

# Supplementary material to “First-year engineering students’ attitudes and learning goals in calculus: A ten-year follow-up study”

**Table 1:** Study habits and final grades of survey completers and drop-outs.

<i>Percentage of classes attended</i>	0-40%	41-80%	81-100%			
	<i>Overview lectures</i>					
Survey completers	0.6%	13.0%	86.3%			
Survey drop-outs	10.7%	22.2%	67.0%			
	<i>Interactive lectures</i>					
Survey completers	0.6%	6.3%	93.0%			
Survey drop-outs	4.2%	14.2%	81.6%			
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<i>Weekly number of working hours</i>	< 10	10-12	> 12			
Survey completers	42.9%	46.3%	10.8%			
Survey drop-outs	52.9%	38.7%	8.4%			
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<i>Final grade</i>	A	B	C	D	E	F
Survey completers	29.8%	30.8%	24.1%	11.4%	0.6%	3.2%
Survey drop-outs	19.9%	30.7%	27.6%	16.5%	3.1%	2.3%

**Table 2:** Descriptive statistics for the achievement goal questionnaire

<i>Subscale</i>	MAP		MAV		PAP		PAV		WAV	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Mean	5.89	5.34	4.10	4.36	4.51	4.16	3.59	3.87	2.41	2.61
SD	0.79	1.00	1.33	1.41	1.32	1.42	1.31	1.23	0.99	0.99
Skewness	-0.75	-0.38	-0.15	-0.17	-0.23	-0.16	0.13	-0.05	0.98	0.73
Kurtosis	3.42	2.70	2.56	2.40	2.59	2.35	2.46	2.68	4.52	3.60
$\alpha$	0.69	0.79	0.80	0.85	0.82	0.87	0.66	0.62	0.70	0.70
$\rho_{12}$		0.59		0.45		0.57		0.52		0.60

**Table 3:** Descriptive statistics for the attitudes towards mathematics instrument

<i>Subscale Time</i>	EN		MO		SE		VA	
	T1	T2	T1	T2	T1	T2	T1	T2
Mean	3.93	3.77	3.84	3.72	3.86	3.55	4.21	4.12
SD	0.50	0.52	0.57	0.65	0.59	0.69	0.43	0.46
Skewness	-0.37	-0.34	-0.34	-0.42	-0.40	-0.24	-0.23	-0.29
Kurtosis	2.79	3.36	3.35	3.46	2.77	2.67	2.94	3.36
$\alpha$	0.82	0.81	0.73	0.79	0.92	0.93	0.79	0.82
$\rho_{12}$		0.72		0.66		0.74		0.68

**Table 4:** Cluster analysis of individual-level changes in achievement goals.

Cluster 1	<i>Subscale</i>	MAP	MAV	PAP	PAV	WAV	
$n_1 = 325$	T1 mean	5.87	4.38	4.55	3.78	2.49	
	T2 mean	5.22	4.21	4.07	3.85	2.65	
	Mean difference (SD)	-0.65	-0.16	-0.49	0.07	0.16	
	<i>Final grade</i> <sup>a</sup>	A	B	C	D	E	F
		24%	33%	22%	16%	1%	4%
Cluster 2	<i>Subscale</i>	MAP	MAV	PAP	PAV	WAV	
$n_3 = 106$	T1 mean	5.79	3.33	4.49	3.17	2.29	
	T2 mean	5.46	4.94	4.53	4.17	2.62	
	Mean difference (SD)	-0.33	1.61	0.04	1.00	0.32	
	<i>Final grade</i> <sup>a</sup>	A	B	C	D	E	F
		37%	28%	33%	0%	0%	2%

<sup>a</sup>Final grade distribution in two clusters was estimated from on line survey responses. Cluster 1 had a 62% response rate and cluster 2 had a 57% response rate at time T3.

**Table 5:** Cluster analysis of individual-level changes in attitudes.

Cluster 1	<i>Subscale</i>	EN	MO	SE	VA		
$n_1 = 172$	T1 mean	3.80	3.69	3.77	4.10		
	T2 mean	3.90	3.84	3.68	4.25		
	Mean difference	0.09	0.15	-0.09	0.15		
	<i>Final grade<sup>a</sup></i>	A	B	C	D	E	F
		24%	30%	29%	13%	1%	3%
Cluster 2	<i>Subscale</i>	EN	MO	SE	VA		
$n_2 = 203$	T1 mean	3.98	3.90	3.86	4.28		
	T2 mean	3.62	3.56	3.39	3.99		
	Mean difference	-0.37	-0.33	-0.47	-0.29		
	<i>Final grade<sup>a</sup></i>	A	B	C	D	E	F
		28%	31%	24%	11%	1%	4%

<sup>a</sup> Final grade distribution in two clusters was estimated from on line survey responses. Cluster 1 had a 58% response rate and cluster 2 had a 62% response rate at time T3.