

# AI and Big Data in Education: New Frontiers and Opportunities

Vilnius Gediminas Technical University, Prof., Dr. Aleksei Iurasov

FULL  
**POSSIBILITIES**  
FOR YOU

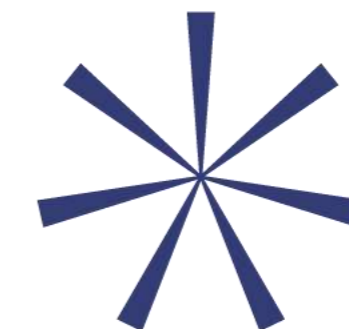


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25<sup>th</sup> – 29<sup>th</sup> | 2023 September | Sitia  
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1<sup>st</sup> **ATHENA**  **TECHNOLOGY FORUM**



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# Presentation summary

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- 1) Lecturer introduction: latest R&D projects**
- 2) Big Data in education obtained through R&D projects**
- 3) Opportunities provided by AI and Big Data in Education**

# 1. Lecturer introduction: latest R&D projects

## Project activities

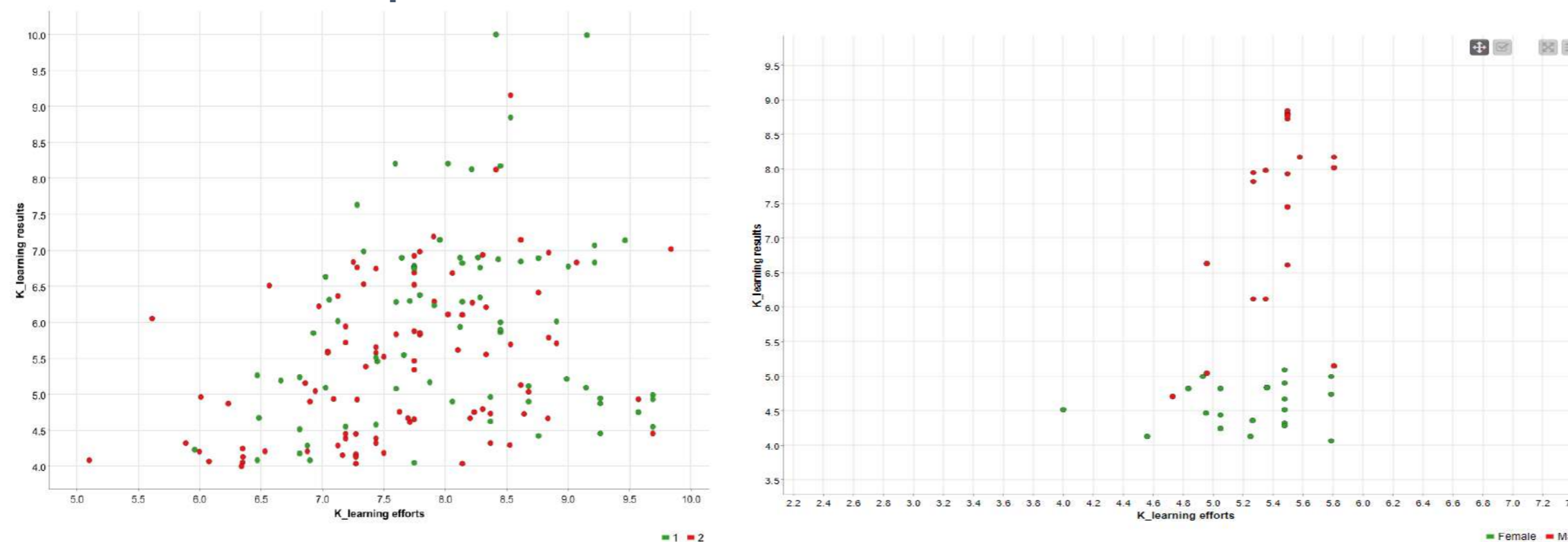
- 2021-2023 Head of research group, Chief Data Scientist, R&D project: "[IT innovation: creation and development of a management system based on Artificial Intelligence](#)" (LT07-1-EIM-K02-023).
- 2020-2022 Head of research group, Chief Data Scientist, R&D project: "[Monitoring and decision-making support system for teaching and learning efficiency](#)" (01.2.1-LVPA-K-856-01-0113).
- 2021 Chief researcher, project: "[Creating a Supportive Learning Environment: in Search for Factors Enabling the School Community](#)" (S-DNR-20-1).
- 2019-2021 Head of research group, R&D project: "[Advanced data analysis and forecasting in education](#)" (J05-LVPA-K-04-0132).
- 2016–2019 Head of research group, R&D project: „[Development of tools for systematic management and analysis of Lithuanian competencies and skills](#)“ (J05-LVPA-K-01-0009).

## 2. Big Data in education obtained through R&D projects

- clickstream data from Lithuanian school e-diary Manodienynas.lt (school marks; attendance information; homework assignments; messages among teachers, pupils and parents, etc.). It is Big Data: hundreds of schools, 9 academic years;
- students' data from Lithuanian universities (demographic data, final school grades, university learning results, etc.). Data from tens of thousands of students;
- Contract employment, self-employment, unemployment data of 140815 graduates of all Lithuanian universities from Employment Service under the Ministry of Social Security and Labor "Darbo Birža" (2014-2021);
- data of the State Matriculation Examination (PUPP VBE);
- Lithuanian vacancies data from "LinkedIn" and cvme.lt.

# 2.1. Clickstream data from Lithuanian school e-diary: monitoring and decision support

- Predicting future learning results
- Detecting **burning out** pupils and teachers (**fatigue** or serious loss of interest);
- Detecting **conflict** between teacher and a pupil/ group of pupils/ class, pupil's stress resistance;
- Detecting **favoritism** and **tendency to unequally evaluate pupils** depending on their gender;
- **Text analytics** of messages among teachers, pupils and parents (e.g., “Labai nedrausmingas per pamokas, nedirba, trukdo mokytėjai, nereaguoja į pastabas, visus kalbina. Net sugeba gadinti ora, vartoja necenzurinius žodžius”, **Topic detection** - Behavior, **Sentiment analysis** - Strongly negative), etc.



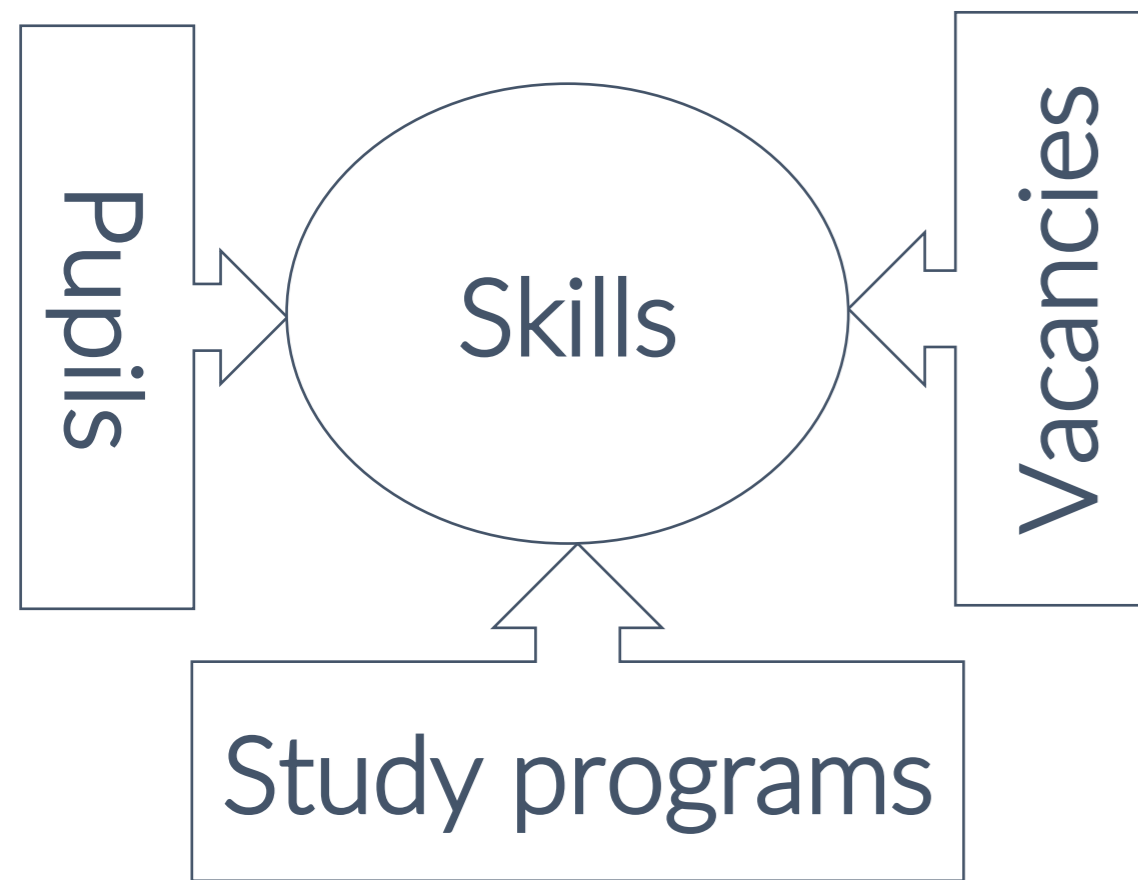
## 2.2. Darbo birža\* data: are there "walking dead" study programs?

S	Institucijos pavadinimas	S	Progra...	S	Programa / mokslo sritis	I	Sum(Absolventai)	I	Sum(Nedirbantys)	D	▲ SP unemployment rate
	Generolo Jono Žemaičio Lietuvos karo akademija		6121LX067		Gynybos ir saugumo institucijų valdymas		152		1		0.007
	"ISM Vadybos ir ekonomikos universitetas", UAB		6211LX008		Švietimo lyderystė		345		9		0.026
	Šiaulių universitetas		6123CX001		Optometrija		105		3		0.029
	Vilniaus Gedimino technikos universitetas		6121EX069		Statybos technologijos ir valdymas		111		4		0.036
	Šiaulių universitetas		6121MX042		Specialioji pedagogika		219		8		0.037
	Vilniaus Gedimino technikos universitetas		6211LX086		Inžinerinė ekonomika ir vadyba		111		5		0.045
	Vilniaus universitetas		6121AX013		Ekonometrija		126		6		0.048
	Vilniaus Gedimino technikos universitetas		6121EX037		Kelių ir geležinkelių inžinerija		281		14		0.05
	Mykolo Romerio universitetas		6121JX056		Policijos veikla		116		6		0.052
	Lietuvos edukologijos universitetas		6310MX003		Pedagogika		115		6		0.052
	Vilniaus universitetas		6211LX022		Apskaita ir auditas		206		13		0.063
	Vilniaus universitetas		6121EX001		Telekomunikacijų fizika ir elektronika		141		9		0.064
	Šiaulių universitetas		6310MX008		Pedagogika		198		14		0.071
	Vytauto Didžiojo universitetas		6121DX011		Biologija		113		8		0.071
	Aleksandro Stulginskio universitetas		6211IX009		Miškininkystė		152		11		0.072
	Vilniaus Gedimino technikos universitetas		6121EX046		Telekomunikacijų inžinerija		150		11		0.073
	Vilniaus universitetas		6121JX021		Informologija		116		9		0.078
	Šiaulių universitetas		6211LX078		Viešasis valdymas		219		17		0.078
	Kauno technologijos universitetas		6121CX011		Taikomoji chemija		190		15		0.079
	Kauno technologijos universitetas		6211EX011		Elektros energetikos sistemos		100		8		0.08
	Kauno technologijos universitetas		6121EX010		Elektros inžinerija		110		9		0.082
	Vilniaus universitetas		6121LX013		Vadybos informacinės sistemos		121		10		0.083
	Kauno technologijos universitetas		6121EX023		Šilumos energetika ir technologijos		133		11		0.083
	Kauno technologijos universitetas		6121EX019		Cheminė technologija ir inžinerija		193		16		0.083
	Lietuvos edukologijos universitetas		612X10005		Ikimokyklinio ir pradinio ugdymo pedagogika		244		21		0.086
	Vilniaus universitetas		6121AX001		Matematika ir matematikos taikymai		209		18		0.086
	Mykolo Romerio universitetas		6121KX010		Teisė ir valstybės sienos apsauga		205		18		0.088
	Mykolo Romerio universitetas		6211LX072		Strateginis organizacijų valdymas		123		11		0.089
	Kauno technologijos universitetas		6121FX007		Maisto mokslas ir technologija		420		38		0.09
	Kauno technologijos universitetas		6121EX021		Atsinaujinančioji energetika		254		23		0.091
	Kauno technologijos universitetas		6121AX005		Taikomoji matematika		287		26		0.091

I	Sum(Absolventai)	I	Sum(Nedirbantys)	D	SP unemployment rate
	260		259		0.996
	133		114		0.857
	124		119		0.96
	112		96		0.857
	106		102		0.962
	91		64		0.703
	80		66		0.825
	74		59		0.797
	71		69		0.972
	67		55		0.821
	67		63		0.94
	61		56		0.918
	59		50		0.847
	58		45		0.776
	57		50		0.877
	56		42		0.75
	52		44		0.846
	50		48		0.96
	48		38		0.792
	48		44		0.917
	47		45		0.957
	40		34		0.85
	37		35		0.946
	36		35		0.972
	35		30		0.857
	33		29		0.879
	32		28		0.875
	31		27		0.871
	31		27		0.871
	27		20		0.741
	27		22		0.815

\* Employment Service under the Ministry of Social Security and Labor of the Republic of Lithuania

# 2.3. Lithuanian vacancies data from "LinkedIn" and cvme.lt



## Industry Knowledge

- + Project Management · 18
- + Business Strategy · 10
- + Science · 5
- + Market Research · 3
- + Testing · 2
- + Distance Learning
- + Strategic Planning · 10
- + Software Development · 8
- + Marketing Research · 3
- + Programming · 3
- + Linux System Administration · 1
- + System Testing

## Tools & Technologies

- + Microsoft Office · 8
- + Microsoft Access
- + HTML5
- + Google Forms
- + Microsoft Excel
- + Cascading Style Sheets (CSS)

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34,362 alumni

## 2.4. Students' data from Lithuanian universities

The student data contains different levels of:

- learning of school subjects ("A level", "B level", "S level", "No level"...);
- grades (annual school grade, school exam, state exam);
- state exam scale (from 1 to 100 and from 16 to 100);
- school grade scale (from 1-5 (till 1993) to 1-10 (from 1994));
- missing values, missing students, etc.

AGE_ENROLLED	DROPOUT	NR_OF_FAILURES	NR_OF_RETAKES	STUDY_PROGRAM	GOVERNMENT_FINANCED	GRADES_FROM	LIETUVIŲ K.	SCHOOL_LEVEL
26	TRUE	3	0	Building Energetics	TRUE	school_grade; school_exam; school_grade; state_exam	4; 10; 7; 30	A; B; B
27	TRUE	6	0	Mechanical Engineering	TRUE	school_grade; school_exam; school_grade; state_exam	4; 10; 7; 30	A; B; B

AGE_ENROLLED	DROPOUT	NR_OF_FAILURES	NR_OF_RETAKES	STUDY_PROGRAM	GOVERNMENT_FINANCED	GRADES_FROM	UŽSIENIO K	SCHOOL_LEVEL
30	TRUE	13	19	Business Management	FALSE	school_exam; school_grade; school_grade; state_exam	8; 9; 9; 70	A; A; B



# 3.1. REST API web-service: Recommendation Engine for school graduates

The image displays a KNIME Explorer interface on the left and a workflow diagram on the right. The Explorer shows a tree view of a KNIME server with folders like 'Admin', 'Examples', 'Intelect', 'Models', 'Study Programs', and 'Users'. Three red boxes highlight specific elements: 1. The server URL 'http://77.241.192.124:8080/kni'. 2. The 'Study Programs' folder containing 'LSU.csv' and 'VGTU.csv'. 3. An 'Intelect' folder containing two job entries from 2021. The workflow diagram consists of four nodes: 'List Files/Folders' (orange), 'String Manipulation' (yellow), 'Container Input (JSON)' (green), and 'JSON to Table' (yellow). Annotations describe each node: 'Select folder with HEI-study programs' for List Files/Folders, 'University abbreviation' for String Manipulation, 'Input from REST call' for Container Input (JSON), and 'Convert the input JSON into a row' for JSON to Table. A 'Dialog - 3:1 - Container Input (JSON)' window is open on the right, showing a 'Parameter Name' of 'pupil-record' and a 'Description' field. Below the dialog, a JSON object is displayed, listing various subjects and their scores for a student from Lithuania.

```
{  "FROM_COUNTRY": "Lithuania",  "SEX": "F",  "AGE_ENROLLED": 19,  "LIETUVIU K.": 8,  "MATEMATIKA": 7,  "UŽSIENIO K.": 8,  "FIZIKA": 7,  "CHEMIJA": 8,  "ISTORIJA": 6,  "INFORMACINĖS TECHNOLOGIJOS": 6,  "GEOGRAFIJA": 8,  "BIOLOGIJA": 7,  "BRAIŽYBA": 7,  "DORINIS UGDYMAS": 6,  "GIMTOJI KALBA": 6,  "ANTROJI UŽSIENIO K.": 6,  "POLITOLOGIJA": 6,  "ASTRONOMIJA": 5,  "MITYBA": 7
```

# 3.1. Study program Recommendation Engine: Returning parameters

Workflow: 3: Intellect | 3:451 - Parameter Normalization & Rating Calculation | Job 7: Intellect

g on KNIME Server (knime-server)

**Table Row To Variable Loop Start**  
Iterate the loop for each HEI

**Loop End**  
Calculation of the parameters of the basic equation

**Parameter Normalization & Rating Calculation**

**Denormalizer**  
Returning the parameters in convenient for user analysis format

**Double To Int**

**Table to JSON**  
Convert the results to JSON format

**Container Output (JSON)**  
Result of REST call

**Timer Info**  
Measure execution time for each node

**Math Formula**  
Sum up execution times

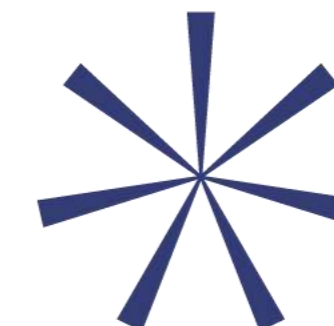
**Output data - 7:61 - Math Formula (job)**

Name	Execution Time	Execution ...	Execution...	I	I	S	D	executi...
.. Container Input (JSON)	0	0	0	1	1	...	...	20,995
.. Container Output (JSON)	0	0	0	1	1	...	...	20,995
.. JSON to Table	16	16	16	1	1	...	...	20,995
.. Timer Info	?	0	0	0	0	...	...	20,995
.. Math Formula	?	0	0	0	0	...	...	20,995
.. Loop End	16	16	16	2	2	...	...	20,995
.. Calculation of the parameters of the basic equation	20917	20917	25757	1	2	...	...	20,995
.. Table to JSON	15	15	15	1	1	...	...	20,995
.. String Manipulation	0	0	0	1	1	...	...	20,995
.. List Files/Folders	31	31	31	1	1	...	...	20,995
.. Table Row To Variable Loop Start	0	0	0	2	2	...	...	20,995
.. Denormalizer	0	0	0	1	1	...	...	20,995
.. Double To Int	0	0	0	1	1	...	...	20,995
.. Parameter Normalization & Rating Calculation	?	0	0	0	0	...	...	20,995

**JSON Snapshot - 3:2 - Container Output (JSON) (Result of REST call)**

```

{
  "P (DROPOUT=TRUE)": 0.46634615384615385,
  "Prediction (WEIGHTED_AVERAGE)": 8.475384099957116,
  "Prediction (NR_OF_FAILURES)": 1,
  "Prediction (NR_OF_RETAKES)": 3,
  "STUDY_PROGRAM_ENG": "Data Analysis Technology",
  "HEI_RATING_QS_world": 591,
  "STUDY_GROPE_QS_RANKING": 101,
  "N": 17,
  "Unemployment rate": 0.015089999999999937,
  "University": "VGTU",
  "P (GOVERNMENT_FINANCED=1)": 1.0,
  "SP_Index": 2.1088892628678706
},
{
  "P (DROPOUT=TRUE)": 0.000037092213773459726,
  "Prediction (WEIGHTED_AVERAGE)": 8.336017538258043,
  "Prediction (NR_OF_FAILURES)": 1,
  "Prediction (NR_OF_RETAKES)": 0,
  "STUDY_PROGRAM_ENG": "Construction and Real Estate Management",
  "HEI_RATING_QS_world": 591,
  "STUDY_GROPE_QS_RANKING": 51,
  "N": 15,
  "Unemployment rate": 0.19800658999999998,
  "University": "VGTU",
  "P (GOVERNMENT_FINANCED=1)": 0.3333333333333326,
  "SP_Index": 2.0445469158110705
},
{
  "P (DROPOUT=TRUE)": 0.16883438270705498,
  "Prediction (WEIGHTED_AVERAGE)": 8.503841915823996,
  "Prediction (NR_OF_FAILURES)": 1,
  "Prediction (NR_OF_RETAKES)": 3,
  "STUDY_PROGRAM_ENG": "Air Traffic Control",
  "HEI_RATING_QS_world": 591,
  "STUDY_GROPE_QS_RANKING": 301,
  "N": 1,
  "Unemployment rate": 0.16000000000000003,
  "University": "VGTU",
  "P (GOVERNMENT_FINANCED=1)": 0.9326923076923077,
  "SP_Index": 2.029222544817174
},
{
  "P (DROPOUT=TRUE)": 0.41428571428571426,
  "Prediction (WEIGHTED_AVERAGE)": 8.454620451817865,
  "Prediction (NR_OF_FAILURES)": 4,
  "Prediction (NR_OF_RETAKES)": 3,
  "STUDY_PROGRAM_ENG": "Civil Engineering",
  
```



# 3.1. Recommendation Engine for school graduates: Services for Universities

## 1) Direct marketing to target auditory

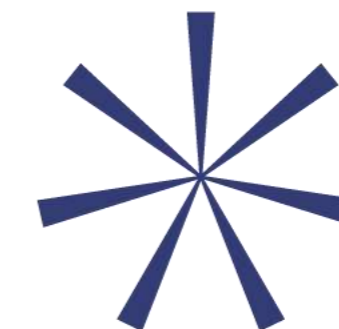
- Attract (improve quality and quantity of students)
- Retain (lower dropouts and fails of students)

## 2) DSS “Study program management”

- Study program life cycle monitoring
- Study program market position (visibility score, etc.) monitoring
- Data-driven decision support on study program management based on analysis of study program relevance, life cycle, market position, skills developed by study program vs skills required by labor market (competitive vs uncompetitive skills), comparative analysis with competitors, marketing and management recommendations, etc.

## 3.2. AI assistant for university applicants, Study program search system for ERASMUS students

- 1) Likelihood of student admission,
- 2) Likelihood of dropping out,
- 3) Likelihood of changing the study program,
- 4) Predicted number of failures to complete the courses,
- 5) Predicted number of retakes to complete the courses,
- 6) Predicted Grade Point Average,
- 7) Likelihood of the student to develop the required skills for the desired job,
- 8) Likelihood of unemployment,
- 9) Likelihood of self-employment,
- 10) Likelihood of contract employment, etc.



# 3.3. Search for partners to prepare and submit proposal

Bridging gaps between secondary, tertiary education and labor market: theoretical basis for policymaker's decision support system (DSS), based on Artificial Intelligence and Big Data

The screenshot shows the European Commission's funding portal. At the top, it says 'European Commission | Funding & tender opportunities | Single Electronic Data Interchange Area (SEDIA)'. Below this is a navigation bar with links: 'SEARCH FUNDING & TENDERS', 'HOW TO PARTICIPATE', 'PROJECTS & RESULTS', 'WORK AS AN EXPERT', and 'SUPPORT'. The main heading is 'Effective education and labour market transitions of young people' with the topic ID 'HORIZON-CL2-2024-TRANSFORMATIONS-01-10'. A 'Grant' button is visible. On the left is a sidebar menu with options: 'General information', 'Topic description', 'Destination', 'Conditions and documents', 'Partner search announcements', 'Submission service', 'Topic related FAQ', and 'Get support'. The main content area shows 'General information' with the following details:

- Programme: **Horizon Europe Framework Programme (HORIZON)**
- Call: **[A sustainable future for Europe \(HORIZON-CL2-2024-TRANSFORMATIONS-01\)](#)**
- Type of action: **HORIZON-RIA HORIZON Research and Innovation Actions**
- Type of MGA: **HORIZON Action Grant Budget-Based [HORIZON-AG]**
- Deadline model: **single-stage**
- Planned opening date: **04 October 2023**
- Deadline date: **07 February 2024 17:00:00 Brussels time**

At the bottom left of the sidebar, there is a 'Go back' button with a left-pointing arrow icon.



# 3.3. Search for partners: requirements

- 1) Publications and implemented projects in the same/related field
- 2) Capacity to contribute to the project goals, activities (needed to be specified in grant application)
- 3) Ability to collect and analyze necessary data from national Employment Agency and/or government data management agency



STATISTICS  
LITHUANIA  
STATE DATA  
AGENCY

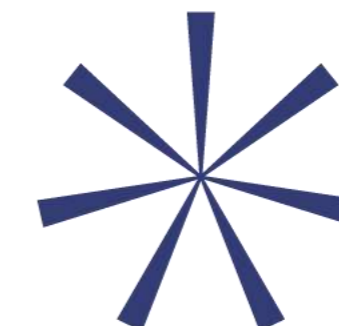
Navigation: Search, Home, My Network, Jobs, Messaging, Notifications (24), Me

**Saulė Gabrielė Petraitytė**  
data-driven gov  
Lithuania · [Contact info](#)  
500+ connections

Education data

Hi Aleksei, I saw your presentation yesterday online. I am currently managing Government's project to integrate all data from e-diaries to the Data Agency. I am interested in your findings and I suggest to have a 30min online meeting on monday / tuesday. Would that work for you?  
Saule

[Latest message](#)



# Thanks for watching

Vilnius Gediminas Technical University, Prof., Dr. Aleksei Iurasov

