

Using Internet as Research Tool: An Example of Meta-Analysis Study

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Abstract: In this paper, we describe how internet can be used as a research tool through providing a study conducted by meta-analysis. Student academic success has always been a priority in education and mathematics education has been a major focus over last few decades. The quality of teachers is one of the most significant factors in shaping the growth and learning of students. The purpose of this study was to review the existing empirical studies accumulated to draw conclusions about various aspects of teacher qualifications that were linked with student mathematics achievement. A meta-analysis was used to provide a descriptive analysis of the existing empirical studies.

Keywords: Internet, Meta-analysis, Teacher Characteristics, Student Achievement, Mathematics

1. Introduction

Researchers are typically interested in finding general answers to questions. Nowadays, we live in an age of technology. Researchers can access journals, magazines, newspapers, and encyclopedias from Internet. Technologies support researchers' exploration and collaboration skills included Internet search engines, online tools for evaluating Web-based information. The Internet has become the universal source of information and also simplified the research process. Consequently, use of the Internet search engines can promote researchers' research skills and techniques and enable them to locate information relevant to any given topic efficiently.

2. Meta-analysis?

Why do Meta-Analysis

Science is cumulative, and scientists must cumulative scientifically. Often times, researchers find themselves going through a dense amount of papers on a certain topic only to find results that do not really seem to point towards a coherent or homogenous conclusion. Single study is often not reliable enough to detect significant differences between two treatments. Multiple studies are needed to reassure researchers the results were not just a coincidence. Therefore, researchers need to understand how an intervention performs in different contexts. For example,

Table 1: An example on the correlation between self-efficacy and job performance

Study	Correlation	Sample Size	<i>p</i> value
1	.25	120	.26
2	-.12	250	.55
3	.33	25	.06
4	.17	95	.26

If the researcher conducted Studies 1 and 3, he/she might claim that there was a positive relationship between self-efficacy and job performance. On the other hand, if the researcher conducted Studies 1 and 2, he/she might conclude that there was no linear relationship. Therefore, the results would look contradicting. In order to avoid errors of “vote counting,” it takes account of the magnitude of the effect estimate, and reveal new patterns and relationships. A statistical method, “Meta-analysis,” can come as a key element to handle a large volume of information in an organized way.

Put simply, meta-analysis is a quantitative analysis that summarizes, integrates and interprets the results of selected sets of the results of empirical research studies in the various disciplines into a coherent product (Hedges & Vevea, 1998; Hunter & Schmidt, 2004; Lipsey & Wilson, 2001). In sum, meta-analysis synthesizes available quantitative information in previous studies and provides precise and systematic results to support a specific hypothetical statement.

Traditionally, performing a meta-analysis required the use of a range of applications - An internet browser for search, a filing system to sort papers for later reference, a word processor or spreadsheet application to make comments on these papers, and a referencing application to make in-text citations and reference lists. In this study, the topic of “The Effect of Teacher Characteristics on Students Mathematics Achievement” will be used as an example to demonstrate how such meta-analysis was conducted.

Research Question

Politicians and school districts evaluate the qualification of incoming teachers based on readily available credentials highlighted by federal government such as certification, academic degrees, test scores, and the amount of completed coursework. In the current climate of educational accountability and the decline of educational monetary resources in schools, how to measure and evaluate teacher qualification and identify the precise hiring methods district can use to make hiring decisions becomes an important issue. Having a clear understanding of the findings regarding teacher quality can further enhance the effort in seeking qualified teachers and highly impact the course of future teacher policy. To this end, a meta-analysis with random-effects model was used to provide a descriptive analysis of the existing empirical studies in this area. Specifically, this study was designed to seek answers to the following research questions:

1. What is the average effect size representing each teacher characteristic on student achievement? Is the average effect size significantly different from zero?
2. Which factors are related to the variability in effect size?
3. How does the result of current study compare to previous meta-analyses?

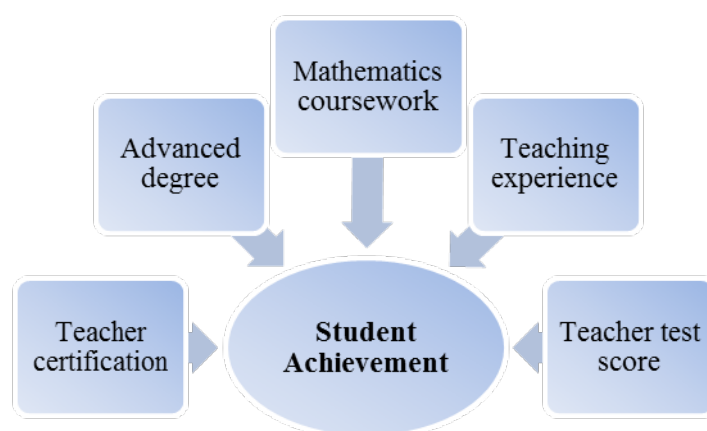


Figure 1. Teacher Characteristics and Student Achievement

Method

2.1.1 Search Strategy and Study Selection Criteria

The majority of the reports were identified through searches of electronic databases, including Educational Resources Information Center (ERIC), ERIC EBSCO, Psychological Abstracts (PSY), PsycINFO, PsychLit, EconLit, Social Sciences Citation Index, Dissertation Abstracts International (DAI), and ProQuest dissertations and theses. Several journal websites were also used. These journals were American Educational Research Journal, Educational Studies in Mathematics, Journal for Research in Mathematics Education, Journal of Educational Psychology, Journal of Educational Research, Review of Educational Research, and School Science and Mathematics.

Furthermore, general web searches using standard search engines, such as Google and Google Scholar, were conducted. Keywords relevant to this dissertation used in searching included “teacher characteristics,” “teacher knowledge,” “teacher preparation,” “mathematics education” and “student performance”. Subsequent searches were expanded by using various combinations of alternatives for achievement, such as “performance,” “success,” and “outcomes,” and by combining them with individual mathematics disciplines, such as “number and operation,” “algebra,” “geometry,” “trigonometry,” and “pre-calculus.” Other terms, such as “mathematics teaching” and “professional development” were also used in search strings.

Using this search procedure, 282 studies met the initial screening criteria. Due to the vast amount of article findings provided from the computerized search, inclusion criteria were needed. Studies for this meta-analysis were selected based on the following criteria:

1. The study was published no earlier than 1960.
2. The study was published in a journal article, conference paper, and dissertation or working paper.
3. The study was only included once.
4. The study was conducted with public school K-12 mathematics teachers and students.
5. The study reported student mathematics achievement using either test results or students grades.
6. The study reported on a measure of teacher knowledge in mathematics.
7. The study used student achievement in mathematics as dependent variable.
8. They study was included only if they used a correlational design.
9. The study reported enough information to compute an index of effect size such as a correlation, regression coefficient, or other test of association linking the teacher knowledge measure to the achievement outcome.
10. The study was conducted in the United States.

2.1.2 Coding Procedure

When a more in-depth examination was performed, several studies were eliminated because they did not meet all specified inclusion criteria and/or because they were duplicates. The final set of 40 studies included 25 journal articles, 2 conference papers, 7 working papers, and 6 dissertations.

2.1.3 Computation of Effect Size

A weighted mean effect size, Pearson’s r , was computed by Comprehensive Meta-analysis program. A confidence interval was set at 95 percent in order to estimate the precision of each mean effect size. SPSS was used to illustrate the confidence interval of individual and overall effect sizes. If the variation in effect size was not caused by sampling error, a follow-up moderator variable analysis was conducted with a between-group heterogeneity test. Additionally, Pearson’s r correlation is one of the most widely used effect sizes. Cohen (1988, 1992) provided the following guidelines for the social sciences: small effect size, $r = .10$; medium effect size, $r = .30$; and large effect size, $r = .50$.

Table 2: The correlation between teacher characteristic and student Mathematics achievement

Variable	R
Coursework	.17***
Certificate	.03***
Test Score	.38***
Advanced Degree	-.05***

Experience	.24***
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*** $p < .001$

The study not only calculated the effect size of each teacher characteristic and student achievement, the heterogeneity of variance between-group groups test was also conducted to examine the statistical differences in the overall mean effect sizes among the subgroups. Binomial Effect Size Display, Fail-Safe N, Forest Plot, and comparison with prior meta-analyses were also included in the study to ensure the necessity of meta-analysis.

2.1.4 Criticism of Meta-Analysis

Although meta-analysis is very powerful, it still has its limitation. One of the weaknesses is that it requires a good deal of effort, and it is much more labor-intensive and time-consuming than a traditional literature review. Another and the most common criticism of meta-analysis is the apples and oranges issue. Although it may seem ideal to combine results of studies, this procedure may not always be appropriate. In dealing with this issue, it is necessary to ascertain that the studies involved examine the same research question. Publication bias also arises from the tendency of journals to reject negative studies. This bias, often called the file-drawer effect because the unpublished results are imagined to be tucked away in researchers' file cabinets, is a potentially severe impediment to combining the statistical results of studies collected from the literature.

3. Importance of Internet Use

Before the Internet, conducting research involved a set of encyclopedias and a trip to the library. Nevertheless, we now live in an age where information is readily accessible from our computers. The use of the Internet has increased dramatically in recent decades and, consequently, finding information about the topic as desire through internet has attracted more and more researchers' attention. Within these technologies, many ethical and methodological issues also arise in the research process. Therefore, researchers should be aware of some of the morally important concerns need to be taken into ethical evaluation and consideration with the potential unintended consequences of the study

References

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155-159.
- Hedges, L.V. & Vevea, J.L. (1998). Fixed and random-effects models in meta-analysis. *Psychological Methods*, 3, 486-504.
- Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings*. Newbury Park, CA: Sage.
- Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.