is the most efficient and effective way to teach difficult modules, match the module with the learning techniques need to the entrepreneur*
- *Teach digital footprints and reputation management and citizenship as part of the curriculum would be useful to entrepreneurs*
- *What are the best and most beneficial*

- More education on this
- To teach how data management improves business
- I think these topics are necessary for every person, so we should teach these topics at the university
- To integrate study modules in business studies
- More information
- More time and modules devote to this.
- There is a lot to be improved in using data in general, from understanding the implications of sharing data to appreciate its value, without forgetting ethic concerns.
- more info on data security needed!
- Access to ms azure, amazon aws
- Students should be aware of the importance of a good data management and the negative consequences regarding the lack of this management.
- Ethical aspects
- With concrete examples
- I have. I did not think about that.
- Usage of examples. All classes I have taken do not have many practical examples.
- Making it more inter-disciplinary
- Relational databases and SQL
- It isn't taught in general, so there is literally nothing to improve at the moment.
- As I see it through my experience, the greatest problem in teaching data management is the shortsightedness of students, it is hard sometimes to make them see the whole picture. Also, integration and good data management allows for more efficient and seamless work, but many do not even try because they cannot see or imagine the benefits of it. It is especially important in collaborative work as is scientific research.
- Theory
- THE EDUCATIONAL STATUS OF STUDENTS
- Software usability for learning or teaching purpose
- The teachers' competences - training actions are very much needed in this area. But it will have positive impact only if a different mindset is developed
- Taylor made programs for teaching staff
- General understanding
- Machine learning/AI. Students should be able to learn from data, not just store them properly.

- topics I can teach entrepreneurs in data management, what is needed in different areas e.g. financial, human resources, marketing etc.
- Be able to formulate the right data management courses and content suitable to entrepreneurship
- I need more information and understanding around security and smart devices, trading online and the implications and how to manage this
- I would like to be able to deliver bite sized modules to my entrepreneurs so that they are learning at their own pace if this is their preference, how do I do this and what topics could be delivered this way e.g. using different devices
- What are the main digital and data management skills that entrepreneurs must know and understand at the different stages of their business
- Managing digital identity should be included. Making sure we are kept up to date with periodic learning modules. Maybe working with other educators and mentors for entrepreneurs in data management
- How the content can be used, is it flexible and can we adapt it t suit the entrepreneur needs. What is the most appropriate content I should teach
- We need further explanation on GDPR, Citizenship, Security, different technologies that can be used, software comparisons, streaming, reporting and semantics
- I want to understand analytical data, data mining and how to display this when I am learning it so it is understandable
- What are the best ways to teach different topics and the technologies to use, my preference would be to have something that can be used in and outside the training room
- Update the technology in the classroom to suit, it impacts the classroom

- *Interesting environments (data + tools) to play with data are lacking*
- *The basics. Many people miss basic knowledge but work with data. An example is the use of statistics software without knowing why and how to choose the right tools.*
- *Overall performance and use.*
- *Marketing*
- *Training the Trainer*
- *Data quality*
- *Data analysis*
- *practical skills*
- *Showing what data analysis CANNOT do*
- *Understanding what data analysis leads to i.e. the importance of applying learnings from what you learned from the data. Use it for continuous improvement. Clear examples or working examples of good practice.*
- *integrating the knowledge*
- *Online help*
- *I am unfamiliar with it in general so anything to do with it*
- *Teach thru practice rather than theory ..*
- *more education on the importance of it*
- *academic staff need to understand it first*
- *Training courses & greater general knowledge*
- *all areas around data management*
- *getting the students to understand the importance*
- *again, perspective required about 'what is data'*
- *should be across all courses*
- *Make staff see the relevance.*
- *level of awareness increased*
- *More understanding about the necessity of teaching about data*
- *Everything*
- *the limitations of data*
- *More practical courses*
- *Lecturer knowledge*
- *better understanding around quality of data*
- *Time allocation.*
- *Data Security*
- *I need training in this*
- *I don't know enough about it and don't have much interest in it*
- *Making it relevant to one's subject area, rather than a generalized approach*

- *learning, we need to use and learn different technology entrepreneurs will use in the workplace*
- *Update the technology in the training room to suit, it impacts the classroom learning, we need to use and learn different technology entrepreneurs will use in the workplace*
- *I find data visualization is very useful and would like to know more and how to incorporate into my curriculum. Other areas I would be interested in knowing more about is big data, storing, processing and deleting data*
- *Decisions about the identification, collection and management of data should be grounded in educational principles. In this way educators can have greater freedom to balance professional autonomy and agency against the demands of the accountability system.*
- *I would like to teach it in a much simpler way, using different software and devices that make it easier to learn for entrepreneurs*
- *I never know what data topics to include and which are the most beneficial, then adapt them to the entrepreneur needs*
- *I need to include more data topics in my courses*
- *The demands of the accountability system need to be reduced. I need to have better understanding of the current entrepreneur world*
- *Preparing entrepreneurs with more up to date data management techniques and the skills and knowledge required, we are still out of date*
- *What are the most beneficial entrepreneurial topics that I need to teach in data management*
- *Adjust our training system to get entrepreneurs ready for the changing work environment which has changed a lot in recent years. They need the most up to date skills and techniques so they*

• *Please make this accessible as a business tool as opposed to making us all into data scientists, it must be an accessible, value adding course* • *How it applies to my teaching environment and what my students need to know when entering the business career world* • *How to educate trainers and how trainers can improve their teaching methods* • *reduce the unnecessary burdens of data management by ensuring that every data collection has a clear purpose and that the process is as efficient as process when teaching* •	*can perform best. Our education curriculum needs to be aligned.* • *The requirements for entrepreneurs has changed and they need to understand the technical needs better at the minute these technical materials are higher than what we currently have* • *I try to keep my data management topics up to date but am not sure if I am using the best versions. Having case studies and more videos would be beneficial for entrepreneurial learning* • •

Table 6: Improvement in teaching about data

STUDENTS

The 276 questionnaires completed by the students or budding entrepreneurs consist of 74 questionnaires made available by the US, 66 by VGTU, 45 by EUCEN, 87 by LYIT, 1 by EUEI and 3 by FELTECH. 97% of respondents were students, and 3% of budding entrepreneurs, see Chart 45.

Are you:

	a budding entrepreneur (up to 5 years in business)	a student
■ Ergebnis	7	269
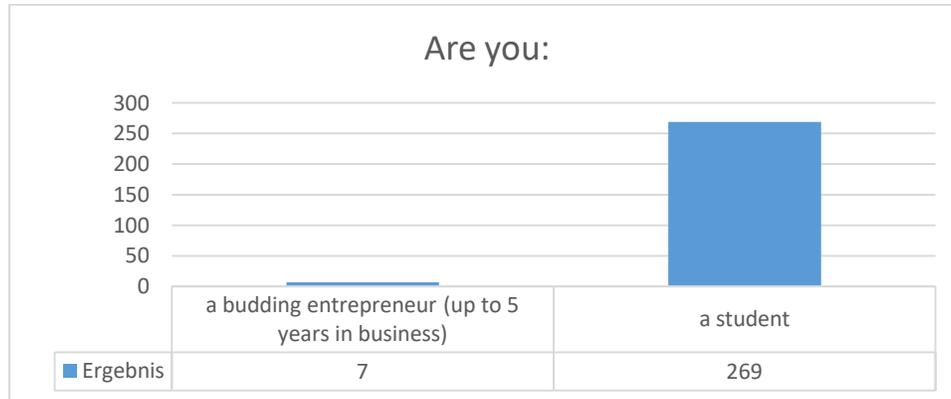
Chart 45: Research sample – students or budding entrepreneurs

Respondents came from 19 different countries, of which the largest group was Poland, Ireland and Lithuania, see Chart 46.

Where are you from (country)?

	Belarus	Denmark	Egypt	France	Germany	Greece	Holland	India	Ireland	Italy	Lithuania	Malaysia	Norway	Poland	Portugal	South Africa	Spain	Ukraine	United Kingdom
■ Ergebnis	2	1	1	1	1	1	1	2	75	1	66	2	1	113	4	1	1	1	1
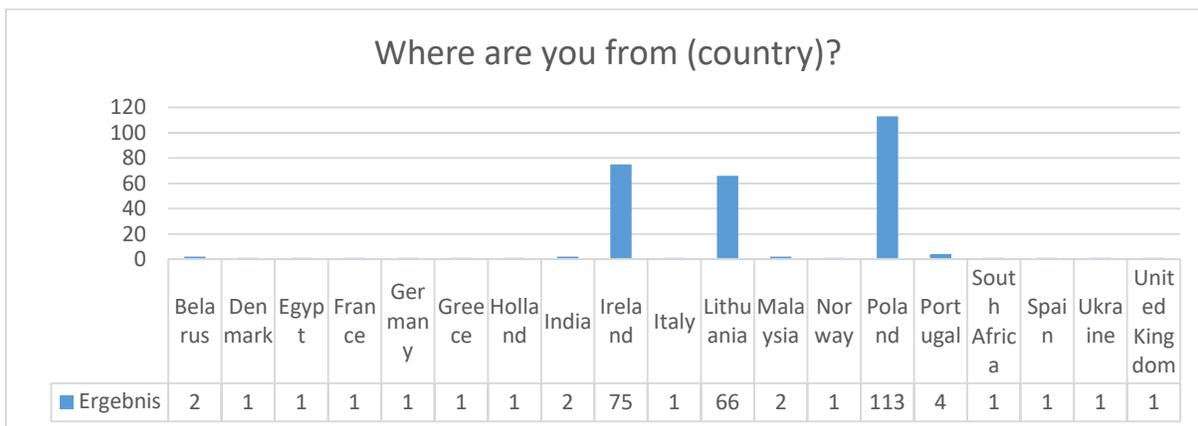
Chart 46: Research sample-countries

41

Respondents were asked about their relationship with data management, asking if they participated in classes related to this topic, see Chart 47.
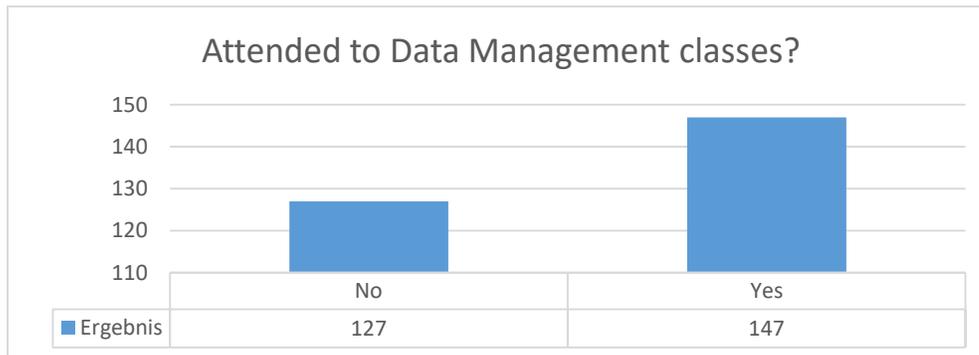
Chart 47: Attended to data management classes

Among subjects related to data management were items such as, see Table 7:

• Digital business	• Data science
• Business management	• Databases,
• Advanced Databases	• Business management
• Data Analytics	• Big Data
• Digital enterprise	• Data security management
• Management and leadership	• Programming with R, Data Science Seminar, NLP
• Business organization	• algorithms and data
• Management, organization change	• IT classes
• Business Information Systems	• e-business
• Information Systems for business	• Data management
• digital enterprise	• Management of data
• data quality	• Data management
• Secure Software Development	• Information Systems and
• Data for science	• Database Systems
• ECDL	• Digital Business, Business Information Systems
• Communications	• Office Administration
• Maths 4- Statistics	• Data Analytics, Project Management
• Mathematical skills for science	• ISI
• Business Intelligence / Big Data Architecture	• Management of knowledge
• Maths	• Office Administration
• Managing the human cap	• Data security
• Data modeling	• Statistics
• Databases	• Analytics
• Data structure and calculating ability	
• IT	

Table 7: Subjects related to data management

Students answered the question whether they are satisfied with teaching subjects related to data management. 106 did not answer, 79 respondents think the system is good, but small changes could have been made, see Chart 48.

	If yes, are you satisfied with the teaching process related to data skills subjects on your studies				
	I'm totally not satisfied, the teaching process should change as soon as possible	It's good, but the teaching process should change a bit	N/A	Not that much, there should be a lot of improvements	Yes, I am very satisfied
■ Ergebnis	9	79	106	39	41
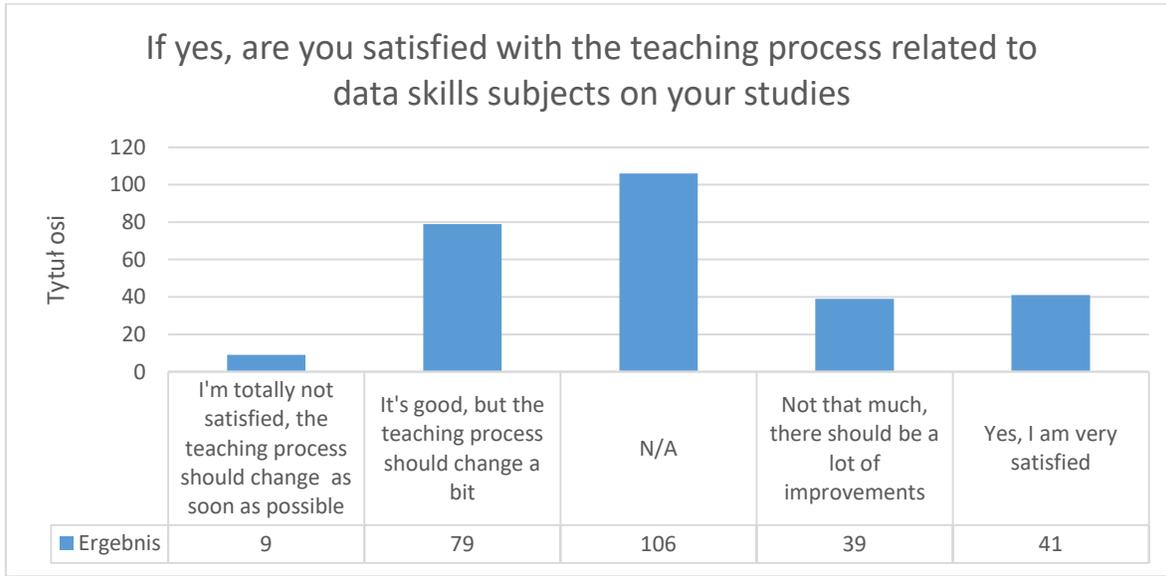
Chart 48: Satisfaction with the teaching process

Chart 49 presents the average of the results of the Smart Data section. Students in 30% indicate lack of skills in this area, and 30% indicate huge lack of skills in this area.
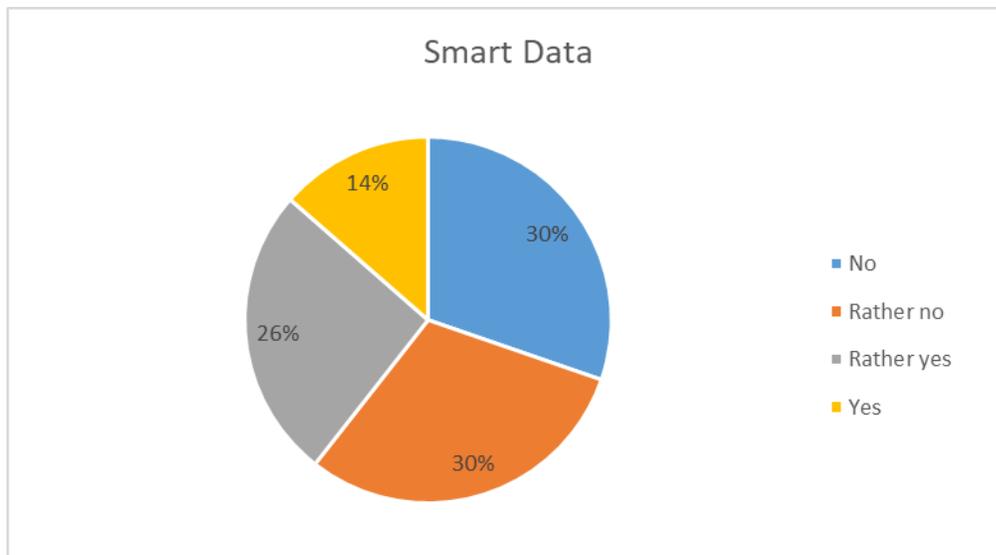
Chart 49: Smart Data

Chart 50 presents the average of the results of the Data governance section. Students in 36% indicate lack of skills in this area, and 27% for smaller lack of skills.
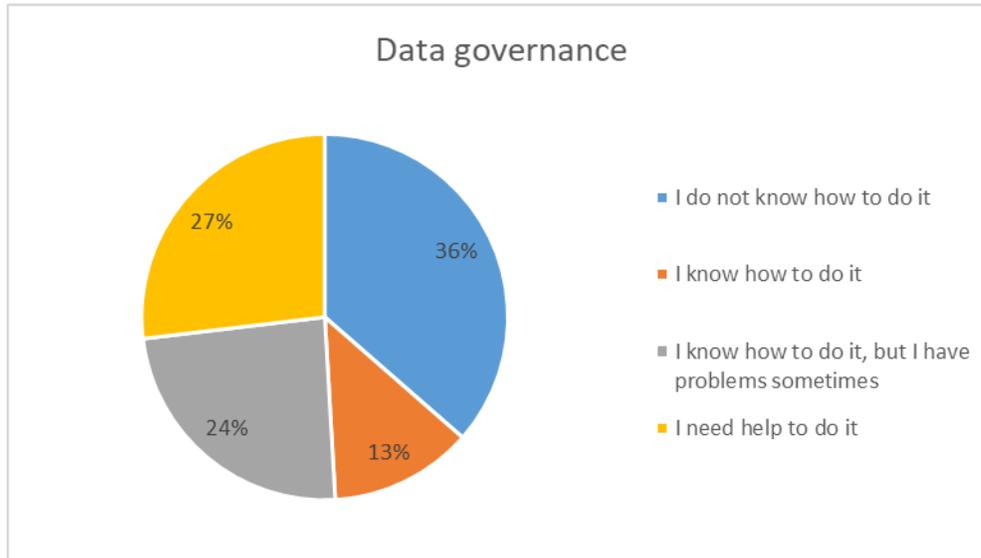
Chart 51 presents the average of the results of the Security section. Students in 29% indicate good skills in this area, and 30% for medium lack of skills.
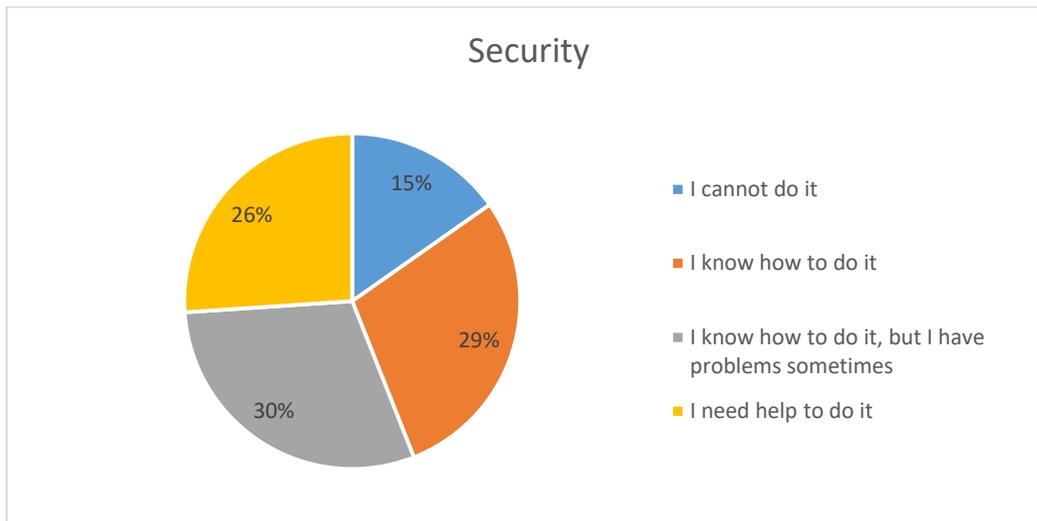
Chart 52 presents the average of the results of the Searching for information section. Students in 60% indicate good skills in this area, and 20% for medium lack of skills.

Searching for information

- I cannot do it — 5%
- I know how to do it — 66%
- I know how to do it, but I have problems sometimes — 20%
- I need help to do it — 9%
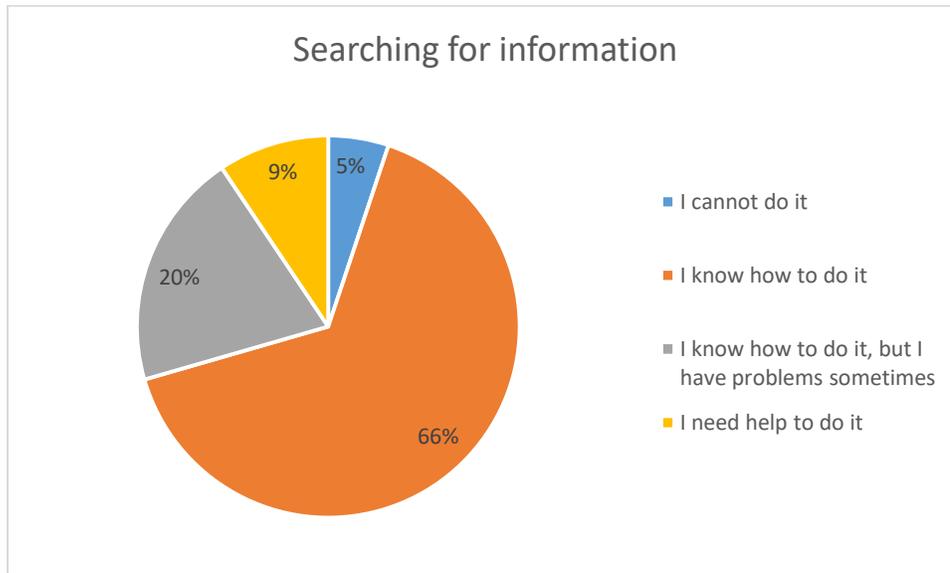
Chart 52: Searching for information

Chart 53 presents the average of the results of the Software Skills section. Students in 49% indicate very good skills in this area, and 28% have good skills but sometimes problem to apply the knowledge.

Software skills

- I don't know what it is, I cannot apply it — 8%
- I know exactly what it is and I how to apply it — 49%
- I know how to do it, but I have problems sometimes — 28%
- I need some help with it — 15%
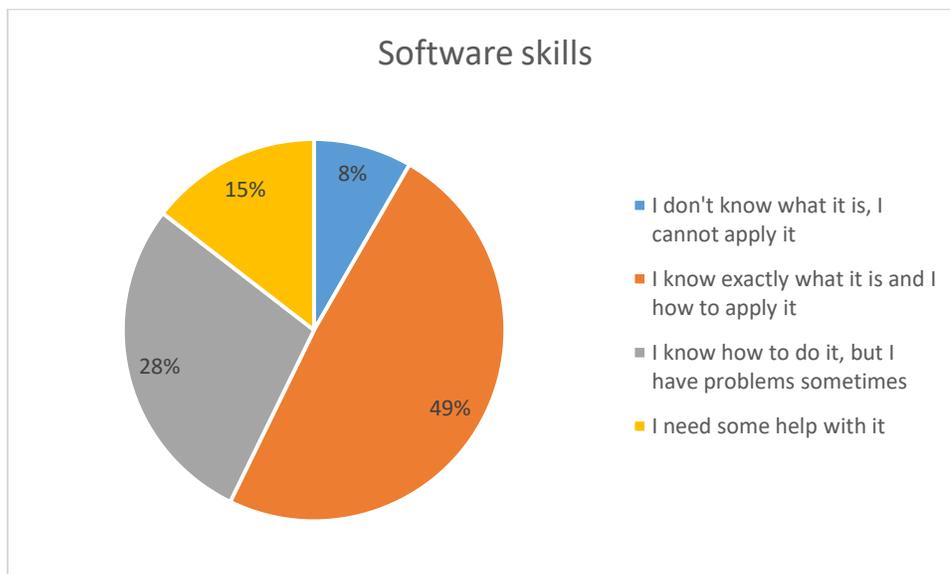
Chart 53: Software skills

Chart 54 presents the average of the results of the online software usability section. Students in 55% indicate very good skills in this area, and 24% have good skills but sometimes problem to do it.
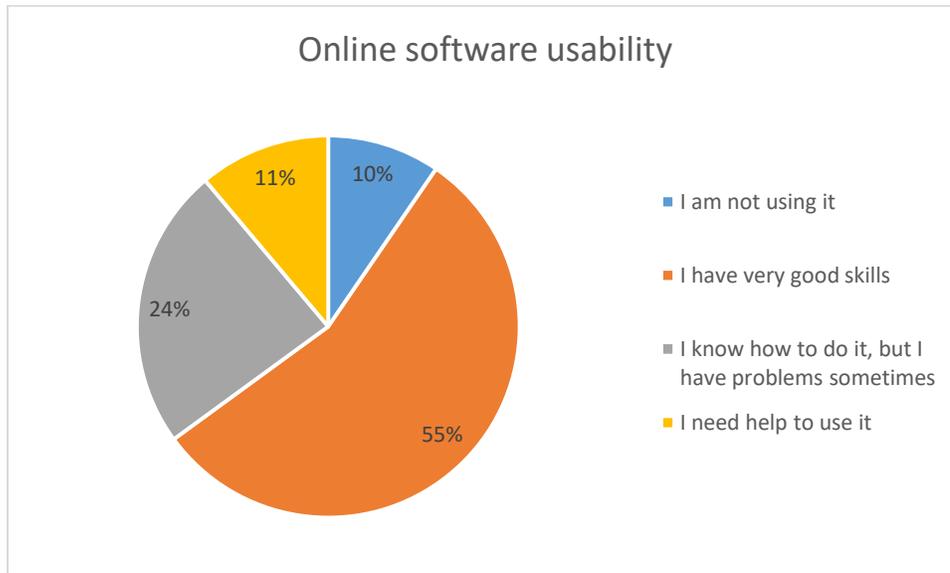
Chart 54: Online software usability

Chart 55 presents the average of the results of the online Software usability for learning or teaching purpose section. Students in 23% indicate very good skills in this area, and 30% have good skills but sometimes problem to do it.
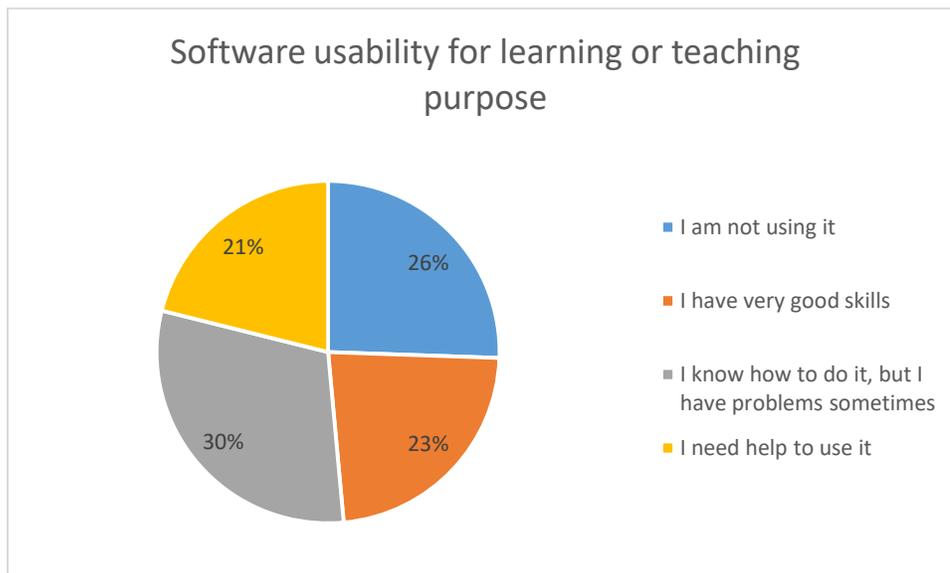
Chart 55: Software usability for learning or teaching purpose

Chart 56 presents the average of the results of the Time spent with digital devices section. Students in 51% indicate using digital devices less than 1 hour a day.

Time spent with digital devices

■	about 2 hours
■	about 4 hours
■	less than 1 hour
■	more than 4 hours

13%
11%
25%
51%
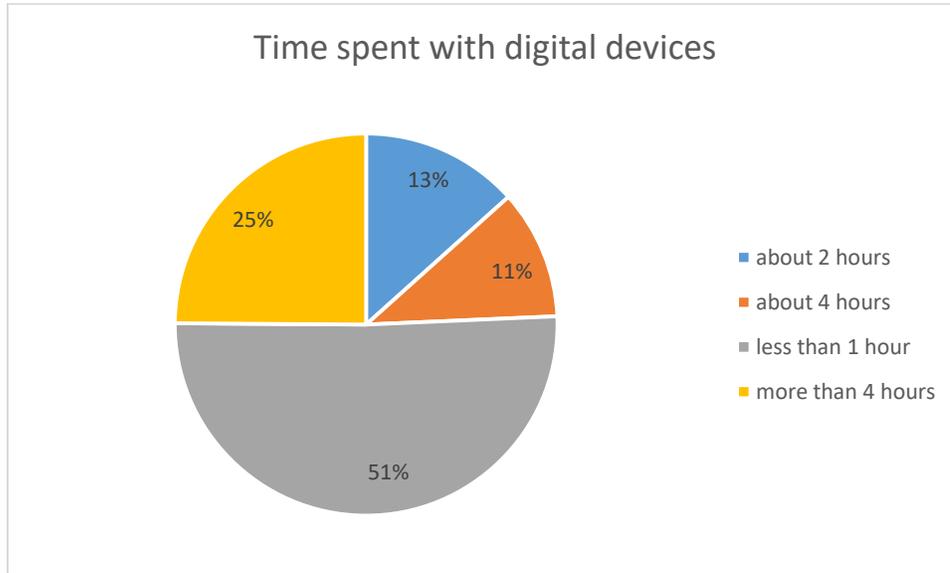
Chart 56: Time spent with digital devices

Chart 57 presents the average of the results of the Education (time spent for learning) section. Students in 58% indicate learning less than 1 hour a day.

Education (time spent for learning)

■	about 2 hours
■	about 4 hours
■	less than 1 hour
■	more than 4 hours

5%
28%
9%
58%
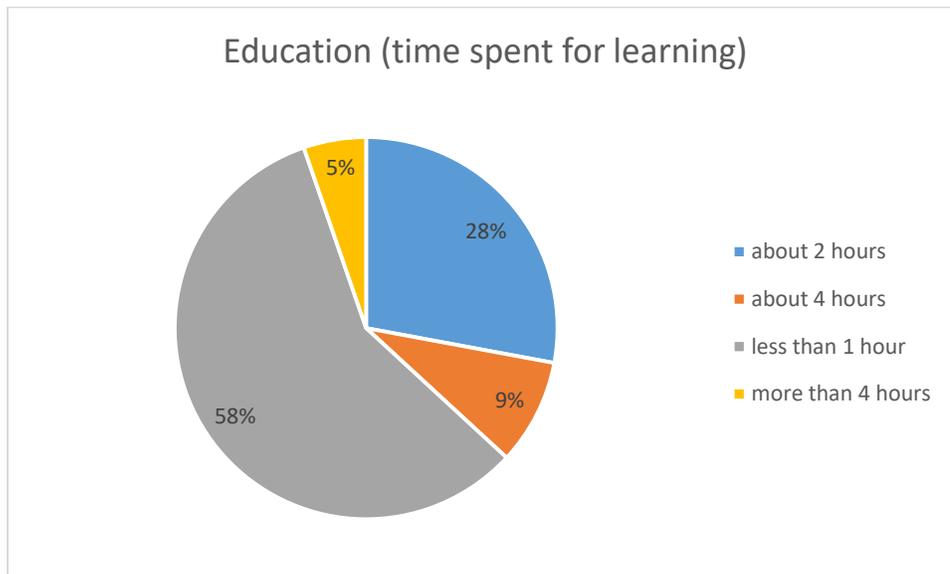
Chart 57: Education (time spent for learning)

Chart 58 presents the average of the results of the Education (attending classes improving data skills) section. Students in 45% are willing to participate in activities improving their data skills, in 43% consider it a good idea, but they would not like to participate in such classes.

Education (atteding classes improving data skills)
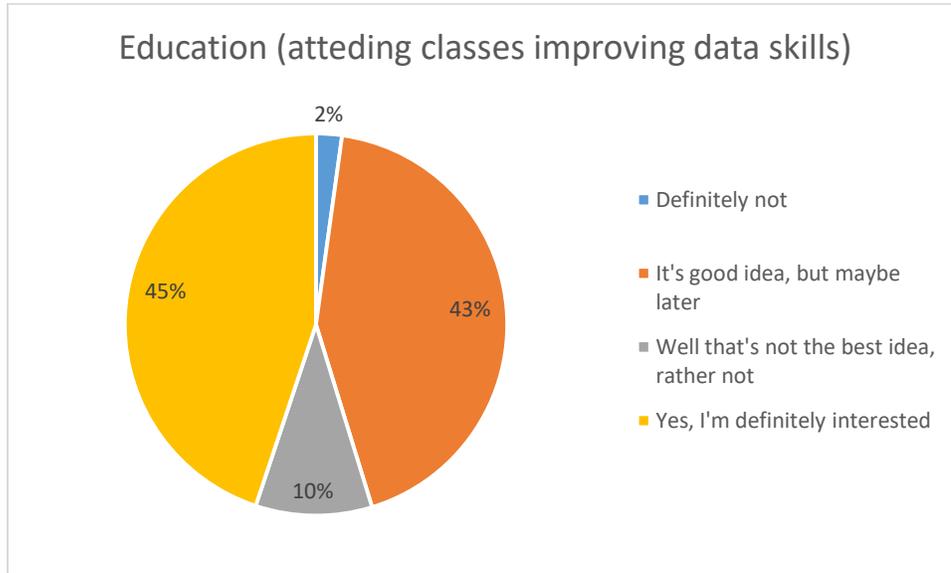
Chart 58: Education (attending classes improving data skills)

Chart 59 presents the average of the results of the Education (applying the knowledge about data) section. Students in 43% declared that they would use the acquired knowledge for business purposes and 33% in every day situation.

Education (applying the knowledge about data)
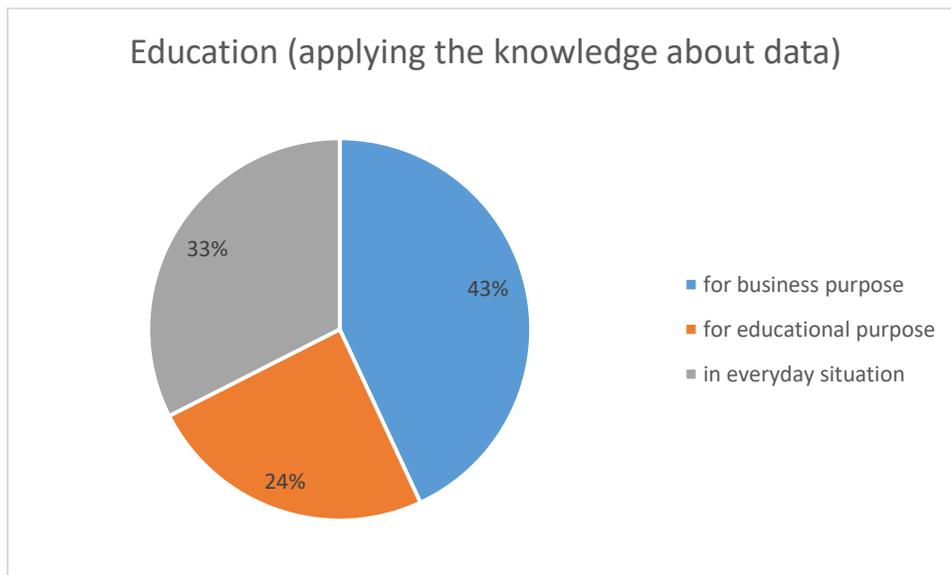
Chart 59: Education (applying the knowledge about data)

Table 8 presents the average of the results of the question which topics related to data management are important and/or should be subject to compulsory education? Arrange the importance (1 - least significant, 6 - most significant)

[Database & Storage Management]	[Data modeling and Design]	[Data Security]	[Data Quality]	[Documents and Content management]	[Data Integration and Inter-operability]
4,266667	4,094444	4,966667	4,566667	4,388889	4,044444

Table 8: Importance of topics related to data management

The most important seems to be Data Security, the least significant topic in our research has become Data modeling and Designing.

IV   RESULTS OF QUANTITATIVE RESEARCH

469 people took part in the research, of which 193 were represented by academic staff. Over 53% of the academic teachers and researchers have more than 10 years of work experience. On the other hand, in the scope of our research we surveyed 276 students, some of them are also beginning entrepreneurs. The dominant nationalities for both of the surveyed groups were Poland, Ireland and Lithuania. Over 52% of the academic staff do has nothing in common with data management and was never involved in holding classes that got any connection with management of data. On the other hand in the student group - more than 53% declare that they took part in courses related to data management. Regarding the satisfaction with University activities related to the Data Skills divided opinions prevail, and 28% of students suggest introduction improvements related to this area.

In the section related to **Smart Data**, both groups of respondents were questioned about their state of knowledge related to the concept of Smart Data, types of analyses and databases, connected with this concept. Only more than half of the academic staff declares knowledge in this field, while 60% of students declare a lack of knowledge in the field of Smart Data

Gathering a large amount of data, and hence the development of large data sets called Big Data, and their ability to be processed in Smart Data is a high value for today's business scene. Smart Data are the data from which you can (authorize us to) make business decisions. Processing information, allowing generating statements, analyzes or reports, ultimately enables effective decision-making and will be the basis for economic growth in the coming years.

Chart 60: Smart Data - results

Data Governance is a data management concept that allows the introduction of governance in the organization of data. In view of the ever-increasing mass of data, and at the same time the increasingly important role of information in management processes, it is important to have a reasonable and organized approach to the way data is managed, processed and protected.

The Data governance section checked the respondents' knowledge related to management and data processing as well as their application in everyday business. In this case, 57% of the academic staff and 63% of students indicate the lack of sufficient knowledge in this area.
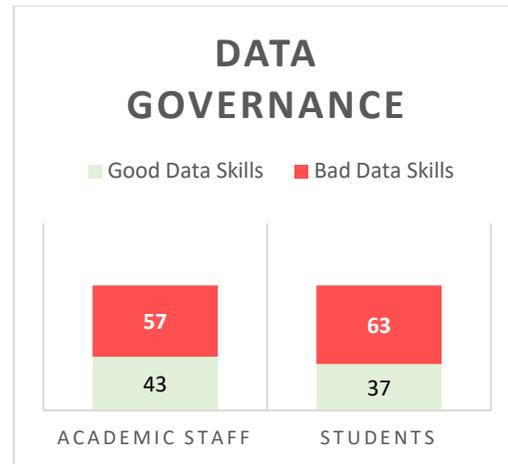
Chart 61: Data governance - results

Security problems should accompany any user of devices that allow data to be disrupted. Therefore, the skills in the field of data security, safe use of devices connecting to the Internet or digital identity protection are one of the most important Data skills aspects.

In the Security section, the respondents' skills in the safe use and security of their data as well as solving problems related to data security and software have

been tested. Among academic staff, 49% of people declare problems related to this, and only 45% of students
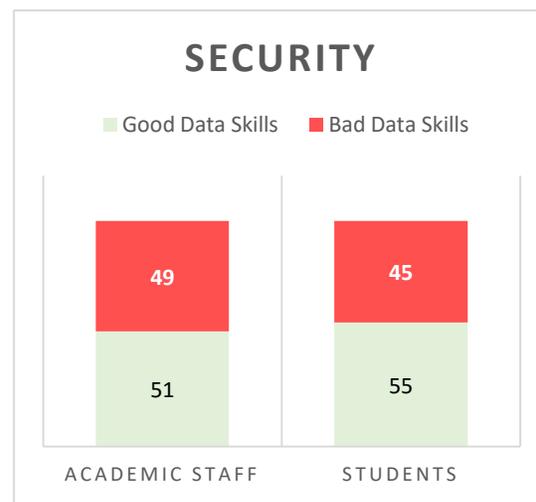
Chart 62: Security - results

51

Searching for information is currently very common and during the day a multitude of repetitive activities. Effective information retrieval, i.e. skills to limit search results and the appropriate use of the full search engine capability, saves time and finds good quality data or information.

In the field of Searching for Information, about 80% of respondents from the group of students (86%) as well as academic staff (83%) declare very good skills.
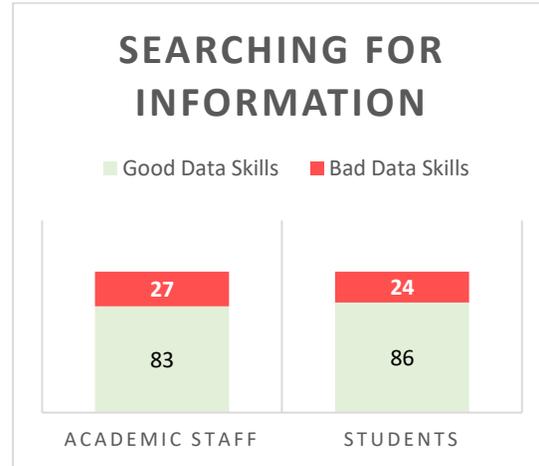
Chart 63: Searching for Information – results

Computers are an essential tool for the work, communication or even entertainment. Skills related to the selection and service of basic and specialized software are highly important and allow free and flexible movement nowadays, which primarily focus on the development of technology.

In the **Software Skills** section, related to the use of software and skills related to its selection, fitting and installation on devices of various types, students

declared 77% good skills in this respect, and the academic staff only declared their skills in 59%
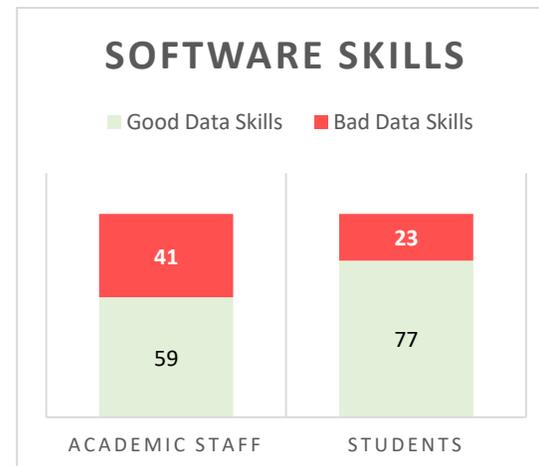
Chart 64: Software skills - results

sensitive data, such as personal data, banking data or third party data. As for the skills related to Online Usability Software, 74% of students and 73% of academic staff declared good skills in this area.

When using online services, attention should firstly be paid to the security of data that may be at risk by hackers, stalking, viruses or spam. Social media, Online banking, or online instant messengers, are particularly vulnerable to data theft, due to lack of knowledge about the proper use of websites and protection of the computer against external attacks.

The **Online Software Usability** section examined whether respondents use online services and their ability to use online software that processes

ONLINE SOFTWARE USABILTY

■ Good Data Skills   ■ Bad Data Skills

ACADEMIC STAFF	STUDENTS
17	16
73	74

Chart 65: Online software usability - results

The Internet is a basic source of knowledge and a learning tool. The interactivity of science supports the learning processes and creates the opportunity to enhance the transfer of knowledge. Knowledge of various tools and services as well as ease of use gives the opportunity to broaden the sources of information, which translates into the development of individual competences.

Software usability for learning or teaching purpose refers to the use of various websites for scientific purposes as well as modern tools for the transmission of information and data generation. 53% of students declare good skills, 26% do not use such tools, 58% declare good skills in the case of academic staff and 21% do not use such tools.

SOFTWARE USABILITY FOR LEARNING OR TEACHING PURPOSE

■ Good Data Skills   ■ Bad Data Skills

ACADEMIC STAFF	STUDENTS
42	47
58	53
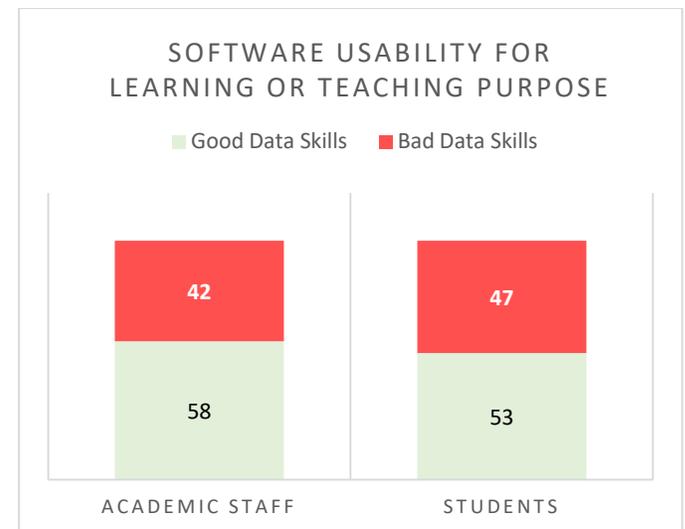
Chart 66: Software usability for learning or teaching purpose - results

53
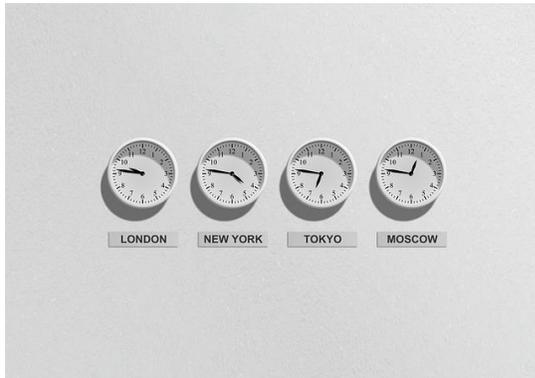
The Time spent with digital devices section defines to us how many times respondents spend time using devices that process data. Overall, 64% of students and 67% of academic staff spend up to 2 hours on using such devices as a computer, tablet, smartphone, wearable devices or gaming devices. Of which 43% of students and 65% of academic staff declare that they spend over 4 hours a day on using a computer. A high percentage, in the case of the academic staff, confirms the fact that the computer is an instrument of their daily work. In the case of students, from the time that they devote to using digital devices, 58% of them spend less than one hour per day for educational purposes.

In the Teaching section, the academic staff was questioned about their skills related to curriculum development and university policy, improving digital competences and contributing to the spread of entrepreneurship among students. 58% of respondents believe that they have problems with shaping the relevant curricula.

On the other hand, students were asked about their interest in subjects that would improve their data skills. 43% of students declare to use these skills for business purposes, 24% for educational purposes, and 33% in everyday situations.

Considering the high demand and interest among students related to the development of data skills competencies, the Academic staff should improve their skills in this area in order to be able to respond to the requirements of today's teaching market.
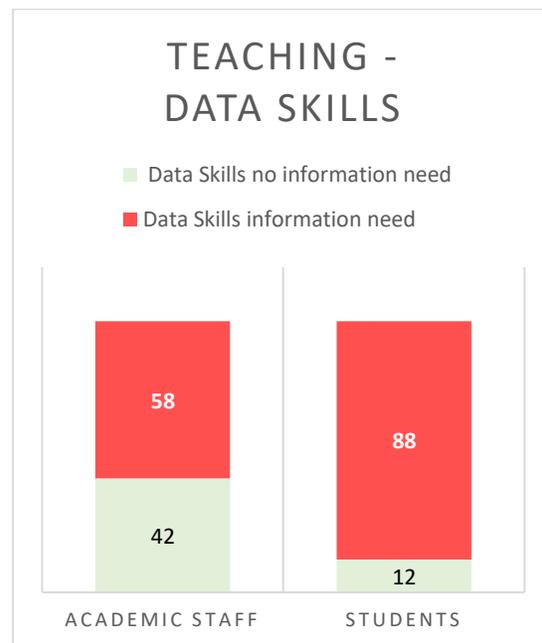
Chart 67: Teaching - results

Academic staff was also asked to indicate the main problems in the current system of teaching related to data skills.

The most important factors indicated are the lack of appropriate shaves (82%) and the lack of specialist knowledge (82.9%), which should be passed on by experts. The smallest problems include the right attitude to the high importance of data skills (54.4%).

PROBLEMS IN THE CURRENT TEACHING SYSTEM

■ Problems - Data Skills

ACCESS TO HIGH QUALITY DATA	70,5
LACK OF COLLABORATION	65,2
NEGATIVE ATTITUDE	54,4
LACK OF TIME	80,8
LACK OF TRAINING	82,9
NO REGULATIONS ON THE USE OF DATA	62,7
LACK OF SPECIALIST KNOWLEDGE	82,9
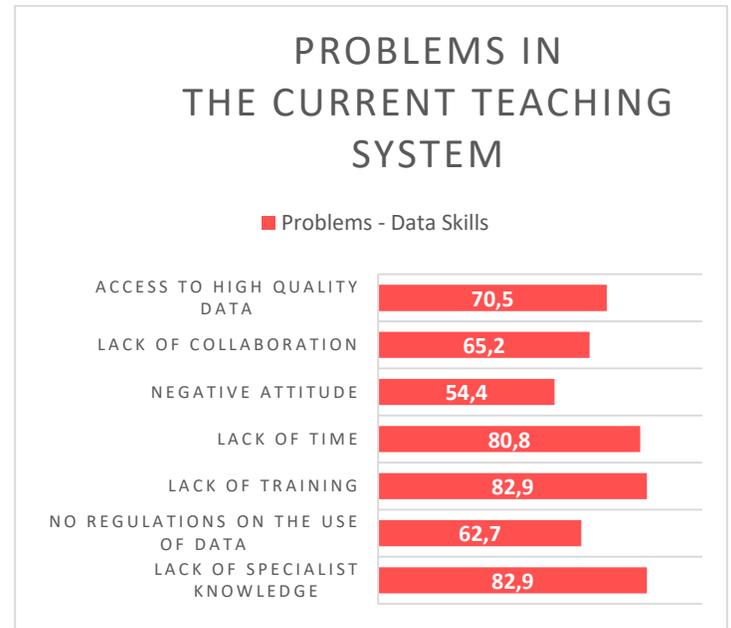
Chart 68: Problems in the current teaching system

In the next section, the academic staff was asked to propose solutions that would improve the teaching system related to data skills. Among others it was proposed to introduce more practice, case studies based on real data and cases that support entrepreneurship in students, creating training, inviting experts, introducing clear vocabulary, adding new teaching modules that take into account effective data management, including data security, data quality and data analysis, introduction of gamification, automation and machine learning.

V   RESULTS OF THE DESCRIPTIVE QUESTIONNAIRE - QUALITATIVE RESEARCH

In the next study, using **questionnaires** containing 7 descriptive questions, the project partners were asked about their opinions on their experience with data skills. The following qualitative study has enabled a deeper analysis of the studied phenomenon as well as obtaining individual views of the studied units. The questionnaire allowed to present a broader view of the problem being examined and to obtain personal recommendations that would enable the achievement of project objectives.

The questionnaire contained the following seven questions:

1. *Do you find the data management important? If so, why?*
2. *How would you assess the usage of data management by entrepreneurs in your region / country?*
3. *Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?*
4. *Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country? If yes, please name them and provide us with a link to website.*
5. *Would you recommend any good practices related to data management courses from your country or from abroad?*
6. *What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?*
7. *In your opinion, what are the most important areas of your life in which you can use data skills?*
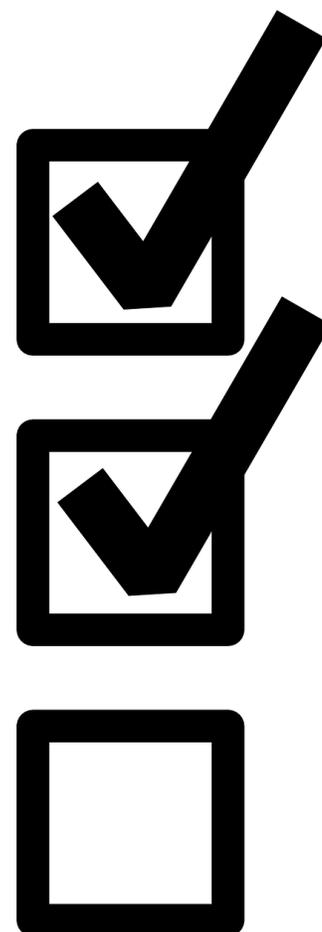
The full results of the analysis have been attached in

Appendices; see **Błąd! Nie można odnaleźć źródła odwołania.** to Appendix 5.

On question 1: "Do you find the data management important? If so, why?" all experts answered YES, justifying their answer with the following arguments:

Data management (…):

- is relevant due to the technological developments and digital advancement,
- in terms of Big Data and Analytics as they are drivers of change,
- is crucial that proper data is used in learning,
- is relevant in context of SMEs as they are of huge importance in industry
- for business purposes, how we store, utilize and analyze data is a vitally important process,
- is important for managing data efficiently and useful in decision making and learning process, for businesses as well as for individuals
- in terms of "big data and smart data" proper management of data can drive productivity, innovation and growth,
- in context of data access over time is a useful way to track progress,
- helps to work more efficient and save the time and helps to improve productivity of data users
- is important when sharing the information between team members. Data stored in a database can be accessed also remotely,
- improves safety, data stored in a database can be better protected (it can be protected with a password or opened only using authorization protocols),
- in terms of data management systems have integrated backup and recovery functions, which protects losing data after crashing or system failure.

In question 2: "How would you assess the use of data management by entrepreneurs in your region / country?" experts pointed out the following problems related to usage of data management:

Data management (…):

- helps to choose the right information in terms of scope and of veracity is crucial for learning in face of an infinite set of data,
- is empowering individuals to handle data is also a responsibility for institutions that are in charge of the common good from universities to governments
- as the awareness grows about the legalities surrounding data management entrepreneurs and companies are becoming more aware of the way in which they store and use their clients' data
- usage of clients' info can be used to optimize and business outputs,
- is creating the greatest opportunities for businesses in terms of data analytics as the emerging technology from business leaders point of view
- in terms of inability to exploit digital analytics is a threat to growth
- gives substantial benefits in terms of jobs and growth from the global expansion of the "Big Data" sector

- is connected with the upsurge in big data, which has been driven by escalating volumes of detailed information originating from business, public sector, mass media, multimedia, social networking platforms and the 'Internet of Things',
- usage is not maximized. Poor knowledge of the potential of data that currently exists within their own organization, because of time constraints and staff limitations
- usage depends on the company size and type: companies, working exceptionally with data understand the importance of the data management and its advantages. Startups, smaller companies or companies not working with data as their main activity understand the benefits of data management and use of data management systems less: they do not have enough information on data management (to less information in educational institutions), do not want to invest time and money into data management. This leads to less efficient work and information sharing, less security and communication within the team.

To the third question: "Do you think that students / early stage entrepreneurs are enough to meet the needs of data management?" the partners replied as follows:

1. Most graduates and young entrepreneurs are not prepared for the importance of data management in a proper way. It is necessary to prepare everyone, not just graduates or young entrepreneurs, to handle data in a world where there is access to infinite data without proper guidance.
2. Most educational programs at all levels from kindergarten to continuing education have no learning outcomes addressing data management.
3. People who are growing up in this digital age and have advanced skills in this area and they can build on these skills through education and further education
4. According experience of working with hundreds of start-up entrepreneurs including students, graduates and early stage entrepreneurs, that their knowledge of and prowess in data management is weak. They may have some basic skills but typically fail to use data to analyze all aspects of a business management and operations to make appropriate business decisions
5. No, focus in the latter college years is on data collection and analysis for academic dissertations and no business purposes.
6. In the other study programmes not related to IT students only get the basics on data management but this topic is not directly involved in the study programmes. This means that if the person after completing a university wants to run a start-up, he needs additional skills and education on data management.

To the fourth question: "Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country?" the partners replied as follows:

- In several countries the application of the GDPR as provided in the European Directive. At national level there are national laws and regulation on privacy protection. There is no recommendation at national, regional or sectoral areas in terms of data management. In fact, the protection of data is envisaged but there are no official recommendations about proper use of data in general. That is fundamental for a democratic society where data use may become a ubiquitous asset like money or air.
- There are some existing study programs on the University connected with data management

- National policy advisory board for enterprise, trade, science, technology and innovation in the paper "Assessing the Demand for Big Data and Analytics Skills, 2013-2020" put forward a number of proposals relating to learning and education. These include that
  - Computer skills should be introduced at an earlier stage in the education system
  - There should be more focus on the teaching of maths at primary level.
  - A problem-solving approach should be adopted in second level maths curricula.
  - Greater female participation in analytics should be targeted from an early age.
  - At third level, cooperation between industry and academia is crucial to ensure that education reflects skills needs.
- In higher education, many modules would contain elements of data management, such as Google Analytics, Digital Marketing, and Statistics. But no official country wide to our knowledge.
- There are no national recommendations, but as an EU Member state Lithuania has to follow EU GDPR. The Ministry of Education and Science performed a research for further recommendations.

To the fifth question: "Would you recommend any good practices related to data management courses from your country or from abroad?" the partners replied as follows:

- The recommendation of any of these depends as in all degrees and courses on quality evaluation in education and training. Choices for this type of courses depend as any other educational area on many contextual indicators.
- It is vital that Data management process and practices are taught form a young age, eg. Implemented into high school curriculum in order to stay in line with market desire and promoting employability of learners.
- A Diploma in Data Analytics for Business (Springboard+). The Diploma in Data Analytics for Business aims to provide learners with a progression pathway to professional roles at entry or junior level in Data Analysis as well as the option to further their education in the area of Data Analytics.   Admission to this Diploma is through one of the following:
  - Evidence of prior learning, including experiential learning, or
  - Possession of an NFQ level 5 award, including leaving certificate, FET award, or equivalent.
- The Springboard+ upskilling initiative in higher education offers free courses at certificate, degree and masters level leading to qualifications in areas where there are employment opportunities in the economy.
- The Canadian University of Waterloo model see students equipped with 24 months of experience upon graduation.
- Courses (and careers) in Big Data Management in Ireland https://www.goireland.in/big-data-management-course-ireland.
- Tech connective live and conferences.
- Follow EU practice (GDPR).

To the sixth question: "What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?" the partners replied as follows:

- Data management should make part of every HEI or VET program in all levels of lifelong learning

- All programs should train everyone with strong analytical skills, capable of collecting, organizing and analyzing the information, translating it into a strategic resource that allows anyone to innovate, to develop competitive advantages and to act as a responsible citizen.
- More hands on and practical implementation of data management education should be adapted, starting school education. Encouraging learners who show an affinity with this topic to continue studying this topic, highlighting the opportunities which will be open to them.
- It is important that learners are shown the practical implications of successful and unsuccessful data management and, by using best practice examples, show the benefits.
- The key to improving data management education is to feature analytical modules across less technical disciplines, such as business and social sciences.
- Allow transition into analytics from other disciplines and up-skilling and retraining into the area should be encouraged. Short courses for individuals with technical backgrounds should be provided.
- Accredited and focused short courses that can be taken as CPD options. These could collate to an overall award. More attractive short/flexible accreditation that is industry recognized.
- Applied projects linked to SME needs
- Add more topics on data management: managers, engineers, artists – everyone has to gain this knowledge.
- Encouraging startups in the university. Each entrepreneur needs the understanding on:
    - data governance and data quality management
    - database management systems
    - data analytics/data mining
    - enterprise content management
    - big data management, etc.

To the seventh question: "In your opinion, what are the most important areas of your life in which you can use data skills?" the partners replied as follows:

- Political: understand what fake news is or choose reliable sources is fundamental in a world where manipulation has become easier.
- Professional: choosing the right data that will improve the procedures used to perform better in the roles assumed as a citizen.
- Personal: find proper data about restaurants to attend, the best route to take home when returning from work, the best flights to travel and the most profitable investment are small examples where data management can highly influence choices and decision making.
- Data management is a task present at any time of the day and of the night and the competences are fundamental to take solidly grounded and conscious decisions.
- Data skills are required for day job
- Data skills make life to easier eg. Google, Excel, Alexa, etc
- Online Shopping. Since the growth of Big Data in retail, the entire industry is completely changing.
- Wearables and health (e.g. my Fitbit and the powerful data in collates for weekly).
- Energy Consumption
- Using data skills to effectively conduct research, communications and message creation
- Interesting article Big Data is Everywhere
- In teaching relevant smart data skills to students and application to micro and small businesses

- From a student perspective, finding relevant, quality research. Business perspective, marketing and customer demand data.
- Ethical use of data needs to be addresses as well as how to be wary of how our own data is collected.
- How to use and link data, the context of key data sets and performance and SMART real/time data - how to manage this from a small business perspective.
- Tracking progression in life and work
- Personal data protection (e.g. product design)
- Customer databases
- Better CRM
- Information distribution between employees and teams
- Company data security
- To make company services more efficient
- To help employees work faster/more efficient
- To improve communication inside the company

VI   POLITICAL AND REGULATORY CONTEXT

GDPR

The European Union regulates provisions related to the subject of data management. Above all, however, he focuses on the topic of data security. The "EU Charter of Fundamental Rights" provides that EU citizens have the right to protect their personal data.

The most important legislative package that emerged from the European Union in May 2016 and has been in force since May 2018 is the General Data Protection Regulation, whose main purpose is to prepare the citizens of Europe for the digital era. The regulations are valid throughout Europe, regardless of the place where data is processed. The Regulation makes it easier to conduct business operations by simplifying the rules related to the processing of digital content. The purpose of this regulation is to strive to ensure that every citizen will have the right to decide on their own personal data and decide who and where to store the data.

Special bodies have been set up in the European Union countries to oversee compliance with personal data protection laws in each country. The supervisory authorities of EU countries are now working together as part of the Article 29 Working Party. The European Data Protection Supervisor (EDPS) and the European Commission are also members of this group. On May 25, 2018, the Art. 29 Working Group will be replaced by the European Data Protection Board.

The Regulation on the protection of personal data sets out the requirements for the collection of personal data and the activities related to the management of personal data, it applies to all companies that collect and use data on individuals.

The regulation is technologically neutral, it does not point to specific, specific tools and systems that are supposed to secure data. Therefore, it allows companies to design their own data protection systems, which means that the implementation of new regulations will require a certain dose of creativity. Because the regulations do not indicate a way to solve the problem, it means that companies must be guided by their own interpretation and adapt the system to the character of their company. Therefore, data protection does not only end with designing the system, but also matching the company's procedures and processes to the requirements of personal data protection.

From the point of view of the consumer, it is possible to request access to personal information that is stored by the given company, but also the possibility to delete them. A consumer agreeing to the storage of personal data must be informed about the purpose of their storage. Personal data includes the following information: name and surname, address, identity card / passport number, income, cultural characteristics, data in the possession of a hospital or doctor (clearly identifying a given person for medical purposes), but also IP addresses and cookies.

When implementing the provisions of the GDPR, it is recommended that the following steps be taken:

1. Inventory of processed data (where, for what purpose and which data are processed)

2. Risk analysis (who has access to data, which can cause data leakage)

3. Risk weight (determine the degree and the risk weight and the probability with which it may occur)

4. Solution (reducing the occurrence of risk, determining the security according to RODO)

ENTRECOMP

Entrepreneurship competence framework was published in 2016 by the European Commission. Over 18 months, many experts from all over Europe worked on the competence frames, which made it possible to take into account the situation prevailing in various Member States.

The main goal of EntreComp is to show the importance of the development of entrepreneurial skills of European Union citizens and to indicate the policy directions of the Member States allowing achieving this goal. The EnterComp framework presented defines entrepreneurship as a competence that enables the creation of a link between the side of education and professional practice. Entrepreneurship as a transversal competence finds application in a wide spectrum of issues such as employment, education, training and in relation to human life. This framework can be

used, among others, to develop teaching programs that lead to the development of entrepreneurship among young people, treating it as a kind of competence and also allow for assessing entrepreneurial skills.

JRC SCIENCE FOR POLICY REPORT

EntreComp: The Entrepreneurship Competence Framework

Margherita Bacigalupo, Panagiotis Kampylis
Yves Punie, Godelieve Van den Brande

2016

EUR 27939 EN
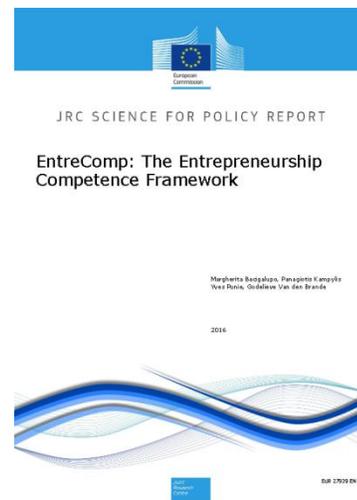
DIGCOMP

Digital Competence Framework version 2.0 was published by the European Commission in 2016. It was developed by a scientific group from European Union countries and a group of interests in industry, education and

employment. In response to the message. "A new agenda of skills for Europe: Cooperation to strengthen human capital, employment and competitiveness", presenting ways of dealing with the subject of competences, aimed at

defining the range of skills that every European citizen should have in order to function in today's fast-growing economy, defined DigiComp framework, which in key skills such as reading, writing, counting, knowledge of science, knowledge of foreign languages, digital competences, entrepreneurship, critical thinking, problem solving and learning, provide tools to improve competences digital, designed to contribute to innovative society and the economy.

DigiComp allows for the formulation of a policy that enables building digital competences, defining a unified technical language of digital areas, defining a reference point on a European scale. The key digital competences include: information processing, communication, creating digital information, including programming skills and knowledge of copyright issues, maintaining safety, and solving problems.

DIGCOMPORG

The European Framework for Digitally Competent Educational Organizations is an extension of the DigComp framework for digital competence training by supporting educational institutions and educational systems in the digital transformation process. The framework allows for the creation of an effective policy that allows the practical use of technology in the education field.

In 2018, the European Commission also published the Digital Education Action Plan, which supports institutions in digital education, recognizing that IT skills development is an important factor. As part of its priorities, this plan provides for investment in IT competences. The plan's most important priorities include: Effective use of digital technologies in teaching and learning, Development of appropriate competences for digital transformation, and: Improvement of education systems through better data analysis and long-term planning.

EDUCATIONAL FRAMEWORK

At universities of our project partner countries there are guidelines for fields of study, primarily related to economics and IT, which define the scope of digital competences, including data skills.

The most important guidelines include:

- ability to understand the fundamental of data analytics and to visualize the data (include extracting, summarizing, filtering, joining, assigning data and create appropriate chart elements, using graphs, coordinates, as well as implementing principles of visualization designs to identify patterns and insight in data),

- ability to make sense of and to communicate with data to relevant audience

- knowledge about popular data analytics tools (i.e., Caseware IDEA, Microsoft Azure Machine Learning, Tableau Prep and Tableau Desktop),

• knowledge about digital media technology area (including problems with continuous change by technologies),

• development of analytical skills on empirical data by introducing popular data science methods to support decision making and evaluation in business (with focus on Business intelligence technologies, applications and practices for the collection, integration, analysis, and presentation of business data in order to support business decision making),

• knowledge about artificial intelligence and machine learning (with focus on analysis of data to perform predictions using statistical tools and methods, providing learning capabilities for machines; hence machine- and deep learning),

• development of computer skills at an earlier stage in the education system,

• development of cooperation between industry and academia (education reflects labor skills needs),

• development of data skills (wit focus on Google Analytics, Digital Marketing, Cloud Computing, Databases, Database Management, Database Administration, Information Security, Data Mining, Statistics, Data Analysis).

The guidelines related to staff training include:

• development of training strategies (changing the training model, including actions motivating academic teachers to draw on digital resources and focusing on activating teaching methods),

• introducing examinations to check the possession of digital competences (introduction of the Integrated Qualification System allowing the assessment of digital competences, recognized as market qualifications),

• elimination of digital illiteracy for teachers (especially people over 50).

VII   RECOMMENDATIONS AND BEST PRACTICES

Among the results, it can be noticed that, on average, about half of the respondents have a lack of adequate knowledge and skills related to data skills. Compared to the students, the respondents of the academic staff show a greater theoretical knowledge in the field of data management, showing at the same time deficiencies in its practical application. While examining the students, this issue looks in an opposite way. In questions about knowledge in the field of theory and procedures, students show less knowledge, while in applications, they declare higher skills. What also results from the greater "online mobility" of current students and the partial access to the computer of this generation.

Academic staff and students were in favor of the great need to improve data skills from theoretical as well as practical sites. Academic staff notices growing deficiencies in current curricula, believes that they are not adapted to the present times, which exposes rapid technological development, and thus a large amount of information processed. In order to solve these problems, trainings conducted by specialized persons are needed, which will allow the academic staff to pass the required

knowledge, which they will then be able to pass to the hundred and future entrepreneurs.

After analyzing both quantitative and qualitative surveys, it can be concluded that most students and academic staff have deficiencies related to data management and there is a growing demand for data skills. Due to the lack of regulations at the national level regarding other areas of data management (apart from the RODO, which is defined in the European Directive), there is a need to define good practices and recommends related to the acquisition of appropriate data skills for institutions educating future entrepreneurs.

RECOMMENDATIONS

1. Developing a strategic framework for the development of e-competences, including the preparation of a data skills development plan. The framework should contain separate strategies for the integration of digitally excluded people and e-activation of people using the Internet, as well as a catalog of digital competences, typologies of the benefits of using it, performance standards, and communication and information strategies for digital competences.
2. Implementation of the model through the introduction of a relational approach to the issue of developing data skills as the basis for all implemented activities. This means, firstly, that the model is popularized through information campaigns, training and educational materials. Promoting the importance of the concept of smart data management and data skills among academic staff and

students. Secondly, it is necessary to develop an operationalized model of relatively treated competences - aimed at achieving functional benefits in various areas of life - for the needs of implemented projects to improve e-competences.

3. Introducing the obligation to analyze the needs of training participants, including gathering information about their previous experience in the use of ICT, as well as about their needs, interests and motivations.

4. Ensuring better coordination of activities between entrepreneurs and universities in order to implement projects for the development of competences leading to the development of entrepreneurship of program participants. This will allow:
   - exchange of experiences,
   - development of standards (among others, the scope of training, the catalog of competences or evaluation and monitoring of activities) and to support self-regulation of entities implementing activities for digital competences,
   - ensuring the complementarity and coordination of activities carried out by various entities and from various sources of financing,
   - support of development of innovative methods for raising digital competences,
   - external monitoring and evaluation of activities,
   - collecting and sharing resources (including educational resources) created as part of ongoing projects,
   - conducting information, education and dissemination activities.

5. Creating tools measuring the demand for data skills of academic staff and students (due to different levels of experience and knowledge), on the basis of which you will be able to introduce training in data management, tools (specific software tools), methods tailored to individual needs, based on remuneration systems such as certificates, gamification.

6. Introduction of training for academic staff in the field of curriculum design, including data skills related topics.

7. Greater participation of entrepreneurs in shaping the curricula

8. Introduction for students (not only IT courses), subjects related to entrepreneurship and data management, based on practical examples (case studies) and salary systems such as ECTS points, certifications, and gamification. It is not recommended to enter too much theory

9. Introducing flexibility in the choice of modules, tailored to the needs of students, including primarily the subject of increasing Data Skills, such as:
   a. Smart Data
   b. Data Governance
   c. Data Security
   d. Software Technology

10. Creation of an effective long-term implementation plan taking into account technological and regulatory changes in the subject of data management

Over the last decade, good practices related to the development of digital competences, including data skills, aimed at developing entrepreneurship, aiming at e / integration and combating digital exclusion have included,

among others, three components: hardware, resource and competence. They provided adequate equipment, internet access, services and products needed to use the internet and training, increasing skills and knowledge.

Early good e-integration practices included equipping educational institutions with computer labs and creating nationwide networks of public Internet access points to improve professional qualifications, called distance learning centers.

BEST PRACTICES

• Training

Training is a good practice focused on developing competences. One of the moving examples may be the e-learning course, e.g. the Polish "N @ utobus", operating in the field of education: the Ministry of National Education has trained nearly 17,000 teachers in the project "ICT teacher training courses". Another example can be the project "SIRMA - Network for Innovative Mazovia e-Development", implemented in the Mazowieckie Voivodeship by the City Association on the Internet. The aim of the project was to increase the potential of innovative activities using ICT through specialized training for representatives of public administration.

• Digital incubators

Creation of digital incubators providing substantive support in the development of digital competences. An example is the project project e-Centers, implemented by the Foundation for Helping Mathematics and Movable Physicists using public Internet access points created under the program "Distance learning centers in the villages".

The main tasks of digital centers would be:

- for identification of partners
- for identification of needs in the field of digital activation,
- for identification of resources and deficits in the field of digital activation,

• Projects using the potential of information and communication technologies

An example is the Orange Academy program, which has been in operation since 2010, promoting innovative projects in the field of cultural education and animation using the potential of IT.

• E-integration and E-activation

Other activities improving digital competences, including data skills, establishing a harmonious team of knowledge, skills and attitudes that allow you to effectively use digital technologies in various areas of life, including entrepreneurship development.

APPENDIX 1: SURVEY RESULTS EUEI

1. ***Do you find the data management important? If so, why?***

    Data Management is a vitally important part of our society in today's day and age due to the technical and digital advancement. For small businesses, larger companies and even sole traders Data Management, how we store, utilize and analyze data is a vitally important process. It comes with the responsibility of hosting others' info and ensuring that this is properly dealt with.

2.   ***How would you assess the usage of data management by entrepreneurs in your region / country?***

    I feel that as the awareness grows about the legalities surrounding data management entrepreneurs and companies are becoming more aware of the way in which they store and use their clients' data. The data management usage of clients' info can be used to optimize and business outputs.

3.   ***Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?***

    I believe that young people who are growing up in this digital age and have advanced skills in this area and they can build on these skills through education and further education. As they are "natives" to digital technology they can meet these market needs.

4.   ***Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country? If yes, please name them and provide us with a link to website.***

    From Study in Denmark:

Data Analytics for Accounting: Case-based Approach 2019	*Economics, commerce, management and accounting*	*Summer School of*	*Aarhus University (AU)*
Data Interaction Cyber Programme 1:1 DTU-KAIST	*Engineering Mathematics, natural- and computer science*	*Master (2 years) of Science in Data Interaction*	*Technical University of Denmark (DTU)*
Data Science for Business Intelligence (DSBI) 2019	*Economics, commerce, management and accounting*	*Summer School of*	*Aarhus University (AU)*

Data science in insurance 2019	*Economics, commerce, management and accounting*	*Summer School of*	*Aarhus University (AU)*
Introduction to Data Science in Python 2019	*Economics, commerce, management and accounting Mathematics, natural- and computer science*	*Summer School of*	*Aarhus University (AU)*

5.   Would you recommend any good practices related to data management courses from your country or from abroad?

I believe that it is vital that Data management process and practices are taught form a young age, eg. Implemented into high school curriculum in order to stay in line with market desire and promoting employability of learners.

6.   What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?

I believe that more hands on and practical implementation of data management education should be adapted, starting school education. Encouraging learners who show an affinity with this topic to continue studying this topic, highlighting the opportunities which will be open to them, also I think it is important that learners are shown the practical implications of successful and unsuccessful data management and, by using best practice examples, show the benefits.

7.   In your opinion, what are the most important areas of your life in which you can use data skills?

Data skills which are required for my day job

Data skills which all my life to be much easier eg. Google, excel, Alexa etc

2. *How would you assess the usage of data management by entrepreneurs in your region / country?*

Data management is power in all society domains and history. Currently it is more relevant due to the technological developments. In education it is crucial that proper data is used in learning. There is an infinite set of data and choosing the right information in terms of scope and of veracity is crucial for learning. This is probably the main role of teachers and trainers in the next decade. Empowering individuals to handle data is also a responsibility for institutions that are in charge of the common good from universities to governments. Data management can return to the dark ages or to sustainable future depending on the quality of the management.

3. *Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?*

Most graduates and young entrepreneurs are not prepared for the importance of data management in a proper way. The search engines create the illusion that the results are reliable and valuable but these depend on the search rules, previous requests and starting positions. It is necessary to prepare everyone, not just graduates or young entrepreneurs, to handle data in a world where there is access to infinite data without proper guidance. Filters are necessary as well as tutoring about values and evaluation of the veracity and quality of results. Most educational programs at all levels from kindergarten to continuing education have no learning outcomes addressing data management.

4. *Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country?*

There is in several countries the application of the GDPR as provided in the European Directive. At national level there are national laws and regulation on privacy protection. There is no recommendation at national, regional or sectoral areas in terms of data management. Of course GDPR conditions the use of data in terms of privacy of individuals and companies but does not address a proper approach to manage data in general. Certain countries have regulations concerning financial data management. In fact, the protection of data is envisaged but there are no official recommendations about proper use of data in general. That is fundamental for a democratic society where data use may become a ubiquitous asset like money or air.

5. *Would you recommend any good practices related to data management courses from your country or from abroad?*

No suggestions for any course or program. There are several courses on data management and program

degrees in data managers. The recommendation of any of these depends as in all degrees and courses on quality evaluation in education and training. Choices for this type of courses depend as any other educational area on many contextual indicators. There are no rankings of these types of courses or programs.

Of course, the topic should be addressed at all levels in the educational systems and HEI could be pro-active in proposing adapted ways to different audiences.

6. **What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?**

Definitely data management should make part of every HEI or VET program in all levels of lifelong learning. In today's society, data handling is becoming more and more complex. Everyone deals daily with a huge amount of data, generated by numerous sources. This reality causes a high demand for people with competences in the area of information management, who are able to use the most modern techniques and analytical tools to support decision making. All programs should train everyone with strong analytical skills, capable of collecting, organizing and analyzing the information, translating it into a strategic resource that allows anyone to innovate, to develop competitive advantages and to act as a responsible citizen.

7. **In your opinion, what are the most important areas of your life in which you can use data skills?**

Competences in data management are useful in all dimensions of my life. Political: understand what fake news is or choose reliable sources is fundamental in a world where manipulation has become easier. Professional: choosing the right data that will improve the procedures used to perform better in the roles assumed as a citizen. Personal: find proper data about restaurants to attend, the best route to take home when returning from work, the best flights to travel and the most profitable investment are small examples where data management can highly influence choices and decision making. Data management is a task present at any time of the day and of the night and the competences are fundamental to take solidly grounded and conscious decisions.

APPENDIX 3: SURVEY RESULTS FELTECH

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1. ***Do you find the topic of data management important? If so, why?***

Absolutely.   Big Data and Analytics are drivers of change. BY MANAGING DATA EFFICIENTLY, SOUND MANAGEMENT DECISIONS CAN BE MADE.   *When "big" data is turned into actionable "smart" data, it can drive productivity, innovation and growth.   Hence the topic has never been more important.   Research conducted in 2012 found that there was an incremental return on investment in big data of more than 200%.*[4]

2. ***How would you assess the usage of data management by entrepreneurs in your region / country?***

PwC's CEO Pulse Survey found that the majority of Irish business leaders (70 per cent) see data analytics as the emerging technology which offers the greatest opportunities for their businesses. At the same time, nearly half (48 per cent) said that the inability to exploit digital analytics is a threat to growth.[i]

The Irish Government has been working on developing Ireland's potential to make the most of big data. 'Assessing the Demand for Big Data and Analytics Skills, 2013-2020[5]*' was the first major report that showed how the Irish skills base and research capability in ICT has the potential to reap substantial benefits in terms of jobs and growth from the global expansion of the "Big Data" sector.   However, the focus currently is very much on research (e.g.* [The INSIGHT Centre](#) *- The National Centre for Data Analytics*[6]*) and larger businesses as opposed to entrepreneur's usage of data management.*

The upsurge in big data in Ireland has been driven by escalating volumes of detailed information originating

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[4] Nucleus Research (2012) – "The big returns from big data".

[5] http://www.skillsireland.ie/media/07052014-Assessing_the_Demand_for_Big_Data_and_Analytics_Skills_Full-Publication.pdf

[6] The Insight Centre for Data Analytics is a joint initiative between researchers at Dublin City University, NUI Galway, University College Cork, University College Dublin and other partner institutions. Insight brings together more than 400+ researchers from these institutions, €100m+ funding, and with over 80+ industry partners, to position Ireland at the heart of global data analytics research.

from companies and enterprises and the public sector, mass media and multimedia, social networking platforms and the 'Internet of Things'.

3. ***Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?***

No. It is our experience of working with hundreds of start-up entrepreneurs including students, graduates and early stage entrepreneurs, that their knowledge of and prowess in data management is weak. They may have some basic skills but typically fail to use data to analyze all aspects of a business management and operations to make appropriate business decisions. As highlighted in the 'Assessing the Demand for Big Data and Analytics Skills, 2013-2020' report "If Ireland is to become a leading country in Europe for big data and analytics, there is a need for a step change in the awareness and image of the business area".

4. ***Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country? If yes, please name them and provide us with a link to website.***

[Assessing the Demand for Big Data and Analytics Skills, 2013-2020](#) put forward a number of proposals relating to learning and education. These include that

- *Computer skills should be introduced at an earlier stage in the education system*

- *There should be more focus on the teaching of maths at primary level.*

- *A problem-solving approach should be adopted in second level maths curricula.*

- *Greater female participation in analytics should be targeted from an early age.*

- *At third level, cooperation between industry and academia is crucial to ensure that education reflects skills needs. Proposals included*

  - *involving industry experts in devising curricula and teaching analytics on university programmes.*

  - *Work placements, both in industry and in research centres, should form an integral part of third level courses for students of big data and analytics and collaboration with industry is vital in this regard. In particular the*

  - *Facilitating students on relevant courses to meet people already working in the area to discuss career options is seen as an effective way to attract them to the field.*

  - *As a means of raising standards it was suggested that universities with the strongest records in maths and statistics should come together in order to offer specialized courses.*

  - *Increased funding should be provided for research to support career options for analytics in academia and to drive innovation.*

o   *Analytical modules should also feature across less technical disciplines, such as business and social sciences.*

5.   **Would you recommend any good practices related to data management courses from your country or from abroad?**

- *A Diploma in Data Analytics for Business (Springboard+) available in colleges throughout Ireland – example from CCT. The Diploma in Data Analytics for Business aims to provide learners with a progression pathway to professional roles at entry or junior level in Data Analysis as well as the option to further their education in the area of Data Analytics.   Admission to this Diploma is through one of the following:*
    o   *Evidence of prior learning, including experiential learning, or*
    o   *Possession of an NFQ level 5 award, including leaving certificate, FET award, or equivalent.*

   In addition, all applicants must evidence competence in mathematics equivalent to O6 standard in leaving certificate and competence in the use of IT. Basic computer literacy is not sufficient for this programme.

   The Springboard+ upskilling initiative in higher education offers free courses at certificate, degree and masters level leading to qualifications in areas where there are employment opportunities in the economy.

- *The Canadian University of Waterloo model see students equipped with 24 months of experience upon graduation. https://uwaterloo.ca/future-students/programs/data-science*

- *Courses (and careers) in Big Data Management in Ireland https://www.goireland.in/big-data-management-course-ireland*

6.   **What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?**

- *As highlighted in question 4 above, the key to improving data management education is to feature analytical modules across less technical disciplines, such as business and social sciences.*

- *Steps should also be taken to allow transition into analytics from other disciplines and up-skilling and retraining into the area should be encouraged. To this end, short courses for individuals with technical backgrounds should be provided.*

7.   **In your opinion, what are the most important areas of your life in which you can use data skills?**

- *Online Shopping. Since the growth of Big Data in retail, the entire industry is completely changing.*

- *Wearables and health (e.g. my Fitbit and the powerful data in collates for weekly).*

- *Energy Consumption.*

- *Using data skills to effectively conduct research, communications and message creation*

    - *Interesting article Big Data is Everywhere*

APPENDIX 4: SURVEY RESULTS LYIT

1. Do you find the data management important? If so, why?

Yes, in context of SMEs as they are of huge importance in Irish Industry.

Yes, even having a working of how data is collected can help young businesses and individuals make smart choices

Access to data over time is a useful way to track progress etc

Yes, it is extremely important for businesses and organizations at all levels to proactively manage and learn from data.

2. How would you assess the usage of data management by entrepreneurs in your region / country?

We believe it is not maximized. Poor knowledge of the potential of data that currently exists within their own organization.

Even though business courses have a data analysis element to them, unless an entrepreneur is coming from a computing background there is limited learning about how to attain data.

While it is important, I think that in it is limited among SMEs. Usually silo based systems that do not link together to provide meaningful information.

Poor mainly because of time constraints and staff limitations

3. Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?

No

No, focus in the latter college years is on data collection and analysis for academic dissertations.

No - they have limited and basic skills in this regard.

No. a solution might be the use of innovation vouchers to help access data analysis or links to student projects etc

4.   Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country?

In higher education, many modules would contain elements of data management, such as Google Analytics, Digital Marketing, and Statistics.

Not enough for competency in the area.

No official country wide to our knowledge.

Data management is increasingly important and courses are embedding data management into modules. Again among many subjects the approach is a broad overview rather than being more in-depth. Not aware of specific benchmarks in relation to data management.

Not that I am aware.

5.   Would you recommend any good practices related to data management courses from your country or from abroad?

To our knowledge, very limited.

Conference on TECH, Internet of Things, 30th May

Tech connective live

Ulster University MSc Data Science?

None come to mind

6.   What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?

I would recommend that they have short directed learning courses with the possibility of accreditation and/or special achievement award/digital badge.

Accredited and focused short courses that can be taken as CPD options. These could collate to an overall award. More attractive short/flexible accreditation that is industry recognized.

Applied projects linked to SME needs

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7.   In your opinion, what are the most important areas of your life in which you can use data skills?

In teaching relevant smart data skills to students and application to micro and small businesses

From a student perspective, finding relevant, quality research. Business perspective, marketing and customer demand data. Ethical use of data needs to be addresses as well as how to be wary of how our own data is collected.

How to use and link data, the context of key data sets and performance and SMART real/time data - how to manage this from a small business perspective.

Tracking progression in life and work

APPENDIX 5: SURVEY RESULTS VGTU

1. Do you find the data management important? If so, why?

Yes.

First of all, data management helps to work more efficient and save the time. The organized data management helps to improve productivity of data users. Organization in this way can work faster and better: it's easier to find, track and review the data.

Effective data management is important when sharing the information between team members. Data stored in a database can be accessed also remotely.

Data stored in a database can be better protected, it can be protected with a password or opened only using authorization protocols.

Data management systems have integrated backup and recovery functions, which protects losing data after crashing or system failure.

2. How would you assess the usage of data management by entrepreneurs in your region / country?

Depending on the company size and type:

Companies, working exceptionally with data (banks and other financial institutions, etc.) and experienced enterprises (hiring data management specialists) understand the importance of the data management and its advantages.

Startups, smaller companies or companies not working with data as their main activity understand the benefits of data management and use of data management systems less: they do not have enough information on data management (to less information in educational institutions), do not want to invest time and money into data management. This leads to less efficient work and information sharing, less security and communication within the team.

3. Do you think that students/early stage entrepreneurs are skilled enough to meet the market needs of data management?

Students or early stage entrepreneurs are skilled on data management depending on the study programme:

IT specialists have few study modules which include knowledge on data management: Cloud Computing, Databases, Database Management, Database Administration, Information Security, Data Mining, etc. Management students have several related study modules: Data Analysis, Data Management. But in the other study programmes (Mechanical Engineering, Product Design, Transport Engineering) students only get the basics on data management but this topic is not directly involved in the study programmes. This means that if the person

after completing a university wants to run a start-up, he needs additional skills and education on data management.

4. Are there any official recommendations in higher education in data management in regional, national or sectoral level in your country? If yes, please name them and provide us with a link to website.

There are no national recommendations, but as an EU Member state Lithuania has to follow EU GDPR:
https://eugdpr.org

The Ministry of Education and Science of Lithuania performed a research for further recommendations:

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwiQoMC9i 7riAhX_AxAIHb3cDysQFjAAegQIABAC&url=https%3A%2F%2Fwww.itc.smm.lt%2Fwp- content%2Fuploads%2F2010%2F12%2FDBVS-ir-kitu-alternatyvu-studija- 2008.doc&usg=AOvVaw03EYug81gZvPVbFh0D-Nvg

Databases used in Lithuanian education and science institutions:

No.	Institution	Object	Name of the database
1.	**Ministry of education and science:**	Management Information System	Microsoft Exchange Server
2.		Accounting	Sysbase, My SQL
3.		E-mail system of the ministry	Microsoft Exchange Server
4.	**Education IT Center:**	Education portal	Microsoft SharePoint
5.		Register of education and science institutions	Informix
6.		License register	Informix
7.		Register of studies and teaching programmes	Informix
8.		Registration of documents	Informix
9.		Lecturers' database	Microsoft SQL Server

10.		Students' database	Microsoft SQL Server
11.		Education management information system	Informix
12.	**Educational Supply Center**	School education programmes	Informix
13.		Textbook register	Postgre SQL
14.	**National Examination Center**	National Examination Center Information System	Oracle
15.	**Schools**:	Scholars database	Paradox or Informix
16.		School library	PostgreSQL
17.		Education reports	Paradox arba Informix
18.	**VET school**	Students' database	Paradox
19.		Library system	PostgreSQL
20.	**Higher education institutions**	Student database	Oracle
21.		Library system	Oracle
22.	**Municipalities**	Students and scholars database	Paradox or Informix
23.		Register of education and science institutions	Informix

5. Would you recommend any good practices related to data management courses from your country or from abroad?

I would recommend following EU practice (GDPR), as it is well prepared and applicable to all our neighbors and collaborating countries. This means we can collaborate between countries efficiently, with a common view and understanding on data security and management.

6. What would you improve in data management education if you could be empowered to implement changes in HEI and VET institutions?

I would add more topics on data management: managers, engineers, artists – everyone has to gain this knowledge. We are encouraging startups in our university. Each entrepreneur needs the understanding on:

- data governance and data quality management
- database management systems

- *data analytics/data mining*
- *enterprise content management*
- *big data management, etc.*
-

7. In your opinion, what are the most important areas of your life in which you can use data skills?

The most important application of data management is in professional work:

- *Personal data protection (e.g. product design)*
- *Customer databases*
- *Better CRM*
- *Information distribution between employees and teams*
- *Company data security*
- *To make company services more efficient*
- *To help employees work faster/more efficient*
- *To improve communication inside the company*

These areas are important not just for the companies working with data, but for each company which seeks to expand and to improve its efficiency and profit. Person with data management skills is a valuable employee.

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[i] https://www.irishtimes.com/sponsored/pwc/data-analytics-an-underutilised-resource-for-irish-businesses-1.3621902