

Statistical Analysis in the third study for students with effective participation

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

	Sum Sq	Df	F value	Pr(>F)	Sig	Df	Sum Sq	H	p.value	Sig
Interest/Enjoyment.(Intercept)	538.876	1	615.747	0.000						
Interest/Enjoyment.Type	0.196	1	0.224	0.639		1	6.035	0.039	0.844	
Interest/Enjoyment.CLRole	0.616	1	0.703	0.407		1	288.400	1.844	0.175	
Interest/Enjoyment.Type:CLRole	3.215	1	3.674	0.063		1	363.625	2.325	0.127	
Interest/Enjoyment.Residuals	34.131	39				39	5911.439			
Perceived Choice.(Intercept)	754.063	1	447.395	0.000						
Perceived Choice.Type	4.574	1	2.714	0.108		1	208.305	1.326	0.249	
Perceived Choice.CLRole	0.245	1	0.145	0.705		1	34.106	0.217	0.641	
Perceived Choice.Type:CLRole	3.285	1	1.949	0.171		1	281.433	1.792	0.181	
Perceived Choice.Residuals	65.733	39				39	6071.656			
Pressure/Tension.(Intercept)	308.385	1	227.118	0.000						
Pressure/Tension.Type	2.447	1	1.802	0.187		1	226.410	1.450	0.228	
Pressure/Tension.CLRole	16.418	1	12.091	0.001	**	1	1088.221	6.970	0.008	**
Pressure/Tension.Type:CLRole	0.124	1	0.092	0.764		1	64.669	0.414	0.520	
Pressure/Tension.Residuals	52.955	39				39	5177.700			
Effort/Importance.(Intercept)	918.241	1	812.543	0.000						
Effort/Importance.Type	6.408	1	5.670	0.022	*	1	673.313	4.327	0.038	*
Effort/Importance.CLRole	2.073	1	1.834	0.183		1	198.997	1.279	0.258	
Effort/Importance.Type:CLRole	0.098	1	0.087	0.770		1	7.613	0.049	0.825	
Effort/Importance.Residuals	44.073	39				39	5655.578			
Intrinsic Motivation.(Intercept)	786.668	1	2303.392	0.000						
Intrinsic Motivation.Type	0.328	1	0.959	0.333		1	35.857	0.227	0.633	
Intrinsic Motivation.CLRole	0.793	1	2.323	0.136		1	343.885	2.181	0.140	
Intrinsic Motivation.Type:CLRole	1.070	1	3.133	0.085		1	360.444	2.286	0.131	
Intrinsic Motivation.Residuals	13.320	39				39	5880.815			
Attention.(Intercept)	568.395	1	329.447	0.000						
Attention.Type	0.356	1	0.207	0.652		1	94.855	0.577	0.448	
Attention.CLRole	0.191	1	0.110	0.741		1	12.076	0.073	0.786	
Attention.Type:CLRole	0.547	1	0.317	0.577		1	51.842	0.315	0.574	
Attention.Residuals	67.287	39				40	6911.728			
Relevance.(Intercept)	882.334	1	942.409	0.000						
Relevance.Type	2.391	1	2.554	0.118		1	38.928	0.238	0.626	
Relevance.CLRole	0.602	1	0.643	0.427		1	101.179	0.619	0.431	
Relevance.Type:CLRole	4.979	1	5.318	0.027	*	1	607.952	3.720	0.054	
Relevance.Residuals	36.514	39				40	6279.441			
Satisfaction.(Intercept)	768.694	1	374.007	0.000						
Satisfaction.Type	0.003	1	0.002	0.969		1	3.914	0.024	0.877	
Satisfaction.CLRole	1.521	1	0.740	0.395		1	105.183	0.642	0.423	
Satisfaction.Type:CLRole	0.092	1	0.045	0.834		1	19.588	0.120	0.730	
Satisfaction.Residuals	80.156	39				40	6918.816			

Table 1: *(continued)*

	Sum Sq	Df	F value	Pr(>F)	Sig	Df	Sum Sq	H	p.value	Sig
Level of Motivation.(Intercept)	703.631	1	850.373	0.000						
Level of Motivation.Type	0.000	1	0.000	0.984		1	8.360	0.051	0.822	
Level of Motivation.CLRole	0.079	1	0.096	0.758		1	19.641	0.119	0.730	
Level of Motivation.Type:CLRole	0.571	1	0.690	0.411		1	147.339	0.895	0.344	
Level of Motivation.Residuals	32.270	39				40	6906.160			

Signif. codes: 0 '***' 0.01 '**' 0.05

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

	N	mean	lsmean	SE	df	lwr.CI	upr.CI	t.ratio	p.value	p.adj	g	sig	mag
Effort/Importance:ont-gamified - w/o-gamified	43	0.762	0.822	0.345		0.102	1.423	2.381	0.022	0.025	0.705	*	medium

Table 3: Summary of Pair wilcoxon in the third 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	ont-gamified.Apprentice	15	3.83	10.53	158.0	38.0	-1.78	0.039	0.362	medium
Interest/Enjoyment.Type:CLRole.less.2	ont-gamified.Master	9	4.00	15.78	142.0	38.0	-1.78	0.039	0.362	medium
Pressure/Tension.Type:CLRole.greater.1	ont-gamified.Apprentice	15	4.00	15.10	226.5	106.5	2.33	0.009	0.476	medium
Pressure/Tension.Type:CLRole.greater.2	ont-gamified.Master	9	2.25	8.17	73.5	106.5	2.33	0.009	0.476	medium
Pressure/Tension.Type:CLRole.two.sided.1	ont-gamified.Apprentice	15	4.00	15.10	226.5	106.5	2.33	0.018	0.476	medium
Pressure/Tension.Type:CLRole.two.sided.2	ont-gamified.Master	9	2.25	8.17	73.5	106.5	2.33	0.018	0.476	medium
Pressure/Tension.Type:CLRole.greater.11	ont-gamified.Apprentice	15	4.00	12.90	193.5	73.5	2.23	0.012	0.487	medium
Pressure/Tension.Type:CLRole.greater.21	w/o-gamified.Master	6	1.12	6.25	37.5	73.5	2.23	0.012	0.487	medium
Pressure/Tension.Type:CLRole.two.sided.11	ont-gamified.Apprentice	15	4.00	12.90	193.5	73.5	2.23	0.024	0.487	medium
Pressure/Tension.Type:CLRole.two.sided.21	w/o-gamified.Master	6	1.12	6.25	37.5	73.5	2.23	0.024	0.487	medium
Effort/Importance.Type.greater.1	ont-gamified	24	5.50	25.52	612.5	312.5	2.08	0.019	0.317	medium
Effort/Importance.Type.greater.2	w/o-gamified	19	4.33	17.55	333.5	312.5	2.08	0.019	0.317	medium
Effort/Importance.Type.two.sided.1	ont-gamified	24	5.50	25.52	612.5	312.5	2.08	0.037	0.317	medium
Effort/Importance.Type.two.sided.2	w/o-gamified	19	4.33	17.55	333.5	312.5	2.08	0.037	0.317	medium
Effort/Importance.Type:CLRole.greater.1	ont-gamified.Apprentice	15	5.67	12.80	192.0	72.0	2.12	0.017	0.462	medium
Effort/Importance.Type:CLRole.greater.2	w/o-gamified.Master	6	4.17	6.50	39.0	72.0	2.12	0.017	0.462	medium
Effort/Importance.Type:CLRole.two.sided.1	ont-gamified.Apprentice	15	5.67	12.80	192.0	72.0	2.12	0.033	0.462	medium
Effort/Importance.Type:CLRole.two.sided.2	w/o-gamified.Master	6	4.17	6.50	39.0	72.0	2.12	0.033	0.462	medium
Intrinsic Motivation.Type:CLRole.less.1	ont-gamified.Apprentice	15	4.31	10.20	153.0	33.0	-2.06	0.020	0.420	medium
Intrinsic Motivation.Type:CLRole.less.2	ont-gamified.Master	9	5.01	16.33	147.0	33.0	-2.06	0.020	0.420	medium
Intrinsic Motivation.Type:CLRole.two.sided.1	ont-gamified.Apprentice	15	4.31	10.20	153.0	33.0	-2.06	0.039	0.420	medium
Intrinsic Motivation.Type:CLRole.two.sided.2	ont-gamified.Master	9	5.01	16.33	147.0	33.0	-2.06	0.039	0.420	medium
Relevance.Type:CLRole.less.1	ont-gamified.Apprentice	16	4.50	11.03	176.5	40.5	-1.79	0.038	0.358	medium
Relevance.Type:CLRole.less.2	ont-gamified.Master	9	6.00	16.50	148.5	40.5	-1.79	0.038	0.358	medium
Relevance.Type:CLRole.greater.1	ont-gamified.Master	9	6.00	9.61	86.5	41.5	1.72	0.045	0.445	medium
Relevance.Type:CLRole.greater.2	w/o-gamified.Master	6	4.38	5.58	33.5	41.5	1.72	0.045	0.445	medium

1 Assumptions for Parametric Tests

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

	normality.fail	W	p.value
Interest/Enjoyment	FALSE	0.963	0.183
Perceived Choice	FALSE	0.987	0.911
Pressure/Tension	FALSE	0.973	0.406
Effort/Importance	FALSE	0.966	0.221
Intrinsic Motivation	FALSE	0.977	0.529
Attention	FALSE	0.984	0.788
Relevance	FALSE	0.983	0.783
Satisfaction	FALSE	0.961	0.148
Level of Motivation	FALSE	0.973	0.393

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

	code	description
Interest/Enjoyment.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Interest/Enjoyment.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Interest/Enjoyment.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Perceived Choice.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Perceived Choice.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Perceived Choice.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Pressure/Tension.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Pressure/Tension.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Pressure/Tension.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Effort/Importance.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Effort/Importance.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Effort/Importance.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Intrinsic Motivation.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Intrinsic Motivation.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Intrinsic Motivation.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Attention.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Attention.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Attention.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Relevance.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Relevance.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Relevance.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Satisfaction.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Satisfaction.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Satisfaction.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-gamified:Master'.
Level of Motivation.Type.1	WARN: sample.size	current size is 13 and recommended size is 15 for the group: 'w/o-gamified:Apprentice'.
Level of Motivation.Type.2	WARN: sample.size	current size is 9 and recommended size is 15 for the group: 'ont-gamified:Master'.
Level of Motivation.Type.3	WARN: sample.size	current size is 6 and recommended size is 15 for the group: 'w/o-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.