Meta-Analysis Model for Education in Pandemic Times

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ABSTRACT

During Pandemic times like the current COVID-19, response protocols pose challenges to researchers especially in regard to data collection. The guidelines such as restriction of movement, social distancing and age-related protocols that guide social groupings and interaction become constraints to research designs that rely heavily on human interaction/contact. The pandemic brings in a new normal for educational research in terms of approach to research design, data collection and data analysis. This necessitates two distinct ways in conducting educational research: The use of Meta-Analysis as an appropriate design; and, the availability of quick reference tools for Effect Size Calculation among studies already undertaken in related fields. This paper discusses ways in which educational research could exploit meta-analysis in achieving reliable results by: (a) Proposing meta-analysis as the most viable option for research design; (b) Recommending a set of tools for different options on Effect-Size Calculation and (c) Proposing a framework for mentoring postgraduate students on this new approach.

Keywords: Educational Research, Meta-analysis, Effect-Size, Sampling, Reliability, Statistics

1.0 INTRODUCTION

During Pandemic times like the current COVID-19, response protocols pose challenges to researchers especially in regard to data collection. The guidelines on social distancing and the introduction of age-related protocols that guide social groupings and interaction are a big hindrance to research designs that rely heavily on human interaction/contact.

This context has immediately created the challenge of accessibility to human sampling. Following this new normal, an approach to Research Design and data analysis is inevitable to guarantee continued research without magnifying the effects of the pandemic.

This can be addressed in two distinct ways:

1. The use of Meta-Analysis as an appropriate design;

2. The availability of quick reference tools for Effect Size Calculation among studies already undertaken in related field.

By answering the question, 'In what way should researchers maximize the value of research without aggravating the effects of any given pandemic?', this study aims at mitigating pandemic exclusion by:

(a) Proposing meta-analysis as the most viable option for research design;

(b) Recommending a set of tools for different options on Effect-Size Calculation.

(c) Proposing a framework for mentoring post-Graduate Students on this new approach.

The paper proposes the use of the statistical technique of 'Meta-Analysis' (MA) as developed by Glass, McGraw and Smith (1981) to synthesize studies collected for meta-analysis. This approach has been adopted because of the many factors preventing movement and gatherings as measures against effects of pandemics like the infection and spread of COVID-19.

2.0 The Rationale and Procedures for Meta-Analysis
2.1 Rationale for Meta-Analysis

Every treatment has an effect. Researchers are usually interested in establishing the size of the effect and its statistical significance.

When an Experimental or a Quasi-Experimental Study is well-designed, the effect of a treatment condition on some defined outcome can be measured. Apart from the Statistical significance of the results, the size of the effect of the treatment condition on the outcome is more significant in making conclusions about future predictions.

The best approach to comparing several empirical studies is Meta-Analysis which consists in several systematic steps.

Meta-analysis procedures are expected to follow the Campbell Collaboration Statistical Analysis (2004) standards, and the Meta-Analysis Reporting Standards (MARS), as required by the American Psychological Association (APA) (2012):

❖ The technique uses a quantitative integration of various findings treating each study as a unit of analysis.
❖ The findings between studies are compared by transforming the results to a common standardized metric called an effect size (ES).
❖ The search strategy covers peer reviewed journal articles and open access publications for wider coverage of the main contributions in the intended field of study (Payne, More, Griffin & Autry, 2011).
❖ A search of various Electronic data bases for titles and abstracts of potentially relevant studies published in the English language is conducted.
❖ The main question of the analysis is to describe comprehensively the relationship between a treatment and quality learning outcomes.

In using MA, procedures, computations, and interpretation of results, the following steps are recommended:

(1) Studies with serious methodological flaws are excluded;

(2) One effect size is computed for each study pertaining to a well-defined dependent variable. (A measure of an observed effect relative to a control);

(3) Effect sizes of separate and independent studies are calculated using z-scores and the N (the total number of observations on which z is based) adopted from Rosenthal (1991, p.19); or other equivalent statistic;

(4) Hunter and Schmidt's (1990) corrections for sampling error, measurement error, range restriction, and other systematic artifacts are applied to the distribution of effect sizes;

(5) Effect sizes are then examined within each stratum and across all of the studies/strata.

3.0 Searching for Relevant Studies:

To guide the literature search and review, **a group of key related terms must be used.** The researcher must develop a conceptual framework identifying key components describing the treatment and its effects. The computerized searches of online databases and citations in prior meta-analyses of similar studies as well as an additional search in key journals may be done. The electronic library and inter-library data banks and services are scanned as well.

3.1 Data Extraction, Coding, and Selection of Final Set of Studies:

The PICO/ SPIDER: are the two principal approaches to meta-analysis.

PICO stands for **P**opulation, **I**ntervention, **C**omparison, and **O**utcome.

SPIDER stands for **S**ample, **P**henomenon**, I**ntervention, **D**esign, **E**valuation and **R**esearch type.

Once the principle is adopted, all studies are compiled into a master database (MDB),

within a MS-Excel spreadsheet file (after being assigned a unique 'I.D. Number'). Data on variables of interest are extracted, recorded and appended to the MDB.

3.2 Selections of Effect Size Calculation Tools

The effect sizes for different studies can be carefully done by selecting relevant tools depending on the initial statistic used in the study to be analyzed. The tools are summarized in table 1.

Table 1: Tools for Effect Size Calculation

No.	Type of calculation tool
1	Cohen's, d
2	t-statistic
3	Chi-Square Statistic
4	F-Statistic
5	Regression Statistic

Source: (Authors' Summary, 2020)

3.3 Equations for Calculating Effect Sizes

Equations 1-5 can be selected in calculating effect sizes:

A standardized Beta coefficient compares the strength of the effect of each individual independent variable to the dependent

$$\text{Cohen's d} = \frac{\bar{Y}_1 - \bar{Y}_2}{s_c} \quad (1)$$

$$\text{T-statistic, } r = \sqrt{\frac{t^2}{t^2 + df.}} \quad (2)$$

$$\text{Chi-square statistic, } r = \sqrt{\frac{x^2}{x^2 + df}} \quad (3)$$

$$\text{F-statistic, } r = \sqrt{\frac{f}{f + df.}} \quad (4)$$

$$\text{Regression} - \text{statistic, } r = \beta \pm SE. \quad (5)$$

variable…

4.0 Interpretation of the effect size

4.1 Cohen's d
When Cohen's d is calculated the interpretation is treated as follows:

r=0.20(small effect), r=0.50(medium effect), r=0.80 (large effect).

4.2 T-statistic

When interpreting the effect size, the following is the guideline:

r=0.10(small effect), r=0.30(medium effect), r=0.50 (large effect).

4.3 Chi-square statistic

When interpreting the effect size, the following is the guideline:

r=0.10(small effect), r=0.30(medium effect), r=0.50 (large effect).

4.4 F-statistic

When interpreting the effect size, the following is the guideline:

r=0.10(small effect), r=0.30(medium effect), r=0.50 (large effect).

4.5 Regression –statistic

When interpreting the effect size, the following is the guideline:

r=0.10(small effect), r=0.30(medium effect), r=0.50 (large effect).

5.0 Conclusion and Recommendations

If our graduate students are guided on the procedure of Meta-Analysis and informed on the available tools to choose from, with illustrative mentorship; they can meaningfully survive the research challenges of pandemic periods.

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