Appendix results in t-tests for

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Abstract. Results of the t-tests done on the learning metrics in the "Predicting self-regulated learning support needs during learning" paper. The learning outcomes are the children's scores on the pre-tests and post-tests, as well as the normalised learning change [2]. The normalised learning change is defined as $\frac{\text{Post}-\text{pre}}{\text{pre}_{\max}-\text{pre}}$ when the child has improved, $\frac{\text{Post}-\text{pre}}{\text{pre}}$ if post-test scores are lower than pre-test scores, and 0 if the child already has the maximum score (of 8) on the pre-test, or if the pre-test and post-test are equal [2].

To see whether the learning outcomes and process measures of the children differ significantly between clusters, we run a linear mixed model in R using lmerTest [1] and, if so, t-tests with corrections using Satterthwaite's method to determine which clusters differ significantly from each other on which measures.

1 T-tests

1.1 Accuracy

Accuracy is measured as the percentage of problems solved correctly. The results of the t-tests is given in Table 1

Table 1. Post-hoc comparisons for accuracy per cluster

Condition	Condition	Mean Difference	SE	df	t	p_{tukey}
J.1	- J.2	0.278	0.022	339.2	12.575	p<0.001
J.1	- J.3	0.136	0.011	347.3	11.974	p<0.001
J.1	- J.4	0.408	0.024	343.6	17.022	p<0.001
J.2	- J.3	-0.142	0.02	311.2	-7.234	p<0.001
J.2	- J.4	0.13	0.028	308.8	4.711	p<0.001
J.3	- J.4	0.272	0.022	327	12.331	p<0.001

1.2 Effort

Effort is measured as the total number of problems solved. The results of the t-tests is given in Table 2

Table 2. Post-hoc comparisons for effort per cluster

Condition	Condition	Mean Difference	SE	df	t	p_{tukey}
J.1	- J.2	11.68	10.433	341.3	1.12	0.677738763694407
J.1	- J.3	-10.917	5.312	339.8	-2.055	0.170131864245454
J.1	- J.4	25.156	11.237	347.9	2.239	0.114933069619867
J.2	- J.3	-22.597	9.342	327.7	-2.419	0.0755156697530543
J.2	- J.4	13.476	13.12	325.7	1.027	0.733650114306893
J.3	- J.4	36.073	10.419	339.8	3.462	p<0.01

1.3   Pre-test scores

Pre-test score is measured as the number of correctly solved problems and is out of a total of 8 problems. The results of the t-tests is given in Table 3

Table 3. Post-hoc comparisons for pre-test scores per cluster

Condition	Condition	Mean Difference	SE	df	t	p_{tukey}
J.1	- J.2	1.983	0.488	316.8	4.06	p<0.001
J.1	- J.3	1.036	0.243	329.8	4.262	p<0.001
J.1	- J.4	2.02	0.537	327.3	3.763	p<0.01
J.2	- J.3	-0.946	0.439	290.6	-2.156	0.138
J.2	- J.4	0.037	0.632	302.7	0.059	1
J.3	- J.4	0.984	0.497	314.7	1.98	0.198

1.4   Post-test score

Post-test score is measured as the number of correctly solved problems and is out of a total of 8 problems. The results of the t-tests is given in Table 4

Table 4. Post-hoc comparisons for post-test scores per cluster

Condition	Condition	Mean Difference	SE	df	t	p_{tukey}
J.1	- J.2	2.648	0.456	320.4	5.806	p<0.001
J.1	- J.3	1.736	0.236	314.7	7.358	p<0.001
J.1	- J.4	4.232	0.512	315.6	8.261	p<0.001
J.2	- J.3	-0.912	0.409	304.7	-2.231	0.117
J.2	- J.4	1.584	0.591	306.5	2.681	p<0.05
J.3	- J.4	2.496	0.476	317.7	5.249	p<0.001

1.5   Normalized learning change

The normalised learning change is defined as $\frac{\text{Post}-\text{pre}}{\text{pre}_{max}-\text{pre}}$ when the child has improved, $\frac{\text{Post}-\text{pre}}{\text{pre}}$ if post-test scores are lower than pre-test scores, and 0 if the

child already has the maximum score (of 8) on the pre-test, or if the pre-test and post-test are equal [2]. The results of the normalized learning change is given in Table 5

Table 5. Post-hoc comparisons for normalized learning change per cluster

Condition	Condition	Mean Difference	SE	df	t	p_{tukey}
J.1	- J.2	0.311	0.114	295.8	2.731	p<0.05
J.1	- J.3	0.289	0.057	283.9	5.065	p<0.001
J.1	- J.4	0.717	0.13	290.1	5.504	p<0.001
J.2	- J.3	-0.022	0.103	286.2	-0.211	0.997
J.2	- J.4	0.406	0.153	291.6	2.66	p<0.05
J.3	- J.4	0.428	0.122	294	3.519	p<0.01

References

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