

# Statistical Analysis in the first study for students with effective participation

Table 1: Two-way ANOVA and Scheirer-Ray-Hare in the first study for students with effective participation

	Sum Sq	Df	F value	Pr(>F)	Sig	Df	Sum Sq	H	p.value	Sig
Interest/Enjoyment.(Intercept)	1074.072	1	878.586	0.000						
Interest/Enjoyment.Type	1.773	1	1.450	0.235		1	362.143	1.860	0.173	
Interest/Enjoyment.CLRole	0.621	1	0.508	0.480		1	50.021	0.257	0.612	
Interest/Enjoyment.Type:CLRole	3.008	1	2.461	0.124		1	439.215	2.256	0.133	
Interest/Enjoyment.Residuals	53.790	44				44	8300.621			
Perceived Choice.(Intercept)	1278.228	1	936.834	0.000						
Perceived Choice.Type	5.835	1	4.277	0.045	*	1	420.000	2.153	0.142	
Perceived Choice.CLRole	0.009	1	0.006	0.937		1	0.187	0.001	0.975	
Perceived Choice.Type:CLRole	0.009	1	0.006	0.937		1	22.634	0.116	0.733	
Perceived Choice.Residuals	60.034	44				44	8726.179			
Pressure/Tension.(Intercept)	102.718	1	402.928	0.000						
Pressure/Tension.Type	0.701	1	2.752	0.105		1	197.486	1.069	0.301	
Pressure/Tension.CLRole	0.066	1	0.258	0.614		1	114.083	0.618	0.432	
Pressure/Tension.Type:CLRole	1.940	1	7.609	0.009	**	1	1034.002	5.599	0.018	*
Pressure/Tension.Residuals	10.197	40				44	7333.929			
Effort/Importance.(Intercept)	1450.796	1	1585.308	0.000						
Effort/Importance.Type	3.117	1	3.406	0.072		1	438.193	2.263	0.132	
Effort/Importance.CLRole	4.836	1	5.284	0.026	*	1	623.521	3.221	0.073	
Effort/Importance.Type:CLRole	2.415	1	2.639	0.111		1	312.872	1.616	0.204	
Effort/Importance.Residuals	40.267	44				44	7724.414			
Intrinsic Motivation.(Intercept)	1359.102	1	2860.746	0.000						
Intrinsic Motivation.Type	2.288	1	4.816	0.034	*	1	678.943	3.464	0.063	
Intrinsic Motivation.CLRole	0.238	1	0.501	0.483		1	96.333	0.491	0.483	
Intrinsic Motivation.Type:CLRole	0.075	1	0.157	0.694		1	60.952	0.311	0.577	
Intrinsic Motivation.Residuals	20.904	44				44	8375.771			

Signif. codes: 0 “\*\*\*” 0.01 “\*” 0.05

Table 2: Summary of Tukey post-hoc in the first study for students with effective participation

	N	mean	lsmean	SE	df	lwr.CI	upr.CI	t.ratio	p.value	p.adj	g	sig	mag
Perceived Choice:non-gamified - ont-gamified	48	-0.707	-0.707	0.342		-1.396	-0.018	-2.068	0.045	0.045	-0.609	*	medium
Pressure/Tension:non-gamified.Apprentice - ont-gamified.Apprentice	22	0.680	0.680	0.216		0.100	1.259	3.143	0.003	0.016	1.236	*	large
Intrinsic Motivation:non-gamified - ont-gamified	48	-0.443	-0.443	0.202		-0.850	-0.036	-2.195	0.034	0.034	-0.642	*	medium

Table 3: Summary of Pair wilcoxon in the first study for students with effective participation

	Group	N	Median	Mean.Ranks	Sum.Ranks	U	Z	p.value	r	magnitude
Interest/Enjoyment.Type:CLRole.less.1	non-gamified.Master	10	3.83	9.20	92.0	37.0	-1.94	0.026	0.396	medium
Interest/Enjoyment.Type:CLRole.less.2	ont-gamified.Master	14	5.17	14.86	208.0	37.0	-1.94	0.026	0.396	medium
Pressure/Tension.Type:CLRole.greater.1	non-gamified.Apprentice	10	2.00	16.15	161.5	106.5	2.29	0.011	0.467	medium
Pressure/Tension.Type:CLRole.greater.2	ont-gamified.Apprentice	14	1.00	9.89	138.5	106.5	2.29	0.011	0.467	medium
Pressure/Tension.Type:CLRole.two.sided.1	non-gamified.Apprentice	10	2.00	16.15	161.5	106.5	2.29	0.021	0.467	medium
Pressure/Tension.Type:CLRole.two.sided.2	ont-gamified.Apprentice	14	1.00	9.89	138.5	106.5	2.29	0.021	0.467	medium
Pressure/Tension.Type:CLRole.less.1	ont-gamified.Apprentice	14	1.00	11.29	158.0	53.0	-2.18	0.014	0.413	medium
Pressure/Tension.Type:CLRole.less.2	ont-gamified.Master	14	2.00	17.71	248.0	53.0	-2.18	0.014	0.413	medium
Pressure/Tension.Type:CLRole.two.sided.11	ont-gamified.Apprentice	14	1.00	11.29	158.0	53.0	-2.18	0.027	0.413	medium
Pressure/Tension.Type:CLRole.two.sided.21	ont-gamified.Master	14	2.00	17.71	248.0	53.0	-2.18	0.027	0.413	medium
Effort/Importance.Type:CLRole.greater.1	non-gamified.Apprentice	10	5.83	13.30	133.0	78.0	2.13	0.017	0.476	medium
Effort/Importance.Type:CLRole.greater.2	non-gamified.Master	10	4.50	7.70	77.0	78.0	2.13	0.017	0.476	medium
Effort/Importance.Type:CLRole.two.sided.1	non-gamified.Apprentice	10	5.83	13.30	133.0	78.0	2.13	0.035	0.476	medium
Effort/Importance.Type:CLRole.two.sided.2	non-gamified.Master	10	4.50	7.70	77.0	78.0	2.13	0.035	0.476	medium
Effort/Importance.Type:CLRole.less.1	non-gamified.Master	10	4.50	8.40	84.0	29.0	-2.42	0.007	0.493	medium
Effort/Importance.Type:CLRole.less.2	ont-gamified.Apprentice	14	6.00	15.43	216.0	29.0	-2.42	0.007	0.493	medium
Effort/Importance.Type:CLRole.two.sided.11	non-gamified.Master	10	4.50	8.40	84.0	29.0	-2.42	0.014	0.493	medium
Effort/Importance.Type:CLRole.two.sided.21	ont-gamified.Apprentice	14	6.00	15.43	216.0	29.0	-2.42	0.014	0.493	medium
Effort/Importance.Type:CLRole.less.11	non-gamified.Master	10	4.50	9.20	92.0	37.0	-1.94	0.026	0.396	medium
Effort/Importance.Type:CLRole.less.21	ont-gamified.Master	14	6.00	14.86	208.0	37.0	-1.94	0.026	0.396	medium
Intrinsic Motivation.Type.less.1	non-gamified	20	5.20	20.05	401.0	191.0	-1.86	0.032	0.269	small
Intrinsic Motivation.Type.less.2	ont-gamified	28	5.63	27.68	775.0	191.0	-1.86	0.032	0.269	small
Intrinsic Motivation.Type:CLRole.less.1	non-gamified.Master	10	4.96	9.40	94.0	39.0	-1.82	0.037	0.371	medium
Intrinsic Motivation.Type:CLRole.less.2	ont-gamified.Apprentice	14	5.72	14.71	206.0	39.0	-1.82	0.037	0.371	medium
Intrinsic Motivation.Type:CLRole.less.11	non-gamified.Master	10	4.96	9.00	90.0	35.0	-2.05	0.021	0.418	medium
Intrinsic Motivation.Type:CLRole.less.21	ont-gamified.Master	14	5.52	15.00	210.0	35.0	-2.05	0.021	0.418	medium
Intrinsic Motivation.Type:CLRole.two.sided.1	non-gamified.Master	10	4.96	9.00	90.0	35.0	-2.05	0.042	0.418	medium
Intrinsic Motivation.Type:CLRole.two.sided.2	ont-gamified.Master	14	5.52	15.00	210.0	35.0	-2.05	0.042	0.418	medium

# 1 Assumptions for Parametric Tests

Table 4: Univariate normality test in the first study for students with effective participation

	normality.fail	W	p.value
Interest/Enjoyment	FALSE	0.953	0.052
Perceived Choice	FALSE	0.968	0.203
Pressure/Tension	FALSE	0.951	0.061
Effort/Importance	FALSE	0.982	0.644
Intrinsic Motivation	FALSE	0.975	0.396

Table 5: Notes to be taken into account about sample size in the first study for students with effective participation

	code	description
Interest/Enjoyment.Type.1	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Apprentice'.
Interest/Enjoyment.Type.2	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Apprentice'.
Interest/Enjoyment.Type.3	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Master'.
Interest/Enjoyment.Type.4	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Master'.
Perceived Choice.Type.1	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Apprentice'.
Perceived Choice.Type.2	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Apprentice'.
Perceived Choice.Type.3	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Master'.
Perceived Choice.Type.4	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Master'.
Pressure/Tension.Type.1	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Apprentice'.
Pressure/Tension.Type.2	WARN: sample.size	current size is 12 and recommended size is 15 for the group: 'ont-gamified:Apprentice'.
Pressure/Tension.Type.3	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'non-gamified:Master'.
Pressure/Tension.Type.4	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'ont-gamified:Master'.
Effort/Importance.Type.1	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Apprentice'.
Effort/Importance.Type.2	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Apprentice'.
Effort/Importance.Type.3	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Master'.
Effort/Importance.Type.4	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Master'.
Intrinsic Motivation.Type.1	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Apprentice'.
Intrinsic Motivation.Type.2	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Apprentice'.
Intrinsic Motivation.Type.3	WARN: sample.size	current size is 10 and recommended size is 15 for the group: 'non-gamified:Master'.
Intrinsic Motivation.Type.4	WARN: sample.size	current size is 14 and recommended size is 15 for the group: 'ont-gamified:Master'.

Recent studies carried out through simulations have indicated that ANOVA is reliable even when the data are non-normally distributed and the sample size is greater than 15 observations for each group. This size value is based on the Reference: Rana, R. K., Singhal, R., & Dua, P. (2016). Deciphering the dilemma of parametric and nonparametric tests. Journal of the Practice of Cardiovascular Sciences, 2(2), 95.

The sample size to carried out any parametric and non-parametric analysis is 5, and it was established using common sense. The warning and fails indicated in this section should be taking into account when a paper or report will be elaborated.