technische universität
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UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

Institut für Entwicklung und Erforschung des Mathematikunterrichts

khd m kompetenzzentrum hochschuldidaktik mathematik

University students' fully digital study of mathematics: an identification of student-groups via their resources usage and a characterization by personal and affective characteristics

Jun.-Prof. Dr. Leander Kempen

[leander.kempen@tu-dortmund.de]

Jun.-Prof. Dr. Michael Liebendörfer

[liebendörfer@khdm.de]

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Introduction

We know about …

- the problematic issue of starting university studies of mathematics
- important aspects: self-regulated learning (Göller, 2020) and motivation (Liebendörfer, 2018)

COVID-19 pandemic, full digital study of mathematics

- new/more digital resources
- fewer opportunities to collaborate (Mullen et al., 2021a) and students experience problems with (intrinsic) motivation (Hyland & O'Shea, 2021)

General question:

- How do the students deal with this new situation?

-> Focus: Students use of resources

Research Questions

RQ 1: How do students evaluate the various resources available to them in the digital mathematics curriculum as useful to their learning process?

RQ 2a: How can we cluster student groups according to the resources they found useful in a wholly online learning setting?

RQ 2b: To what extent can a connection be made between the clusters and the biographical and psychological variables?

Instruments and Data

Resources

For my study in the course "Linear Algebra 1" . . . is very useful: [1] „totally disagree" … [6] „totally agree"

… attending the lecture; … attending the full-class tutorial; … attending the small group tutorial;
… the use of the lecture notes;
… the videos of the professor and his assistants; videos recommended by the teaching team; … videos from external resources
… webpages; … digital chats
… supplementary literature
… communication with other students

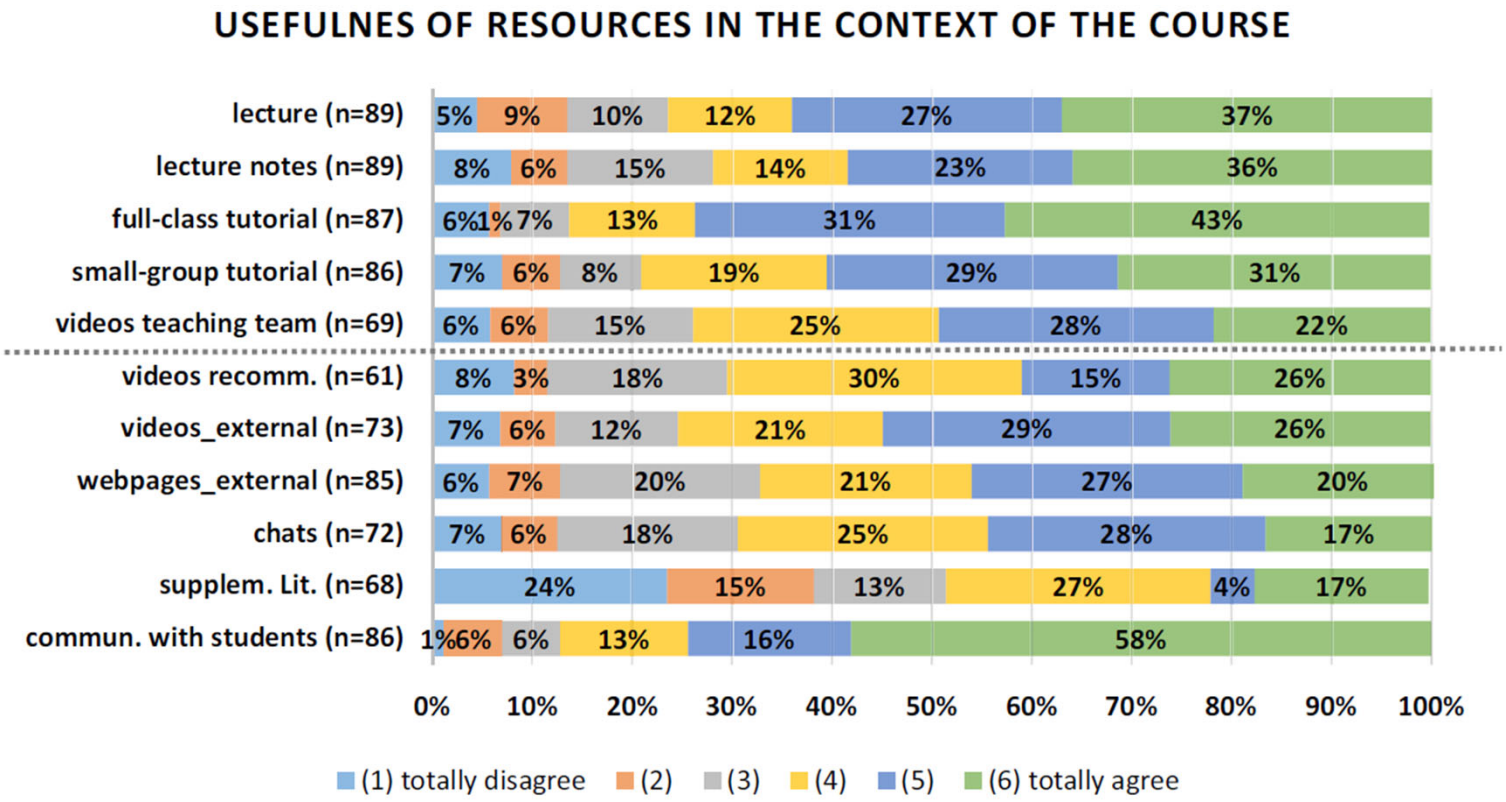
Psychological Variables:

(Theory of motivation and self-regulated learning)

	taken from …	**# items**	∝
Self-efficacy (I am confident that I can perform well on homework and exams.)	Hochmuth et al. (2018)	4	0.92
Identification with university mathematics (I would describe myself as a mathematician.)	*new*	5	0.86
Peer learning (I enlist the help of other students when I have serious comprehension problems.)	Liebendörfer et al. (2021)	3	0.81
Self-regulated learning (My learning behaviour follows a conscious pattern.)	*new*	4	0.75
Resisting frustration Even if I don't make any progress at all, I (keep trying until I get it right.)	Liebendörfer et al. (2021)	3	0.86
Social relatedness (I feel very close and connected with my fellow students.)	Longo et al. (2014)	4	0.81

- pilot study in summer term 2020
- main study (online survey) in December 2020, in the middle of the semester
- students of a first-year 'Linear Algebra 1' course that was held entirely digitally.
- $n = 89$

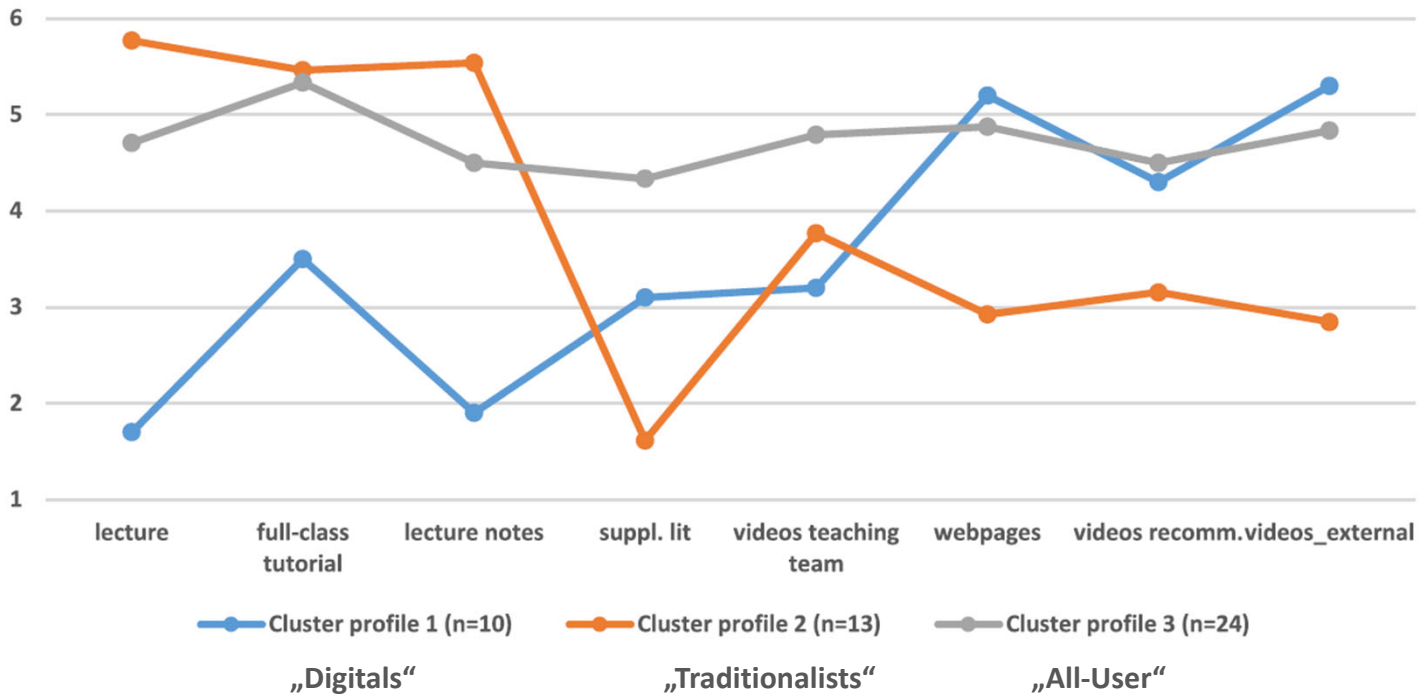
RQ 1: How do students evaluate the various resources available to them in the digital mathematics curriculum as useful to their learning process?



- All the (digitalized) traditional parts of mathematics teaching (lecture, full-class tutorial, small-group tutorial and lecture notes) were considered highly useful.
- The digital resources (videos, webpages and chat) were also generally rated as useful, yet they achieved fewer ratings of 6 ('totally agree') in comparison with the traditional ones.
- Videos from external resources ('videos_external') had also been evaluated positively, achieving approximately equal positive ratings (76%) as the videos from the teaching team.
- Communication with other students is rated overall as the most useful resource for learning in the course (58% 'totally agree').

RQ 2a: How can we cluster student groups according to the resources they found useful in a wholly online learning setting?

The cluster analysis yielded three clusters:



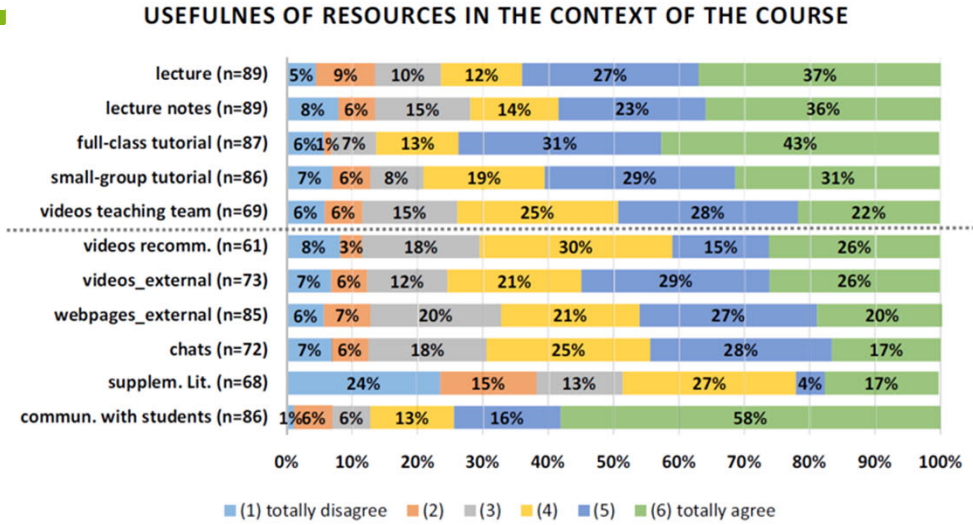
RQ 2b: To what extent can a connection be made between the clusters and the biographical and psychological variables?

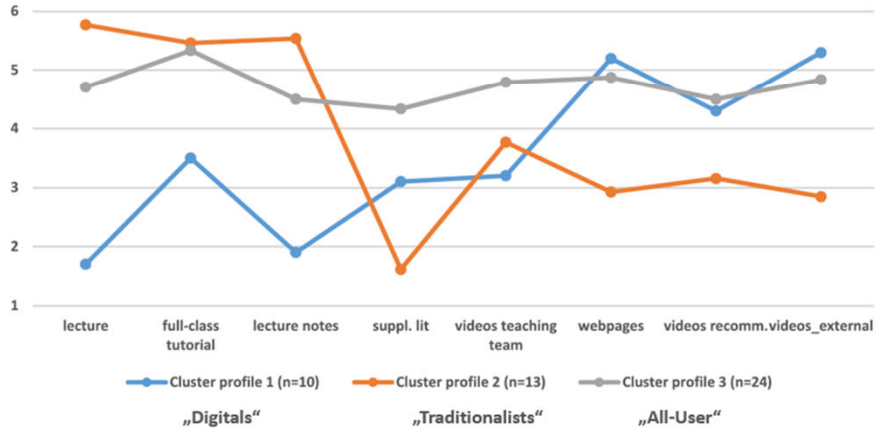
TABLE 4. *Biographical data and personal variables by cluster profiles*

		Total	Digitals ($n = 10$)		Traditionalists ($n = 13$)		All resource users ($n = 24$)	
Age	≤20 years	36	9		9		18	
	21–25 years	10	1		4		5	
First semester?	Yes	35	10		7		18	
	No	11	0		6		5	
Gender	Male	18	2		7		9	
	Female	28	8		6		14	
Study programme	Teaching degree	35	10		9		16	
	Comp. Science	3	0		0		3	
	Math Bch.	7	0		4		3	
	Physics Bch.	1	0		0		1	
			Mean	SD	Mean	SD	Mean	SD
Secondary school graduation mark			2.29	0.62	2.19	0.35	2.27	0.56
Self-efficacy			2.28	1.18	3.92	1.19	3.32	1.22
Identification			3.00	0.93	4.07	1.20	3.88	1.32
Peer learning			4.90	1.36	4.90	1.17	4.69	1.35
Self-regulation			4.00	1.31	4.54	0.96	4.64	0.91
Resisting frustration			4.60	1.24	4.74	0.75	4.88	1.22
Social relatedness			3.50	1.70	4.15	1.31	3.91	1.48

- All ***'digitals'*** were in their first semester at university and studying for a teaching degree, most of them were women. They reported substantially less self-efficacy and identification with the study programme, less self-regulated learning and less social relatedness than the other groups.
- The ***'traditionalists'*** had the highest proportion of males, non-first semesters, older students and students in the mathematics bachelor's programme. They showed a particularly high self-efficacy and social relatedness.
- The ***'all resource users'*** formed the largest group of about half of the students in our study. They showed no prominent characteristics.

Summary





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Thank you!