FIDELITY OF IMPLEMENTATION OF INSTRUCTIONAL MATERIALS

PROJECT BRIEF #1:  
THE FIDELITY OF IMPLEMENTATION CONCEPTUAL FRAMEWORK

PROJECT OVERVIEW
The “Applied Research on Science Materials Implementation: Bringing Measurement of Fidelity of Implementation (FOI) to Scale” project has two main goals. First is the development of a suite of instruments to measure the implementation of standards-based science and mathematics instructional materials at the K-8 level. Second is the use of those instruments to measure the FOI of science and mathematics instructional materials in the Chicago Public Schools. Over three years, the project is producing instruments for measuring FOI of five specific curricula (FOSS, STC, Science Companion, SEPUP, and Everyday Mathematics) and a User’s Guide that describes procedures for using the instruments and adapting them for use with other instructional materials. This project, funded through a three-year grant from the National Science Foundation, comprises four strands of work: development of a conceptual framework of FOI, instrument development, data collection and analysis, and dissemination and knowledge building. This project brief describes the work of the first strand – the development of the FOI Conceptual Framework.

CEMSE’s FOI project builds from earlier work on fidelity of implementation in the fields of education and health and on more recent studies of FOI of science and mathematics instructional materials. This project furthers research in this field in several ways. First, it supports the growing call for high quality rigorous research in education by developing instruments necessary to study enactment, efficacy and effectiveness of instructional materials programs and making them widely available. Second, through its approach to defining and measuring FOI, it facilitates the characterization of differences in instructional materials and FOI of those materials and sheds light on relationships between different “typologies” of implementation and student outcomes. And third, it contributes to the field by bringing conceptual clarity to what “fidelity of implementation” of instructional materials means and how it can be defined and used across multiple programs.

Project progress and findings will be shared in an on-going manner through the web site at http://cemse.uchicago.edu/foi. This site houses the products of this project including papers and presentations produced by the project, technical reports, the instruments and User’s Guide, and project briefs such as this one. The site also houses a forum for others in the field studying FOI. It is a goal of this project that the products of this project, including the instruments developed (interview protocols, a classroom observation protocol, a walk-through protocol, questionnaires, and logs) will be of use not only to researchers, but also to school and central office leaders.

INTRODUCTION TO THIS PROJECT BRIEF
This project brief provides an overview of CEMSE’s conceptual framework for Fidelity of Implementation (FOI). The development of this framework was an essential first step in the work for several reasons. First, the field has no agreed upon understanding of what FOI of instructional materials is, or how to define it. Typically, FOI is determined by measuring the extent to which identified important characteristics of a specific program are present when the program is implemented. While this approach is very practical when studying the effectiveness of a particular program, it defines FOI in an operational, non-transferable way that is bound by the constraints of
the particular program being studied. The goal of this project, on the other hand, is to create instruments for measuring FOI that will be useful for a range of programs, and will facilitate efficacy and effectiveness studies by leading to detailed, but still comparable descriptions of those programs’ enactments. In order to ensure applicability across programs, the CEMSE FOI instruments are not based on a single program. Rather, they reside within a larger conceptual framework that delineates distinct, measurable aspects of FOI that are applicable to a range of instructional materials but still can be customized to ensure meaningful application and utility.

Second, some of the foundational work focused on better understanding FOI has emerged from studies of programs from other fields. While many of the conceptual underpinnings of FOI remain similar across these different fields, this effort focuses specifically on fidelity of implementation of instructional materials. As such, it draws from the important work outside of education (Dane & Schneider, 1998; Linda Dusenbury, 2004), while building from more recent work on mathematics and science programs (Lynch & O'Donnell, 2005; Songer & Gotwals, 2005) to create a framework and aligned tools that focus specifically on instructional materials. Furthermore, the framework provides an organizational structure for mapping the elements of the instructional materials that will be measured (these are defined as “critical components” and are described more specifically in Project Brief #2) and for determining which of those elements are shared, and which ones are unique to particular instructional materials programs.

Third, the development of this framework was an effort to bring some clarity to discussions in the field among researchers studying FOI. There is not an expectation that others will adopt this framework in its entirety. Rather, the framework can serve as a tool to facilitate discussion and support accumulation of knowledge about FOI by providing a structure for sharing information and data about particular programs and study findings.

The Organizational Framework for the Fidelity Framework

Before focusing on the FOI framework, it is important to understand where that framework resides within a larger organizational framework of school change. The organizational framework could be described as the “logic model” of school change that focuses on use of instructional materials as a key intervention. In the simplest scenario, a set of instructional materials is implemented with the expectation that it will lead to desired student outcomes. The extent to which that program leads to those outcomes defines the efficacy or effectiveness of that program. However, in order to draw truly meaningful conclusions about instructional materials programs’ effectiveness, it is essential to determine the extent and nature of their use – the fidelity of implementation.

We also need to address the fact that FOI is affected by a wide range of contexts and conditions that reside outside of the materials themselves (e.g. teacher content knowledge, teacher professional development experience, student demographics). Where there is existing data, some of these factors (e.g. demographics, teacher experience) can be accounted for through the research design and analysis strategies. Others need to be addressed through collection of new data. While an in-depth study of the contexts and conditions that affect FOI is beyond the scope of this project, where possible, the FOI instruments will target data collection on some of these factors. Primarily though, they will focus on describing FOI itself. The instruments developed through this project will open up the “black box” of FOI by measuring the presence and nature of the “critical components” of instructional materials programs and by providing a deeper understanding of the relationships between those components and student outcomes.
THE FIDELITY OF IMPLEMENTATION FRAMEWORK

The work of this project began with a review of studies of fidelity of implementation of programs in various fields including education, mental health, criminal justice, health, manufacturing, organizational change, prevention, substance abuse, technology, and transportation. This review of over 100 articles (a literature review is under development) informed the project’s direction for initial framework development and led to the identification of a few foundational resources. Those resources are referenced throughout and at the end of this brief. The framework described here builds on the work of others (Dane & Schneider, 1998; Linda Dusenbury, 2004; Lynch & O'Donnell, 2005; Lynch S., 2007; Mowbray, Holter, Teague, & Bybee, 2003), but differs in that it organizes the critical components into specific analytic categories (procedural, educative, pedagogical, student engagement) within two larger categories and does so in a way that allows measures of those components to be used across multiple programs. For more description of the evolution of the CEMSE team’s thinking behind the framework development, see the extended version of this project brief on the project website. Though CEMSE’s FOI framework serves as a sound starting point for the instrument development, we expect that it will be revised over time, informed by consulting advisors, the on-going project work, and the field.

Definition of FOI of Instructional Materials: The first step in developing the framework was arriving at a definition of FOI. While there isn’t agreement in the field about how to describe or define FOI at any level of great detail, there is a general consensus about what it is. We chose to word that general definition as follows: The extent to which an enacted program is consistent with the intended program model. This definition closely matches Bodzin, et al. (2003) who stated that fidelity is “the degree to which instructional materials are being used in a classroom setting as intended by their developers” (p.1). Others also share this point of view (Lewis & Seibold, 1993; Ruiz-Primo, 2005).

Approach to the Framework: With the general definition of FOI clearly stated, the next step was to operationalize that definition into a framework of measurable constructs. In order to do so, we articulated some underlying assumptions for this project. First, we confirmed that in the context of this project, FOI refers to the implementation of science and mathematics instructional materials programs. A second assumption was that instructional materials are developed based on an intended program model that is either explicit or implicit. The third assumption acknowledged that in order to measure FOI, it would be necessary to identify the essential elements of the program model (whether explicit or implicit). We refer to these elements as critical components.
We began, as others have, by considering a framework built around “dimensions” of fidelity already identified in the literature: exposure, adherence, quality, participant responsiveness, and program differentiation (Dane & Schneider, 1998; L. Dusenbury, Brannigan, Falco, & Hansen, 2003; Lynch & O'Donnell, 2005). As we proceeded, however, it became clear that while it was helpful to consider and address those dimensions, they were not an appropriate starting point for our framework. We came to understand that our framework needed to be more closely tied to instructional materials programs, so we took an approach aligned with Mowbray, et al. (2003) who focused first not on the dimensions of “fidelity,” but rather on the “critical components” of the programs. Thus, the earlier identified dimensions became analytic categories embedded within the framework while the framework itself is focused on the measurable critical components of programs and their categories.

Organization of Critical Components of Instructional Materials

“Critical components,” more explicitly defined, are the elements of an instructional materials program model that are essential to its implementation. They are the broad variables one must measure in order to determine fidelity of implementation of individual programs and their efficacy. Likewise, they are the variables one must identify and measure in order to engage in comparison studies of instructional materials programs and their relative effectiveness (through a process the FOI project refers to as differentiation). Clearly articulating the critical components of an instructional materials program model is key to accurate measurement of the fidelity or even the presence of the program. So, if we return to the conceptual definition of FOI – the extent to which the enacted program is consistent with the intended program model – we can operationalize it using the idea of critical components. Therefore, an operationalized definition of FOI is: the extent to which the critical components of an intended program are present when that program is enacted. With this explanation as background, following is a description of the FOI framework and each of its parts.

Developers of the programs being studied consider many different issues and factors as they engage in the complicated work of creating instructional materials for teachers. Some of the decisions they make are grounded in their beliefs about the best way to design and structure materials for teachers and students. Other decisions are grounded in developer beliefs about classroom practice and the students’ roles in the instructional “transactions” that take place in the classroom. These beliefs and decisions together comprise the intended program model. Critical components then, are the operationalizations of developers’ intentions and thus, at the heart of measurement of FOI.

The next step in developing the framework was to organize the critical components into categories that would allow for rigorous and systematic measurement and analysis of FOI of those components. After much discussion, we arrived at the following two broad categories: 1) Structural Critical Components of Materials Design and 2) Instructional Critical Components of Materials Design. This approach, generally speaking, aligns with Mowbray’s structure/process categories (and proved to be consistent with later work by Lastica and O’Donnell, 2007), but frames the concepts of “structure” and “process” differently by identifying specific sub-categories and explicitly embedding Dane and Schneider’s dimensions within it (described at the end of this brief).

These are not “clean” categories. Instructional materials development is a complex activity that doesn’t lend itself to distinct, exclusive categories. However, for the purposes of this project, we made decisions about the categories, acknowledging that there is overlap while still working to ensure the categories are as exclusively defined as possible.
Specified Categories of Critical Components

Because this framework would be the foundation of instruments that could be applicable across multiple programs, it was essential to appropriately identify sub-categories that would be meaningful across a range of instructional materials and facilitate specific analyses within and across programs. Those categories are described below.

Structural Critical Components of Materials Design

Structural critical components are those that reflect the developers’ decisions about the design and organization of the materials and fall into two types: 1) Procedural and 2) Educative.

1) Structural-Procedural Critical Components of Materials Design

These critical components communicate to the teacher, in the simplest sense, what to do in the classroom. While one might suggest that all parts of instructional materials “tell” a teacher what to do, this category of critical components is focused on the elements that provide the basic steps of specified lessons.

2) Structural-Educative Critical Components of Materials Design

These critical components communicate to the teacher, in the simplest sense, what to know. They acknowledge the complexity of instruction as well as the likelihood that teachers may not necessarily have the wide range of expertise needed to teach the program as intended. Educative critical components can range from general advice about cooperative learning to science content summaries. Structural-Educative critical components reflect the authors’ decisions about how to organize and structure that information for the teachers.

Instructional Critical Components of Materials Design

The critical components that are instructional elements of the materials design are those that reflect the developers’ decisions about the intended instruction that takes place in the classroom. These decisions include intentions about the students’ role in the instructional process as well as the teacher’s.

1) Instructional-Pedagogical Critical Components of Materials Design

The critical components that fall into this category are those that indicate the developers’ intentions about the general instructional strategies the teacher will use in the classroom. They are not tied to a specific section of a lesson or teacher’s guide, but can occur at a range of places in the enacted instruction.
2) Instructional-Student Engagement Critical Components of Materials Design

The student engagement critical components are those that reflect expectations about the students’ participation in the instructional process. This includes the students’ demonstrations of what are commonly referred to as “process skills.” Like the pedagogical critical components, these critical components are not tied to a specific section of the lesson or teacher’s guide.

Some critical components of programs reside squarely within one category; other critical components cross the defined boundaries of these category types. Our instrument development strategy will, wherever possible, account for those that cross categories by measuring them multiple times in different ways.

Typologies: This organizational structure lends itself to doing analyses of the relationships between specific written (Structural) elements of the program and particular enacted (Instructional) elements of the program, as well as the creation of “typologies” of implementation that can be used in analyses that focus on relationships between materials use and student outcomes. For example, a study could identify teachers that demonstrate high fidelity to the Structural-Procedural components, yet low fidelity to the Instructional-Pedagogical. Other teachers might demonstrate high fidelity to Instructional-Pedagogical components, but low fidelity to the Structural-Procedural components. Analyses might reveal that some implementation typologies demonstrate a relationship to positive student outcomes while others do not. Such analyses will allow researchers to determine whether particular configurations of science materials implementation yield better outcomes, and why.

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<th>Levels of Differentiation</th>
<th>FOI for Instructional Materials</th>
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<td></td>
<td>Structural Critical Components of Material Design</td>
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<td></td>
<td>Procedural</td>
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<td>Common to Math and Science Materials</td>
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<td>Common to Science Materials Only</td>
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<td>Common to Math Materials Only</td>
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<td>Program Specific</td>
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Levels of Differentiation: The framework is further broken down into groups of critical components that we refer to as “levels of differentiation.” This portion of the framework indicates those critical components that are common to reform-based math and science programs; those that are common to math programs only; those that are common to science programs only; and those that are program specific. The ability to rigorously measure the FOI of the critical components, and understand which characteristics are and are not shared is a basic goal of the FOI project and an essential part of any experimental or quasi-experimental comparison study of these materials.

Summary

Now that we have briefly described the FOI framework and its development, we can return to the earlier comments about Dane & Schneider’s “dimensions” of fidelity. These dimensions are still significant and present in our framework. Organizing the framework with critical components
allows for data collection and analysis at a level of specificity that will facilitate meaningful conclusions about relationships between particular elements of structural and instructional design and specific student outcomes. In the context of this project, the more broad dimensions of fidelity become larger analytic categories that allow for more general conclusions and comparisons with other reform programs that are not grounded in an instructional materials intervention.

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<th>FOI OF INSTRUCTIONAL MATERIALS</th>
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<td><strong>(Adherence)</strong></td>
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<tr>
<td>Structural Critical Components of Materials Design (Structure)</td>
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<td>Procedural (Dosage, Exposure)</td>
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Figure 3. FOI Framework with Aligned Elements from Previous Frameworks

Specifically, in this framework, the notion of “adherence” has become synonymous with the overall definition of FOI. In other words, conclusions about FOI, and any indices developed to describe FOI, will be measures of overall adherence to the program. The dimension of “exposure,” on the other hand is embedded in the “structural” portion of the framework. Similarly, in the “Instructional Critical Components” portion of the framework (process), data collected on the extent and nature of the pedagogical components will lead to conclusions about the larger analytic category of “quality.” Likewise, conclusions about “Student Responsiveness” can result from analysis of data on the presence and nature of student engagement. “Differentiation” has been described above.

When used as intended, the suite of instruments developed from this project will provide a range of data that can then be analyzed at varying levels of specificity. Researchers or school districts may decide to focus on particular types of critical components, on particular dimensions of FOI, or on overall FOI. In this sense, the instruments, with the User’s Guide will increase meaning and rigor in studies of instructional materials effectiveness.

REFERENCES


