# The Impact of use of manipulates on the math scores of grade 2 students

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*Abstract:* **This research report "The Impact of Use of manipulates on the math scores of grade 2 students" Liggett (2017) published in the *Brock Education Journal* is a quantitative research report. According to Leavy (2017), "quantitative research is characterised by deductive approaches to the research process aimed at proving, disproving, or lending credence to existing theories. This type of research involves measuring variables and testing relationships between variables to reveal patterns, correlations, or causal relationships. Researchers may employ linear methods of data collection and analysis that result in statistical data" p.9. Thus, the author of this journal under study (Liggett, 2017) adopted an experimental research design (which is deductive) to prove the hypothetical idea that "the use of manipulates can improve upon Grade 2 students' mathematics scores". (p.6). This study represented a true experimental design because of three factors namely manipulation, control, and randomization (Creswell, 2009). As such, the researcher used random selection to establish the treatment group and control school who are all Grade 2 students in a school in Northern Saskatchewan. He subjected the two groups to series of tests before and after his intervention (experiment) which saw the treatment group using mathematical manipulatives (plastic unifix cubes) for a specific period and the control group being denied the use of those manipulatives in Mathematics lessons.**

## I. INTRODUCTION

The researcher then analysed the numerical data he got through the various tests scores (pre-tests and post-tests) using "descriptive statistics to summarize the results with respect to the sample data including calculating the mean, mode, and range of the test results from Grade 2 students within the school. Inferential statistics were also utilised to look at the difference in comparing the outcome of using manipulatives across two groups (control and treatment) over a specific time (pre-test to a post-test). Additionally, relationships were observed by focusing on how one variable (using manipulatives) might relate to another (improved tests scores)" (Liggett, 2017, p.7).

### 1. The problem investigated in the study

Creswell (2012) defines a research problem as a general educational issue, concern, or controversy addressed in research that narrows the topic. The problem investigated in the article is "the extent to which the use of mathematical manipulatives improves test scores of Grade 2 students at a school in Saskatchewan?" (Liggett, 2017 p.89). This is actually an educational issue of concern that the researcher has identified which focused on a targeted group of students (Grade 2 students) in a given location (a school in Northern Saskatchewan) and examined how the issue (the influence of the use of manipulatives in Mathematics) affect the participants.

It is a statement about an area of concern, a condition to be improved, a difficulty to be eliminated, or a troubling question that exists in scholarly literature, in theory, or in practice that points to the need for meaningful understanding and deliberate investigation (Bryman, 2007). As such, "the extent to which the use of mathematical manipulatives improves test scores of Grade 2 students at a school in Saskatchewan" is a condition to be improved which is related to a practical classroom situation that Liggett (2017) deliberately decided to find answers to. Thus, to address the research problem, the researcher adopted an experimental research design involving two groups of students (a treatment group and a control group). Also, the literature reviewed in this article shows that other scholars have investigated similar issues suggesting that the troubling question in Liggett's published research report exists in scholarly literature and in practice in a school in Saskatchewan where the research was conducted.

### 2. Hypotheses

The null hypothesis in this research was that "there is no significant difference in test scores between the two groups" (Liggett, 2017, p.89). This agrees with the definition of Cohen, Manion & Morrison (2018) that says the "the *null hypothesis* states that, for example, there is *no* relationship between two variables, or that there has been *no* difference in participants' scores on a pre-test and a post-test of "Mathematics" p.171. Here, the researcher's first argument is that the use of mathematical manipulatives by Grade 2 students in a school in Northern Saskatchewan may have less or no impact on their performances/scores in mathematics as compared to their counterparts who do not use the mathematical manipulatives. This is called a null hypothesis because "it predicts no significant difference between two groups with respect to the variable being tested" (Leavy, 2017, p.70).

The researcher's directional hypothesis in this article was that "when manipulatives are used with a group of Grade 2 students in one school in Saskatchewan, the higher the post-test scores will be" (Liggett, 2017, p.89). Cohen, Manion & Morrison (2018) explain that "a directional hypothesis states the kind or direction of difference or relationship between two conditions or two groups of participants" p.171. What makes this hypothesis directional is that "it predicts a specific

difference between two groups with respect to the variable being tested" (Leavy, 2017, p.70). That is, the difference in performance/scores. And this case the difference is that the group using the mathematical manipulatives will record higher scores in mathematics compared to their counterpart who do not use the mathematical manipulatives.

### 3. Independent and dependent variable

An independent variable is one that is likely to have effects or influences on another variable (dependent variable). Researchers manipulate independent variables. A dependent variable is a variable that is affected or influenced by another variable (independent variable). Researchers observe dependent variables to determine the effect of the independent variable (intervention or experiment) (Gravetter & Wallnau, 2013). In research on the "The Impact of Use of manipulates on the math scores of grade 2 students" Liggett (2017), the use of mathematical manipulatives is the independent variable which is used by Grade 2 students in one school in Saskatchewan to improve their performances or test scores in Mathematics (which is the dependent variable). The researcher then observed that the test scores of the treatment group were increasing as compared to the control group who did not use the mathematical manipulatives. It follows that the "*use of mathematical manipulates*" is an independent variable because it manipulates or uses as an intervention to influence or improve the "*test scores in Mathematics*" of the Grade 2 students at the end of the intervention. Thus, the "*Mathematics test scores*" being influenced or improved by the "*use of mathematical manipulates*" is the dependent variable in this case.

### 4. Statements of problem and hypotheses

In this portion of the research report which bears the caption "Statement of Problem", the reader's attention is drawn to the specific troubling question that the research seeks to find answers to (research problem) and the tentative answers that will guide the study (hypotheses). Naturally, when one reads the paragraph under the statement of the problem in Liggett (2017), one becomes aware that the focus of his study is to find out "the extent to which the use of mathematical manipulatives improves test scores of Grade 2 students at a school in Saskatchewan?" (p.89). Bak (2015) posits that the statement of the problem is the portion of the work that captures the essential focus of the author's work and drives the various sections, directs the discussion towards the destination one wants to get to, and informs how one will develop one's work. It is usually stated in a single sentence or question. Leavy (2017) further explains that in quantitative research one might be using hypotheses instead of research questions. However, even when hypotheses are used, they are often preceded by a primary research question. A hypothesis is a statement predicting how variables relate to each other and that can be tested through research. In Liggett (2017) which is quantitative research, there are one primary question and two hypotheses (null and alternative) under the Statement of Problem. The primary question is "to what extent does the

use of mathematical manipulatives improve test scores of Grade 2 students at a school in Saskatchewan?" The null hypothesis in this research is that "there is no significant difference in test scores between the two groups" and the alternative hypothesis is "when manipulatives are used with a group of Grade 2 students in one Saskatchewan school, the higher the post-test scores will be" (Liggett, 2017, p.89). These statements (problem and hypotheses) follow a brief background to the issue at stake which consisted of relevant pieces of literature giving the reader an insight into the subject matter and situating the problem under investigation into its rightful context.

### 5. Clarity of problems and hypotheses Statements

The research problem and hypotheses in Liggett (2017) clearly identify with the characteristics of a good research problem/hypothesis outlined by Bryman (2007) who argues that a good research problem/hypothesis should be clearly stated, precise and concise. It should be a compelling issue; it must be researchable and support multiple perspectives and must not pose any ethical problem in its implementation. As such, Liggett's primary research question was "to what extent does the use of mathematical manipulatives improve test scores of Grade 2 students at a school in Saskatchewan?" This was one concise and precise question that clearly and precisely indicates the variables being tested or observed and the group of individuals involved in the study as well as the exact location where the study is being conducted. Additionally, Liggett's hypotheses clearly predict that there is no significant difference between the two groups with respect to the variable being tested (null hypothesis) on one hand and the other hand predicts that there is a specific difference between the two groups concerning the variable being tested (directional hypothesis). These were the question and the tentative answers with clarity of purpose that guided the study to a successful conclusion. Hence, there is no doubt that they were precise, concise, and researchable and were not associated with any unethical research practice.

### 6. Suggestion of further research

The author suggested further research on the problem. The suggestion pointed out areas that the study did not touch on which could become the starting point of new research. According to the author Liggett (2017, p.96), "additional research into the effects of using manipulatives with specific genders remains unclear". This is because "this study was unable to analyse gender due to non-normality in the data, and did not include a measure of students' preferred learning styles. Future research is required to shed light upon the degree to which manipulatives differentially improve the instruction and learning of mathematics within education for specific gender and learning styles. These insights would prove beneficial to the instruction and learning of mathematics in the long term". p.96.

## II. CONCLUSION

In sum, Liggett (2017) is a quantitative research that employs an experimental design to find out the extent to which the use of mathematical manipulatives could improve the mathematics scores of Grade 2 students in a school in Northern Saskatchewan. Random selection was used to establish the control group and a treatment group for the study. Null and alternative hypotheses were coined to guide the study. After two (2) weeks of intervention, data from pre-tests and post-tests were analysed using descriptive and inferential statistics. The study eventually established that those students who used mathematical manipulatives performed better on the post-test than those who did not use treatment manipulatives.

However, the lack of a formal and recognized standardized test that could be used and repeated in the study posed a hindrance. Also, the size of the population in the and control group was small (only 43). This constitutes a limitation to this study as its findings could not be generalised to a large population. Again, the 2 weeks used for the study were inappropriate.

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