

Teaching Matrix Algebra Using Technology – Do the Students' Attitudes Change with Time?



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Background

- **Schmalkalden University of Applied Sciences**

- Established in 1991
- 5 Faculties
- 3,000 Students



- **Faculty of Business and Economics**

- Established in 1992
- 4 Bachelor programs
- 1 Master program (English)
- 1 MBA program
- 600 Students



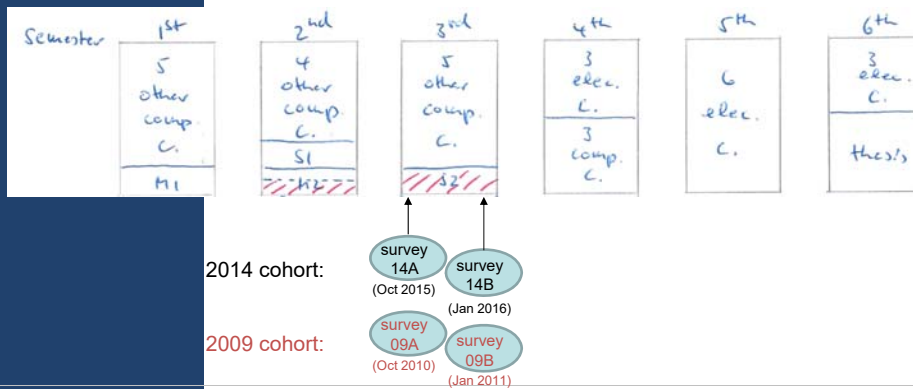
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History of Matrix Algebra course (50% of M2)



- **Until 2001**
 - Lecture hall (2 groups of up to 70 students)
 - Blackboard & overhead projector; pocket calculators
- **2002**
 - In PC lab: 2 of 15 weeks
- **2003 - 2004**
 - In PC lab: every other week (4 groups ≤ 40)
- **2005 - 2011**
 - Course and exam in PC lab (3 groups ≤ 40)
- **2012 - 2014**
 - Lecture hall (2012: PC labs) (2-3 groups ≤ 70)
- **2015 - 2016**
 - Course and exam in PC lab (3-4 groups ≤ 40)

General design of Bachelor programs






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Questionnaire 2014 cohort (survey 14A)

1st Survey on the Use of Technology
in Compulsory Mathematics and Statistics Courses
at the Faculty of Business and Economics 2015/16




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Dear Students,
Last semester you attended the course "Matrix Algebra". The Computer Algebra System DERIVE was used regularly throughout the course that took place in the PC lab, which was certainly new for you. Such an approach is called "technology-supported teaching". As your experiences can help us with the future teaching at our faculty, we kindly ask you to answer the following questions.

After having worked with DERIVE for at least one semester, please give your opinion on the following 8 statements:

	definitely true						definitely not true
1. Working with DERIVE is <u>no</u> big problem for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. DERIVE allows more vivid problem solving.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. DERIVE helps to avoid computing errors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I can work faster when using DERIVE.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I like mathematics and statistics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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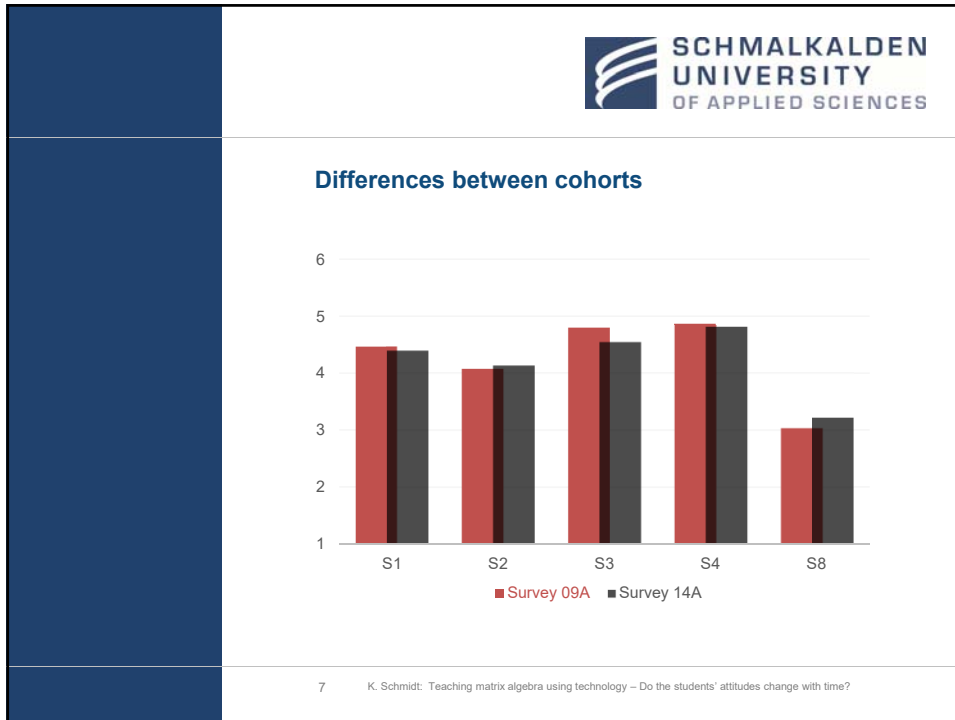


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Overall averages (survey 09A vs. 14A)

Stmt. No.	Statement	2009 cohort N=96	2014 cohort N=78
S1	Working with DERIVE is <u>no</u> big problem for me	4,5	4,4
S2	DERIVE allows more vivid problem solving	4,1	4,1
S3	DERIVE helps me to avoid computing errors	4,8	4,5
S4	I can work faster when using DERIVE	4,9	4,8
...			
S8	I like mathematics and statistics	3,0	3,2

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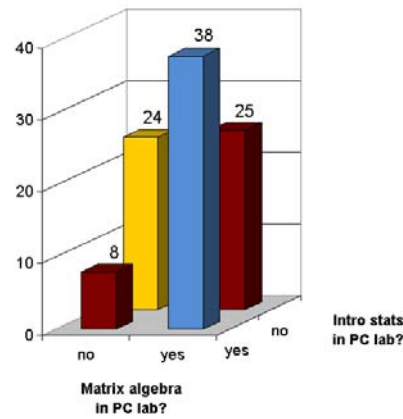
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Frequency distribution of responses to statement S8 (survey 14A vs. 09A)

	definitely true		...			definitely not true	
	O ₆	O ₅	O ₄	O ₃	O ₂	O ₁	
8. I like mathematics and statistics.							
2014 cohort (N=78)	8	13	18	7	13	19	
		Σ: 39			Σ: 39		
2009 cohort (N=96)	8	14	13	16	28	17	
		Σ: 35			Σ: 61		

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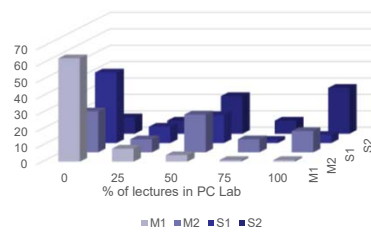
Students' attitudes toward technology (AtoT; survey 09A)



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Students' attitudes toward technology (AtoT; survey 14A)

	quarters of lectures		% of lectures		V11A		V11B		V12A		V12B	
	in PC Lab	in PC Lab	in PC Lab	in PC Lab	M1	M2	S1	S2	S1	S2	S1	S2
only Lecture Hall	0	0	0	0	63	25	43	10				
75% Lecture Hall	1	25	8	8	8	8	10	8				
50% LH / 50% Lab	2	50	4	23	4	23	17	23				
75% PC Lab	3	75	1	8	1	8	2	8				
only PC Lab	4	100	1	13	1	13	5	28				



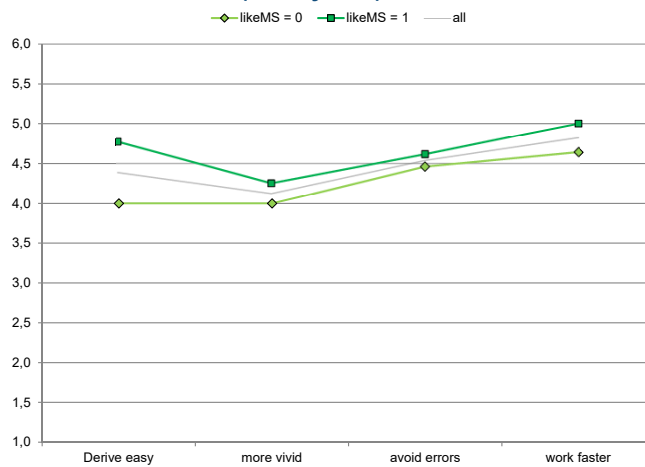
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Frequency distribution of categories of Matrix Algebra results (survey 14A vs. 09A)

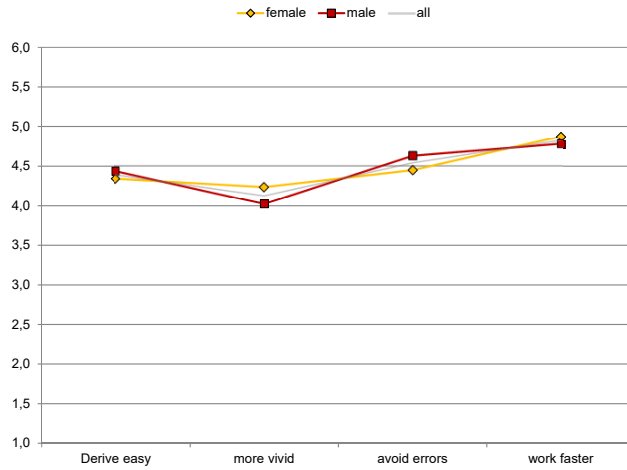
Please turn this questionnaire over to find your result (as percentage of total points) in the “Matrix Algebra” part of the “Mathematics II” examination last semester, and mark the respective category accordingly:

2014 cohort (N=74)	<input type="radio"/> 0-30%	<input type="radio"/> 31-40%	<input type="radio"/> 41-50%	<input type="radio"/> 51-60%	<input type="radio"/> 61-70%	<input type="radio"/> 71-80%	<input type="radio"/> 81-100%
	6	3	12	15	14	13	11
2009 cohort (N=64)	<input type="radio"/> 0-20%	<input type="radio"/> 21-30%	<input type="radio"/> 31-40%	<input type="radio"/> 41-50%	<input type="radio"/> 51-60%	<input type="radio"/> 61-80%	<input type="radio"/> 81-100%
	1	5	11	20	7	8	12

“Don’t like maths & stats” vs. “Like maths & stats” students (survey 14A)

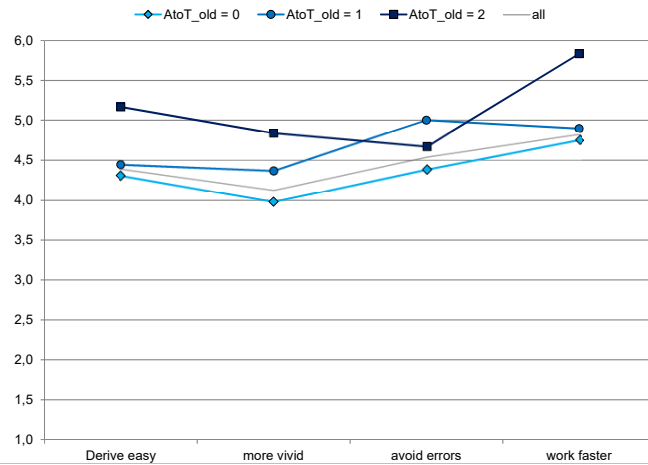


Female vs. male students (survey 14A)



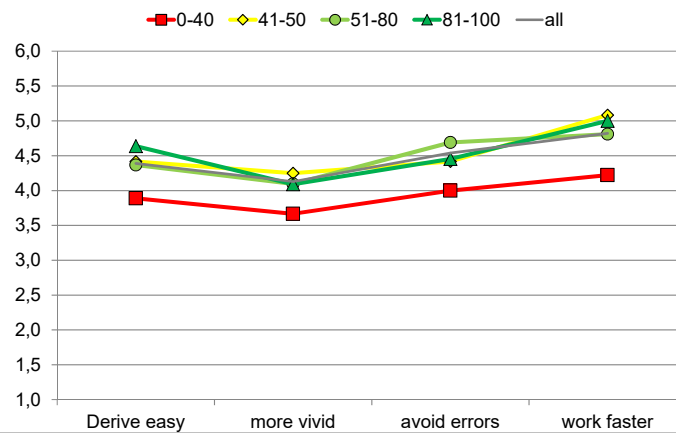
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Students with low vs. medium vs. high attitudes toward technology (survey 14A)



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Performance in Matrix Algebra part of “Mathematics II” examination (percentage of points; survey 14A)



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Hypotheses based on previous results

- Students who like mathematics and statistics more have more positive attitudes toward the use of technology in mathematics education
- The attitudes toward the use of technology in mathematics education do not significantly depend on the sex of the students
- Students who are more open to computer use in teaching have in general more positive attitudes toward the use of technology in mathematics education
- Students who are better in mathematics have more positive attitudes toward the use of technology in mathematics education

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Regression models (survey 14A)

$$Sx = b_0 + b_1Male + b_2AtoT + b_3S8 + b_4PercMA$$

Independent variables:

- *Male* dummy variable: 1 if male, 0 if female
- *AtoT* “Attitude toward Technology” (this is defined as the number of quarters (of all four compulsory courses in maths and stats) a student would prefer to sit in the PC lab instead of in a lecture hall (possible values: 0 to 16))
- *S8* answer to statement S8 “I like mathematics and statistics”: 1 “definitely not true” ... 6 “definitely true”, (used to generate dummy variable *likeMS*)
- *PercMA* percentage of points in Matrix Algebra portion of “Mathematics II” exam (generated by replacing the categories of the variable with the Matrix Algebra results of the previous semester by the actual mean percentages of the 7 categories in the questionnaire)

Linear regression results (survey 14A vs. 09A)

Oct2015	R²	const.	Male	AtoT	S8	PercMA
dependent variable:						
S1 no big problem working with	0,28	2,14	0,49	0,13	0,26	0,007
S2 more vivid problem solving	0,21	2,70	0,06	0,17	0,10	0,002
S3 helps to avoid computing errors	0,14	3,00	0,41	0,12	0,10	0,006
S4 work faster when using it	0,21	3,13	0,27	0,15	0,14	0,006
Oct2010	R²	const.	Male	AtoT	S8	PercMA
dependent variable:						
S1 no big problem working with	0,28	2,98	0,10	0,28	0,20	0,011
S2 more vivid problem solving with	0,11	3,23	-0,02	0,38	0,07	0,006
S3 helps to avoid computing errors	0,32	3,67	0,47	0,39	0,07	0,009
S4 work faster when using it	0,22	3,72	0,30	0,46	0,03	0,010