Approaches to learning, LMS usage and academic performance among engineering and education undergraduates

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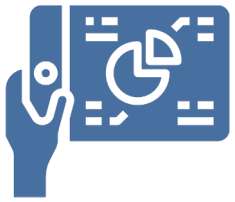
Outline

- Literature Review
- Objective and questions
- Context and participants
- Data sources and instruments
- Results
- Discussion
- References

Literature Review

Learning Management Systems (LMS)



Learning Analytics (LA) ⟷ Learning Theories

Students' Approaches to Learning (SAL)

- Deep approach
- Surface approach
- Strategic approach

Literature Review

Study Process Questionnaire (SPQ) and Observational data obtained from LMS

- Deep approach is related to more use of the **online environment and better marks.** (Ellis et al., 2017)
- Groups of students with LMS sequences of activities labeled deep had significantly higher scores on **the deep strategy and deep approach scales**; and **better final exam scores** than those labeled as surface. (Gašević, Jovanović, Pardo, Dawson, & Dawson, 2017)
- **Learning strategies**, understood as traces of students' activities carried out within the LMS, are associated with **deep learning approaches** and not with surface approaches. (Tempelaar, Rienties, & Nguyen, 2018)

Objective

To analyze associations between approaches to learning, LMS usage patterns, and academic performance among engineering and education students.

Research Questions

1. What are students' **LMS usage patterns**? Are there any differences between disciplines and institutions?

2. How do students **approach learning**? How are these approaches associated with LMS usage and academic performance?

3. What variables better predict the second semester (end of the year) **academic performance**? Are there any differences between disciplines and institutions?

Context and participants

First-year students

Metropolitan Region • Research Oriented • Highly Selective

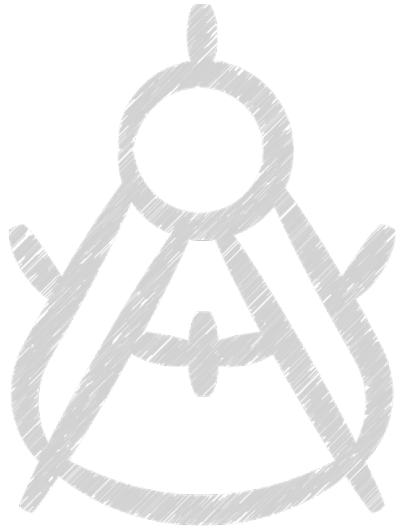
Faculty of Education

Sakai

259 students (1st semester)	
237 students (2nd semester)	**Q.1 Dataset**
125 answered questionnaire	**Q.2 & Q.3 Subset**
More females, private school	

Faculty of Engineering

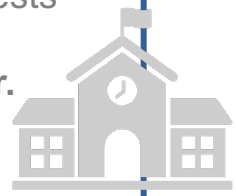
890 students (1st semester)	
871 students (2nd semester)	
296 answered questionnaire	
More males, private school (also ps+ss), high GPA & PSU	



Data sources and instruments

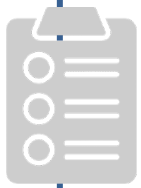
Presage

- **Preenrollment variables**
  - High School GPA.
  - High School Ranking.
  - University Admission Tests (UAT) scores.
- **Socio-demographic var.**
  - Gender.
  - School Type.
- **University Context var.**
  - Major (elementary /preschool education).
  - Type of Admission (Regular, Special, and Boundary).
- **1st semester academic performance var.**
  - 1st Sem. Standardized Mark.
  - Ratio of Failed Credits.
  - Enrolled Credits.



Process

- **LEARN questionnaire**
  - Deep, Surface and Strategic Scales.
- **LMS interactions**
  - Academic Content, Administrative Content, Read Comment, Write Comment, Task.
  - Metrics: Standard Deviation, Skewness, Participation Ratio, Compact Index, Center of Mass.



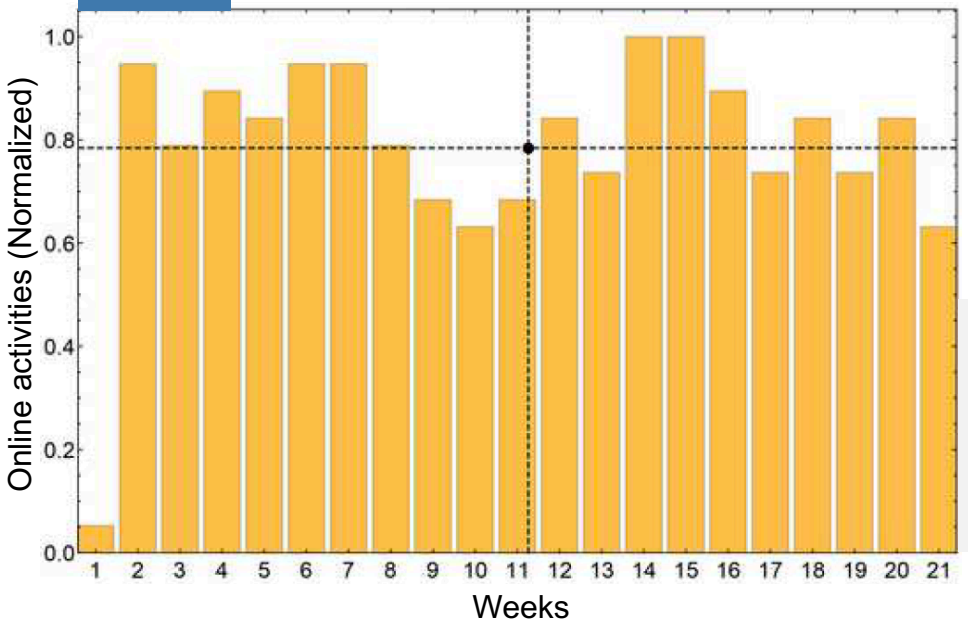
Product

- 2nd Semester Standardized Mark.

Method

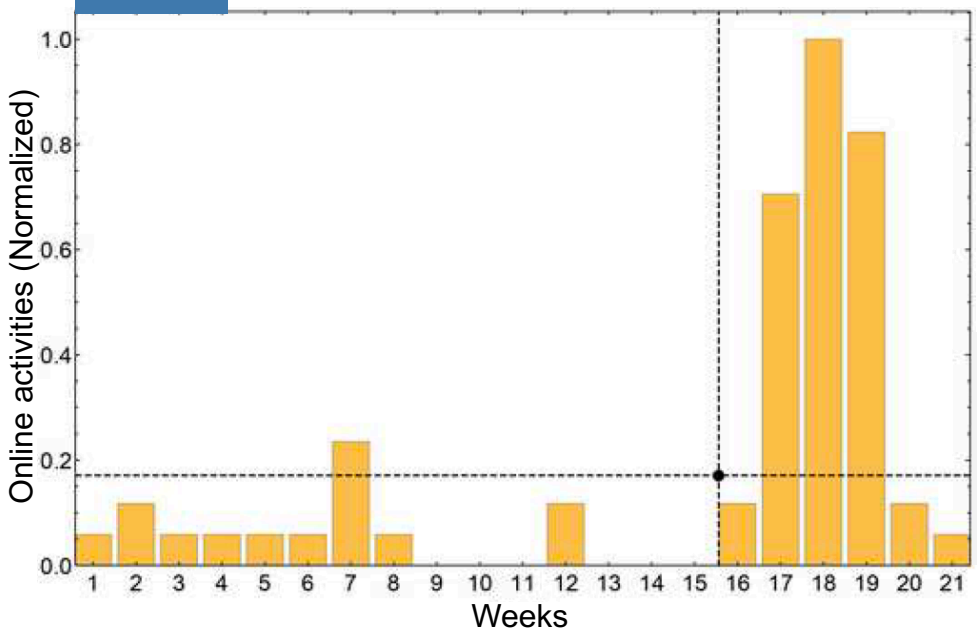
Q.1 Descriptive statistics Q.2 Hierachical cluster analysis
Q.3 Support vector regression algorithm

Case A



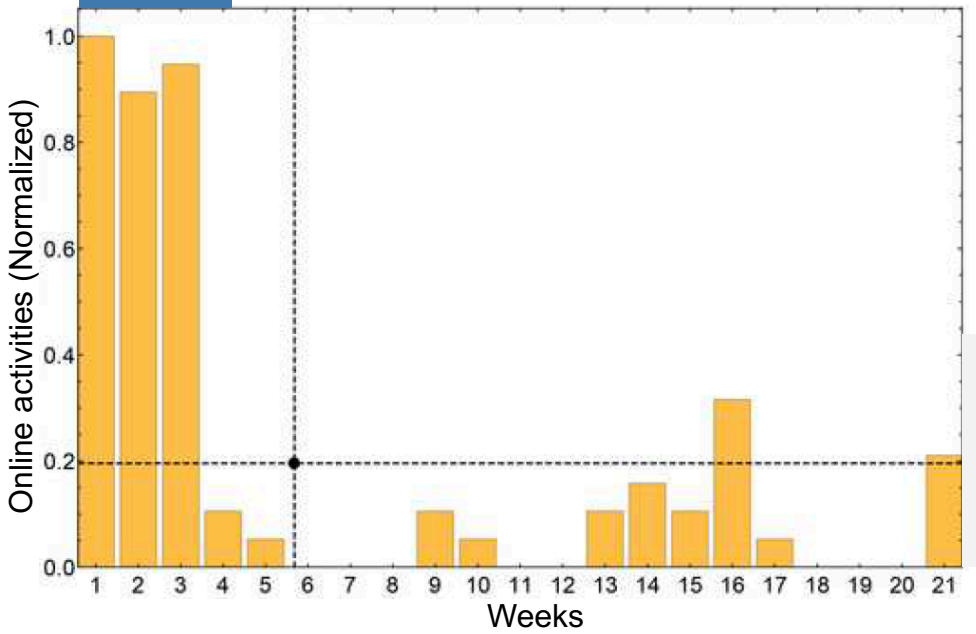
Mean= 0.784
Standard Desviation= 0.202
Skewness= 0.001
Participation Ratio= 0.940
Compact Index= 0.939
Center of mass= -0.023

Case B



M= 0.171
SD= 0.283
SK= -1.454
P.R.= 0.277
C.In.= 0.273
C.M.= 0.387

Case C



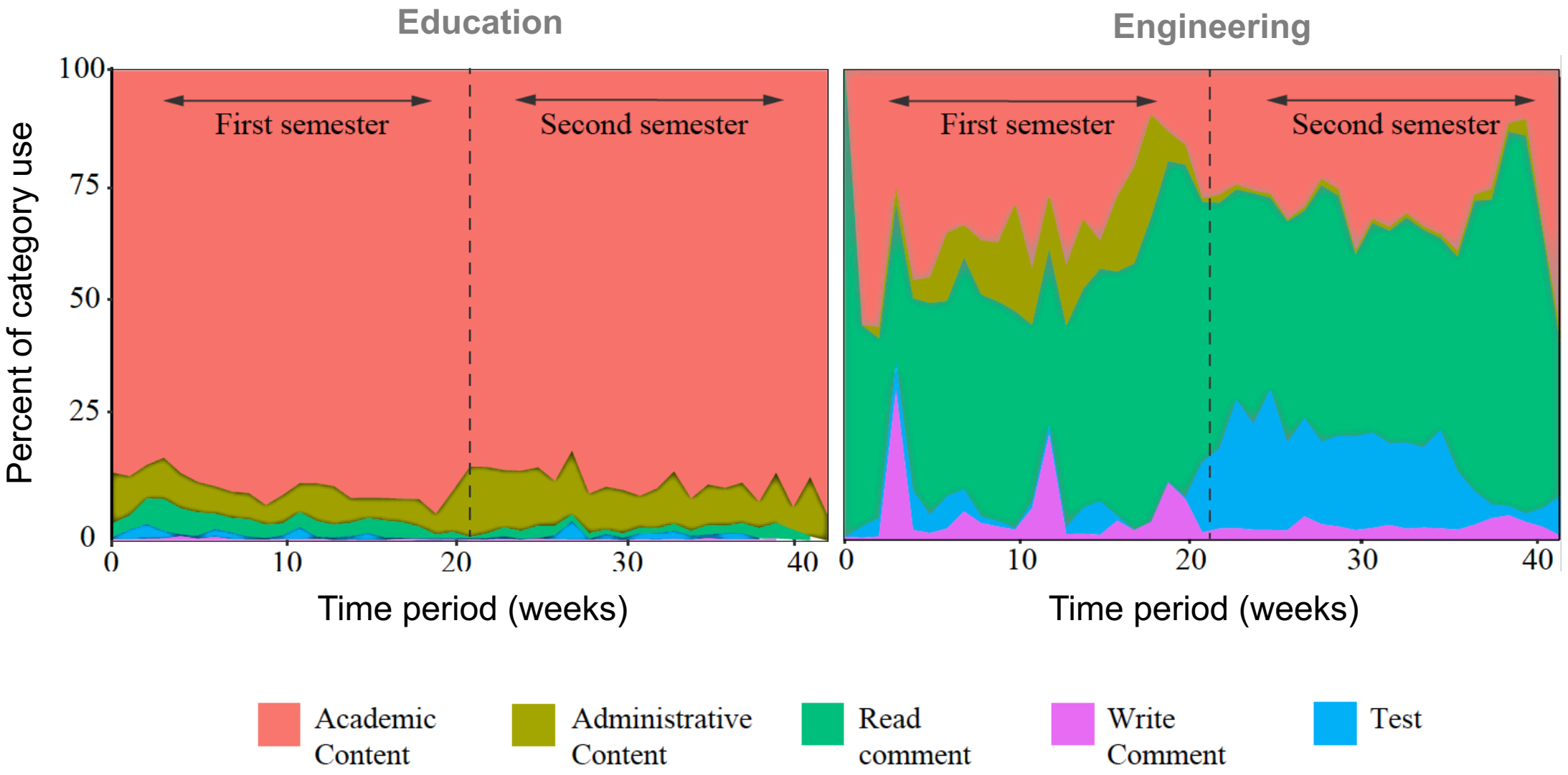
M= 0.195
SD= 0.325
SK= 1.256
P.R.= 0.275
C.In.= 0.122
C.M.= -0.554

RESULTS

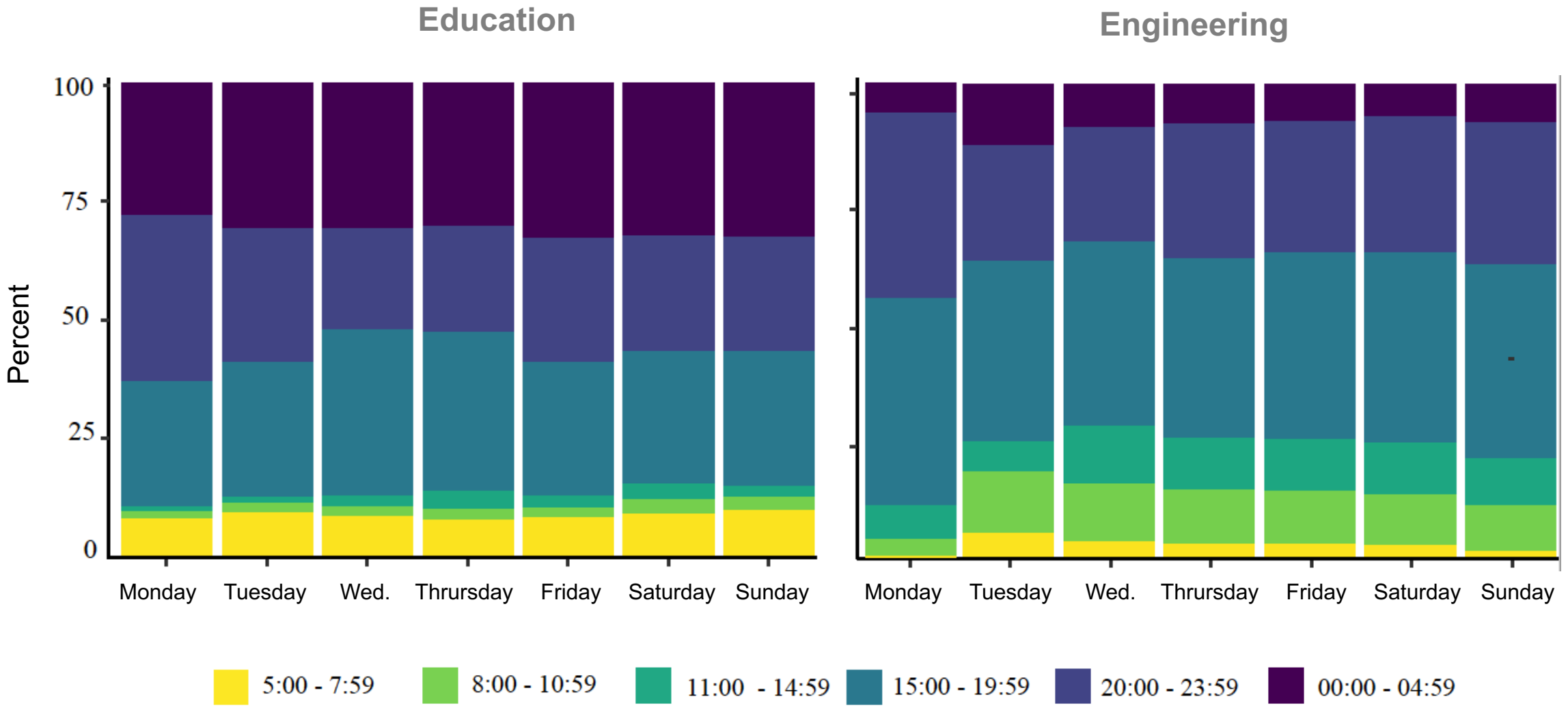
Question 1

What are students' **LMS usage patterns**? Are there any differences between institutions?

LMS tools used by the students



Time of the day students use the LMS



Question 2

How do students **approach learning**? How are these approaches related to LMS usage and academic grades?

Summary of statistics for the Surface and Deep-Strategic clusters

	Education					Engineering				
	Surface (N=50) M(SD)	Deep-Strategic (N=85) M(SD)	F	p	$\eta 2$	Surface (N=112) M(SD)	Deep-Strategic (N=182) M(SD)	F	p	$\eta 2$
Deep Approach	-0.69 (0.67)	0.40 (0.94)	51,501	0,000***	0,279	-0.50 (0.82)	0.31 (0.98)	54,162	0,000***	0,156
Strategic Approach	-0.72 (0.94)	0.42 (0.77)	58,4	0,000***	0,305	-0.77 (0.8)	0.47 (0.80)	168,25	0,000***	0,366
Surface Approach	0.27 (0.98)	-0.16 (0.98)	6,127	0,015*	0,044	0.40 (0.90)	-0.25 (0.98)	31,755	0,000***	0,098
2nd Semester Standardized Mark	-0.73 (1.04)	0.43 (0.68)	62,48	0,000***	0,32	-0.53 (0.74)	0.33 (1.00)	60,862	0,000***	0,172
Academic Content	-0.30 (0.87)	0.17 (1.04)	7,287	0,008**	0,052	-0.19 (0.89)	0.12 (1.05)	6,861	0,009**	0,023
Administrative Content	-0.15 (0.94)	0.09 (1.03)	1,877	0,173	0,014	-0.14 (0.92)	0.08 (1.04)	3,36	0,067.	0,011
Read Comment	0.10 (1.01)	-0.06 (0.99)	0,848	0,358	0,006	-0.29 (0.98)	0.18 (0.98)	15,806	0,000***	0,051
Write Comment	0.07 (1.13)	-0.04 (0.92)	0,377	0,54	0,003	-0.16 (1.10)	0.10 (0.92)	4,827	0,029*	0,016
Test	-0.12 (0.83)	0.07 (1.08)	1,097	0,297	0,008	-0.09 (0.97)	0.06 (1.02)	1,561	0,212	0,005
Mean	-0.29 (0.87)	0.17 (1.04)	6,83	0,009**	0,049	-0.29 (0.96)	0.18 (0.98)	15,884	0,000***	0,052
Participation Ratio	-0.11 (0.94)	0.06 (1.03)	0,91	0,341	0,007	-0.21 (1.12)	0.13 (0.89)	7,916	0,005**	0,026
Compact Index	-0.13 (0.91)	0.07 (1.05)	1,285	0,259	0,01	-0.12 (1.03)	0.07 (0.98)	2,6	0,108	0,009
Center of Mass	-0.04 (1.06)	0.02 (0.97)	0,099	0,752	0,001	-0.08 (1.20)	0.05 (0.85)	1,282	0,258	0,004
Standard Deviation	-0.21 (1.03)	0.12 (0.96)	3,558	0,061.	0,026	-0.26 (0.96)	0.16 (0.99)	12,602	0,000***	0,041
Skewness	0.07 (0.95)	-0.04 (1.03)	0,337	0,562	0,003	0.18 (1.14)	-0.11 (0.89)	5,87	0,016*	0,02

*p < 0.05; ** p < 0,01; *** p <0,001.

Question 3

What variables better predict the second semester (end of the year) **academic performance**? Are there any differences between institutions?

Stepwise support vector regression of 2nd Sem. Standardized mark as a dep. variable in function of Presage and Process variables

	Education			Engineering		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Presage						
Pre-enrollment						
UAT Math Score	0.574	0.968	1.325	-0.024	-0.031	-0.122
UAT Language Score	0.080	0.403	0.328	0.179	-0.067	0.101
UAT History/Sciences Score	0.574	0.543	0.391	0.257	0.553	0.590
High School Ranking	0.816	0.579	0.183	0.708	0.293	0.324
High School GPA	0.327	0.457	0.531	-0.263	0.008	-0.067
Socio-demographic						
Gender						
Female	0.000	0.000	0.247	-0.029	-0.038	-0.044
Male	0.000	0.000	-0.247	0.029	0.038	0.044
School Type						
Public	0.008	0.028	0.158	0.004	0.010	0.015
Private	-0.002	0.010	-0.071	-0.065	-0.084	-0.080
Subsidized	-0.006	-0.038	-0.087	0.060	0.074	0.065
University Context						
Major*						
Preschool Education	0.004	-0.062	-0.020	-	-	-
Elementary Education	-0.004	0.062	0.020	-	-	-
Admission Type						
Regular	-	-	-	0.077	0.086	0.076
Special	-	-	-	0.000	-0.087	-0.094
Boundary	-	-	-	-0.077	0.001	0.018
1st Sem. Academic Performance						
1st Sem. Standardized Mark	2.019	1.751	1.605	2.196	1.793	1.743
Enrolled Credits (second semester)	1.041	0.471	0.315	0.348	0.352	0.331
Ratio of Failed Credits (first semester)	-0.265	-0.157	-0.145	-1.126	-0.991	-1.017
Process						
LMS usage						
Academic Content	-	0.620	0.660	-	0.037	0.066
Administrative Content	-	0.284	0.301	-	0.005	0.025
Test	-	0.073	-0.274	-	0.278	0.284
Write Comment	-	-0.003	-0.127	-	0.054	0.025
Read Comment	-	-0.240	-0.532	-	0.170	0.101
Mean	-	0.598	0.615	-	0.187	0.149
Standard Deviation	-	-0.033	0.188	-	0.368	0.366
Skewness	-	-0.606	-0.709	-	-0.086	-0.014
Center of Mass	-	-0.115	0.021	-	-0.534	-0.416
Compact Index	-	-0.396	-0.531	-	0.115	0.181
Participation Ratio	-	-0.054	-0.130	-	0.099	0.065
Approaches to learning scales						
Strategic Approach	-	-	0.577	-	-	0.175
Deep Approach	-	-	0.451	-	-	0.143
Surface Approach	-	-	-0.986	-	-	-0.105
R-squared	**0.331**	**0.382**	**0.457**	**0.320**	**0.376**	**0.379**

* Only for Education students where two majors are considered.

DISCUSSION

Discussion: Results' Summary

- Differences in uses of LMS tools

F. Education

- Content and information centered
- Outside university time (night)

F. Engineering

- Comunication centered
- Within university time (day)

- Two groups emerged

Surface approach to learning

- Lower academic performance
- Less LMS usange

Deep-strategic approach to learning

- Higher academic performance
- More LMS usange

- Variables that better predict 2nd semester academic performance

Presage variables

- 1st Sem. Standardized Mark

Process variables

- LMS var. increase the explanatory power by approx. 5%.
- Approaches to learning var. increase prediction power in Education but very little in Engineering.

Discussion: Contributions

- **Results consistent with the international literature.**

  Deep-strategic approach is more beneficial for learning. (Haarala-Muhonen et al., 2017)

- **Comparison of LMS usage patterns across institutions.**

  The homogenization problem was solved by conceptual definitions from e-learning literature. (Gonzalez 2012, Laurillard, 2013)

- **New metrics to explore LMS usage patterns, beyond number of activities.**

  Standard deviation, skewness, participation ratio, compact index, center of mass.

- **Debate on the possibilities of using questionnaires to embed theory (SAL).**

- **The research provides important information to students, teachers and academic managers as a practical tool.**

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