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Labs 11 & 12

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Results

How did the students do with manipulatives? Was there an improvement? Overall an improvement was observed. A histogram was produced for each of the assessment scores with normal curves superimposed. The researcher then conducted a paired samples *t* test to find if the difference observed is significant. The Pretest seen in *figure* 1 shows a distribution that does not approach normality. The histogram for the posttest seen in *figure* 2 shows a slightly more normal curve than that of the pretest. Neither histogram skews heavily in either direction. The class, obtained slightly higher scores in the posttest (m = 83.80, sd = 9.81, n = 30) when compared to the pretest (m = 82.26, sd =10.61, n = 30). The difference between the two means is statistically significant at the .05 level ($t(29) = 2.34$, $p = .026$). Because of this, the researcher's hypothesis that the students would score better with manipulatives is accepted and the null hypothesis is rejected. These results suggest that manipulatives do have a positive effect for the class overall, although not every student showed improvement. As you can see in Table 1, there were a few students who received the same score on the second test and some that scored lower. Despite that, the stats show that overall, manipulatives helped the students.

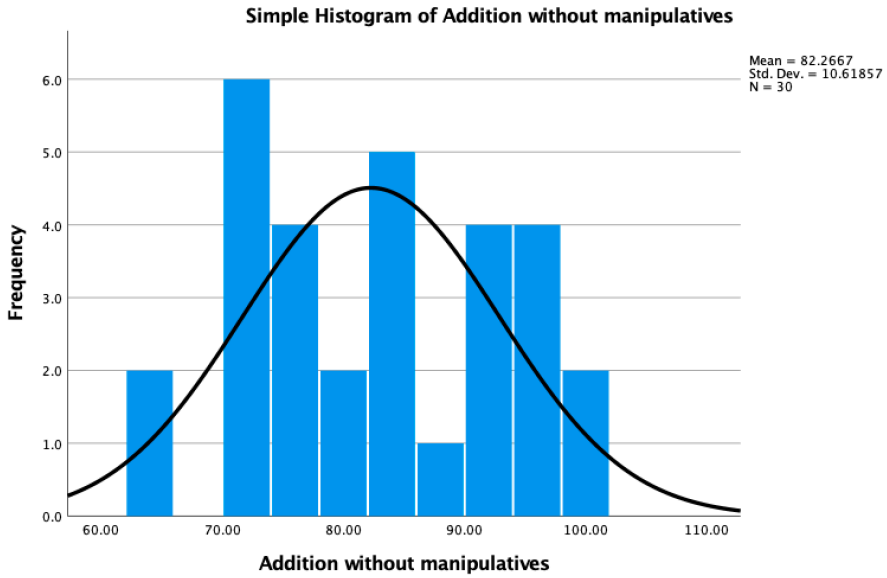

Figure 1. Histogram for pretest for addition without manipulatives.

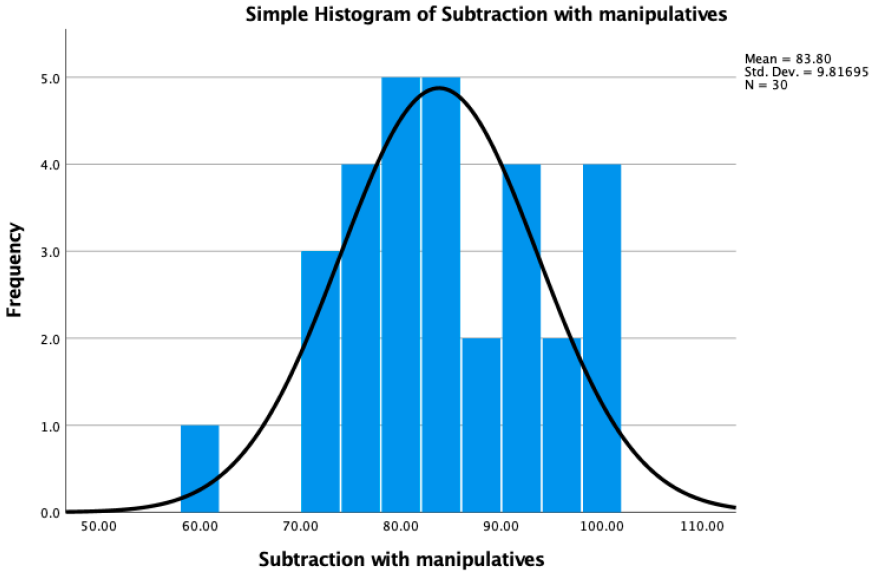

Figure 2. Histogram for posttest for subtraction with manipulatives.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Addition without manipulatives	82.2667	30	10.61857	1.93868
	Subtraction with manipulatives	83.8000	30	9.81695	1.79232

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Addition without manipulatives & Subtraction with manipulatives	30	.941	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Addition without manipulatives - Subtraction with manipulatives	-1.53333	3.58862	.65519	-2.87334	-.19332	-2.340	29	.026

Figure 3. Paired samples *t* test comparing the means of pre and post assessments.

Table 1

Pretest and posttest scores.

Participant Number	Pretest score	Posttest Score
1	72	78
2	76	76
3	84	88
4	88	90
5	72	72
6	96	96
7	92	92
8	72	84
9	64	76
10	82	84
11	80	84
12	100	98
13	82	80
14	74	78
15	96	96
16	72	70
17	74	76
18	90	88
19	90	90
20	72	72
21	96	98
22	92	92
23	72	74
24	64	60
25	82	84
26	84	84
27	100	98
28	78	80
29	76	78
30	96	98

Limitations

The researcher used the one class they had access to and was able to make the lessons part of the required curriculum. The fact that only one class was tested is a limitation of this experiment. Time limitation was another obstacle. Recommendations for future experiments on this subject would be a bigger sample size that can be split into two groups, both taking the same assessment, one with manipulatives and one without. The lessons should take place over a longer period of time and with a bigger sample size of responses in assessments.

Implications

The researcher set out to find what worked better for this class. The research showed that the class overall did better with the use of manipulatives. Many of the students individually received higher scores on the posttest while few received the same scores and even less got lower scores as seen on Table 1.1. One thing that stands out is that the two students that received perfect scores on the first exam, both lowered their scores on the second exam slightly. For these two students the use of manipulatives did not seem to have a positive effect, or it could be an indication of their abilities in addition being stronger than in subtraction. The students, due to their young age need guidance and supervision when using the cubes which they may find colorful and fun to put together and pull apart, but again, an overall improvement was observed.

Conclusion

The researcher's hypothesis that the students would do better with manipulatives is accepted and the null hypothesis rejected. This experiment's result is in line with the findings of Robert S. Liggett who in 2017 studied how second graders in a Northern Saskatchewan school would perform with manipulatives compared to without, finding that manipulatives indeed are

helpful in mathematical learning (Liggett, 2017). The researcher also concurs with the findings of Elida V. Laski as students need to use manipulatives consistently with complexity growing over time. Also the less of a distraction the manipulatives are, the better. (Laski et al., 2015) As mentioned previously, time was not something this experiment had much of and therefore more time should should be made for further studies. This is especially true when you consider that not all of the previous research has provided results that are statistically and significantly in favor of manipulative use. Hurst et al. (2020) studied participants ages 9-11 and found that manipulatives did not have anything positive to offer due to being distracting to some and difficult to use for others. This is just one example of quite a few results that did not seem promote the use of manipulatives. These mixed results is precisely the reason the researcher decided to do this experiment and more experiments should be done. We must actively adapt to methods that work for our students. As educators we encourage our students to explore, discover the unknown and then learn even more about it. As professionals, it is our duty to do the same.