

HAS INQUIRY MADE A DIFFERENCE?
A SYNTHESIS OF RESEARCH ON THE IMPACT OF INQUIRY SCIENCE INSTRUCTION
ON STUDENT OUTCOMES

Technical Report 4:
Report-Study Reconciliation Process

The Inquiry Synthesis Project
Center for Science Education
Education Development Center, Inc.

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OVERVIEW AND INTRODUCTION TO THE REPORT-STUDY RECONCILIATION ISSUE

The Inquiry Synthesis project is organized into three phases. Phase I, the search-and-retrieval process (see *Technical Report 1*) yielded 1027 documents that potentially held data relevant to our question: *What is the impact of inquiry instruction on student outcomes*. Phase II of the project, study coding, is organized into three stages. The first stage, the inclusion/exclusion coding (see *Technical Report 3*), identified 443 “reports” (defined below) as potentially providing appropriate and sufficient information to move on to the second stage of coding— inquiry-science-instruction coding (see *Technical Reports 2 and 5*). This second stage of coding could not proceed until a process of reconciling which reports represented common studies. This technical report describes this issue and the solutions we devised to address it. The third stage of coding is for research rigor, context, and study findings, (see *Technical Report 6*) which will be followed by Phase III of the project— analysis and dissemination of findings.

The unit of analysis for this project is the study. However, as is common with synthesis projects, we found that the number of documents we had collected did not represent the equivalent number of studies. Some documents reported findings of more than one study. In other cases, multiple documents reported on parts of a single larger study. Other complications, such as the presence of replicated and longitudinal studies, also emerged. Thus, to ensure that no single study was over- or underrepresented in our final analyses because of its particular documentation configuration, it was critical to resolve all of our documents into unique studies. The results of this process can be found in *Technical Report 1*, which describes the sample of this project in detail.

The Importance of Defining Documents, Studies, and Reports

A first step toward understanding the report-study reconciliation process is defining terms. For the purposes of this project, a *document* is the physical manifestation/form in which studies reside. Document types include books, journal articles, theses, dissertations, conference papers, reports, and other unpublished documents. A *study* is a portrayal of a *unique* research endeavor. As described by Lipsey and Wilson (2001)¹, “a study consists of a set of data collected under a *single research plan* from a *designated sample of respondents*” (emphasis added). To disentangle studies from documents, we needed to establish a “least common denominator,” i.e., the report, as a unit of analysis. A *report* is a term the research team used to refer to one representation of a study. This representation could be partial (e.g., one report presents Year-One findings of a longitudinal study; another report presents Year-Two findings of that same study) or complete (e.g., one complete report on the findings of a study).

During the search-and-retrieval process, we were acquiring documents. A document containing only one report was assigned unique Report ID and Document ID numbers. When a document contained more than one report that was potentially relevant for inclusion in the synthesis, each report within that document (e.g., separate chapters of a book or two sections of a single journal article) was assigned a different Report ID number, though they shared the same Document ID number. The resulting database was organized by Report ID numbers for each independent instance of reported research and, thus, the number of reports was higher than the total number of collected documents in this database. However, the most common scenario was that the document and the report were synonymous (e.g., noted as “document/report”). The more difficult relationship to determine was between a document/report and a study.

From this starting point, we set out to identify whether each report was truly a representation of a study separate and unique from any others in the database, or whether they were related to other reports that were, in fact, generated as part of the same study. A hypothetical example to help clarify the distinction between these three terms is that of a research book (i.e., document) with three chapters. One of the chapters in this book focuses on one study; the other two chapters are dedicated to a different study. Our process would categorize this research book as one document (the book), three reports (the chapters), and two studies (unique research endeavors). This example represents the most common instance when there was a

¹ Lipsey, M., & Wilson, D. (2001). *Practical meta-analysis: Applied social research methods series* (vol. 49). Thousand Oaks, CA: Sage.

meaningful distinction between document, report, and study. However, instances of meaningful distinctions between document/report and study were more varied. The two most prominent kinds of report-study relationships identified were:

- (1) a one-to-one relationship between a study and a document/report; and
- (2) a single study presented in multiple document/reports (e.g., authors might report on the creation and implementation fidelity of an instructional treatment in one report, and present research on student outcomes in another report).

A third, less-common relationship was that of multiple studies appearing in a document that, on the face of it, appeared to describe findings of only one.

Shifting from Reports to Studies—The Scope of the Task

Upon completion of the search-and-retrieval and inclusion/exclusion-coding processes, we had a single database with 913 reports. Some of these reports had been included (443); the rest had been excluded (470). Then we faced the task of resolving these reports into unique studies. Even a report that had been excluded² remained part of the pool for report-study reconciliation, because we recognized that even though it did not meet the criteria to be included on its own, if related to a report that was included, it could inform our coding of that report to ensure greater accuracy.

Reconciling reports that were generated from the same study proved to be more complex than previously anticipated. Although we expected there would not always be a one-to-one relationship between reports and studies, we did not anticipate the magnitude of this scenario. We obtained an initial measure of the degree to which this issue permeated the dataset by looking at the number of times individual authors appeared on reports. Looking at authors was the most appropriate starting point for understanding the scope of the reconciliation process because “author” was the report characteristic that was the strongest indicator of potential relatedness and was the most easily tracked.

When we searched the entire database, we found that a total number of 1,202 authors were represented in our 915 reports. The 1,202 did not represent unique authors; rather, it represented a count of all the authors listed in the “author field” in our database. Thus, if a single author contributed to two reports, his name would appear two times in the author list. Seventy-six percent (75%) of authors appeared only once in the database, meaning, they appeared on only one report. Twelve percent (12%) appeared on two reports, 4% appeared on three, 3% appeared on four, and the remainder (approximately 6%) included those who appeared on five or more reports. While the least prevalent authors appeared only once, the most prevalent author appeared 25 times, meaning he contributed to 25 reports in the database.

Even when an author appeared only once in the database, we could not assume that the report associated with that name represented a unique study. To explain with a hypothetical: Author **A** appeared among the list of 1,202 authors only once. Upon looking at the report associated with Author **A**, we could see that **A** co-authored that report with Authors **B** and **C**. Thus, to ensure that the report associated with **A** was unrelated to any others in our database, we needed to look at all reports authored by **B** and **C** and at reports written by *their* co-authors. The process for using the authors to determine the report-study relationships in our database required the systematized approach described in detail below.

THE REPORT-STUDY RECONCILIATION PROCESS

The report-study reconciliation process has two steps. Step One—generation—entailed the creation of what we came to call “webs” of potentially related reports. Step Two—reconciliation—entailed organizing each set of potentially related reports into discrete studies.

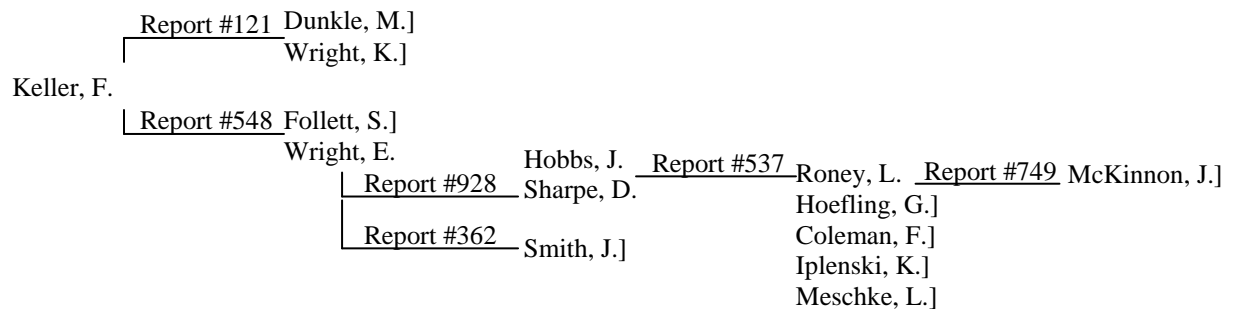
Generation

² Reports were excluded for a number of reasons. Among the most commonly excluded were those that contained a description of an intervention but were not actually research and those that were research endeavors but didn’t focus on student outcomes. For more information on Inclusion/Exclusion, see *Technical Report 3*.

Generation began by looking at authors—the most obvious starting point for identifying potentially related reports. We moved alphabetically through the list of authors of included reports to begin formulating the sets of reports that were potentially related. We began with an author (e.g., Author **A**) and a single report identified with that author. Then, we searched the database for other reports with **A** listed as author. If **A**'s name appeared on no other report and had no co-authors on the report associated with **A**'s name, the process ended and we determined that **A**'s report could be considered a study. It was then given a unique Study ID number.

However, if **A** had, in fact, authored other reports, we recorded those Report ID numbers by making an “author web” with the report of origin at the hub, and additional identified reports (and co-authors names) connected to that hub like a family tree. Once all of the reports authored by **A** were identified and recorded on the web, we then expanded the web by “one degree.” In other words, we also searched for all reports authored by all of the co-authors associated with **A**. Then, essentially, we continued to expand the web by degrees using the steps described above for **A** for each of the co-authors. We repeated this process until all potential connections to additional reports had been exhausted and no more new reports could be added to the web by authorship. For an example of an author web, see Figure 1.

Figure 1: Example of an Author Web



Key: the symbol “]” denotes the end of a branch, such as when an author only authored one report.

Throughout this process, we understood that it was possible that two reports related to the same study could be written by two completely separate authors or groups of authors and, thus, would not necessarily appear in the same author web. Thus, following the creation of the author web, we employed several other strategies to identify any additional reports that were potentially related to those in the web, but not identified through authorship. For these next steps, we focused on the following information: report titles, research question(s), abstracts, funding information, graduate committee chairs, and notes from earlier phases of coding that indicated a suspected relationship between reports. Keywords and characteristic phrases were identified in the title, research question(s), and abstract fields for each report in the web. These keywords were then used to perform additional searches in the database for reports that contained those keywords (and thus might be potentially related) but were not included in the author web. Similar searches were performed using funding sources/grant numbers and the names of graduate committee chairs. At the end of this process, reports were either identified as being unique and *not related* to any others, or, they were part of a web of potentially related reports. These potentially related reports moved onto Step Two of the report-study reconciliation process: reconciliation.

Reconciliation

The reconciliation step focused on determining which reports included in a single web (a set of reports) were in fact representations of unique studies, and which reports represented the same study, meaning they should be given the same Study ID number and be coded together in the next coding stage.

The first part of reconciliation entailed organizing the set (all of the reports in a web) of potentially related reports into groups. Using datasheets with summaries of report characteristics, reports were grouped by

shared characteristics (such as author, keyword, or research question) that suggested they were likely to be related. Once all groupings were complete, any reports that stood alone were determined to be unrelated to any others and given a unique Study ID. For example, a report on a 12th-grade-ecology-classroom intervention conducted in New Zealand might have been part of the same set as a report that describes elementary school students engaging in museum exhibits about light and optics at a science center in Minnesota. As a result of the grouping process, the New Zealand report would stand alone—clearly, it would not be related to any other reports in the set. The Minnesota report, on the other hand, would be grouped with several other reports that describe interventions in a science center in Minnesota. This group of reports would move on to the second part of the reconciliation process.

Up to this point, reports were grouped and sorted using datasheets generated from the database. The second part of the reconciliation process, however, required a closer look at the original reports and documents on file. Only by looking at the reports themselves could a coder determine, for example, that a sample identified as “middle-grades level” in the database was actually “sixth-grade.” Likewise, other pertinent information, such as the time period during which sampling took place, was not recorded in the database and was only available in the report itself. If the reports contained the same sample, intervention, and study design, they were determined to be derived from the same study and identified as “related reports.”

During this process, there were times when the relationship between particular reports simply was not clear. For example, sometimes the sample information or intervention descriptions in the written reports were not specific enough to determine whether possibly related reports were actually the same study. These reports retained their classification as “possibly related reports” and were grouped together for the next stage of coding, during which they would be read with more scrutiny and identified as actually related or not. There also were situations in which possibly related reports had the same intervention description and methodology but differed by the sample population. Because these reports were based on separate samples, they were, in fact, separate studies and could not be classified as “related reports” or even “possibly related reports.” However, to classify them as “not related” was not an accurate designation either. These reports were described with a different classification: “similar but not related.”

To summarize the process:

- (1) A web of potentially related reports is created by:
 - (a) generating a set of reports from the entire database (including excluded reports from the inclusion/exclusion coding stage) that contain the same authors and co-authors until no other reports are connected to the included set by author or co-author(s); and
 - (b) using each report in the set to search for other potentially related reports by keywords and phrases, grant numbers, and graduate committee chairs.
- (2) The datasheet record for each report in the set of potentially related reports is then read for possible relationships, and reports are placed into groups within the set. Those reports clearly not related to other reports in the set are labeled “not related reports.”
- (3) The documents of each group of possibly related reports within the set are examined, and sample information, intervention descriptions, and other detailed characteristics are used to determine the level of relationship.
- (4) Each report is then labeled for its degree of relationship to others in the database, thus identifying unique studies within the database:
 - (a) Reports that are clearly unrelated are labeled “not related reports” and each is assigned a Study ID in the database.
 - (b) Reports that are clearly related are labeled “related reports” and all assigned the same Study ID number in the database. They are to be coded together in subsequent stages of coding.
 - (c) Reports that clearly do not share the same sample but have very similar interventions or methodologies are labeled “similar but not related” reports and each is given a different Study ID number in the database. Since these studies share similar characteristics, they are assigned together in subsequent stages of coding to expedite the coding process.
 - (d) Reports that still cannot be classified as “related” or “not related” from this level of examination retain the designation of “possibly related reports” and in the next stage of coding—inquiry science

instruction—they are assigned together with the coders being charged with making a final determination about the Study ID assignment to be entered in the database.

INTERESTING CASES

Longitudinal studies represented through several reports served as interesting cases in the report-study reconciliation process. Data that were periodically gathered on the same sample of participants were reported in several different reports. In other instances, data were gathered using the same teacher or school, but at different time periods with different samples of participants. We faced the challenge of determining if these reports should be coded as part of a single study or coded independently. After noting which of our reports were longitudinal studies we made a decision to select only the results from the first outcome measurement after the study treatment had ended, which according to Lipsey and Wilson (2001), “is the most commonly collected and reported information in such studies and may be deemed sufficient for the purposes of meta-analysis.”

Some instances of large-scale studies proved to be interesting cases as well. Situations arose where one report contained information about the overall large-scale study that might have included several schools and groups of participants, while other separate reports contained information from different sub-populations of the larger study. Thus, if these reports had not been identified as being part of the same larger study, they could have been reported as separate studies only to be detected as part of the same study through the report-study reconciliation process. These instances were noted and either classified as “related reports” or “possibly related reports,” leaving the final decision of whether they should be identified as the same study to the inquiry science instruction coding process.

ADDITIONAL INFORMATION

For more information on this or other CSE research projects or to view additional technical reports, visit <http://cse.edc.org/work/research/>

Inquiry Project Staff

Daphne D. Minner, Ph.D., Principal Investigator (dminner@edc.org)

Abigail Jurist Levy, Ph.D., co-Principal Investigator

Jeanne Rose Century, Ed.D., co-Principal Investigator (August 2001-July 2005)

Erica S. Jablonski and Erica T. Fields, Research Associates