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Developmental Research Methods: Creating Knowledge from Instructional Design and Development Practice

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ABSTRACT

THE PURPOSE OF THIS ARTICLE is to provide direction to those entertaining a developmental research project. There are two categories of developmental research, both of which are examined here. The two types vary in terms of the extent to which the conclusions resulting from the research are generalizable or contextually specific. This article describes developmental research in terms of the traditional stages of planning, conducting, and reporting a research project—problem definition, literature reviews, and research procedures. Examples of adapting a literature review to a developmental study are identified. Problem definition procedures encompass focusing on and framing the problem, and identifying the limitations of the research. Research procedures are adapted to developmental studies, particularly with respect to identifying the study's participants, creating a research design, and collecting and analyzing the data. Finally, issues with respect to reporting developmental research are discussed. (*Keywords: developmental research, evaluation research instructional design, research methods, theory to practice*)

INTRODUCTION

FOR MANY, the design, development and evaluation of instructional products and programs are considered to be the heart of instructional technology. It is also critical to those engaged in a broad range of computer applications. Consequently, it follows that a substantial part of our research should address design processes and tools. In other words, we should be studying design, development, and evaluation as well as doing it. Of course, this is not a new suggestion; some scholars have heeded it, even though the innovators often put more effort into doing rather than studying.

The body of research literature that directly pertains to instructional development is known as developmental research: "the systematic study of designing, developing and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness" (Seels & Richey, 1994, p. 127). Developmental research seeks to create knowledge grounded in data systematically derived from practice. It is a pragmatic type of research that offers a way to test "theory" that has been only hypothesized and to validate practice that has been perpetuated essentially through unchallenged tradition. In addition, it is a way to establish new procedures, techniques, and tools based upon a methodical analysis of specific cases. As such, developmental research can have a function of either creating generalizable conclusions or statements of law, or producing context-specific knowledge that serves a problem solving function.

There are two categories of developmental research, referred to as Type 1 and Type 2 (Richey, Klein, & Nelson, 2004). They vary in terms of the extent to which the conclusions resulting from the research are generalizable or contextually specific. Type 1 developmental studies focus upon a given instructional product, program, process, or tool. They reflect an interest in identifying either general development principles or situation-specific recommendations. Typically Type 1 studies address not only product design and develop-

ment, but evaluation as well. At times they may validate a particular design or development technique or tool. Type 2 studies, on the other hand, focus upon a given design, development, or evaluation model or process. They may involve constructing and validating unique design models and processes, as well as identifying those conditions that facilitate their successful use.

Developmental research is different from the design-based research that has been recently discussed. This research emphasizes the study of learning as a result of designing unique instructional interventions (The Design-Based Research Collective, 2003). It is also different from traditional research in instructional psychology, media comparison, and message design. However, well-conceived developmental research can offer a direct response to the many demands for research that is prescriptive and meets the pressing needs of practitioners (Richey, 1997).

The aim of this article is to provide some direction to those entertaining a developmental research project. In essence, it is a discussion of establishing the credibility of a given developmental study by assuring authenticity and methodological precision. Since many developmental research topics can be addressed in a number of different ways, this paper may also help the reader recognize the potential of a given problem to be addressed as a developmental topic. Below, we describe developmental research in terms of the traditional stages of planning, conducting, and reporting a research project:

- Problem definition;
- Literature reviews; and
- Research procedures.

DEFINING THE RESEARCH PROBLEM

The authenticity of a developmental research project often depends upon the problem selected. Is the problem one that is common to many designers and developers? Is it one that is currently critical to the profession? Does the problem reflect realistic constraints and conditions typically faced by designers? Does the problem pertain to

cutting-edge technologies and processes? Answers to these questions not only predict interest in the project, but also whether the research is viewed as relevant. "Explorations of research relevance are typically examinations of shared perceptions, the extent to which researchers' notions of relevance are congruent with the perceptions and needs of practitioners" (Richey, 1998, p. 8). This is particularly true with developmental research where the object of such research is clearly not simply knowledge, but knowledge that practitioners can use.

Focusing the Problem. Given a relevant research topic, the project must first be given a "developmental twist." This begins in the problem definition stage. It is done by focusing the research problem on a particular aspect of the design, development, or evaluation process, as opposed to focusing on a particular variable that impacts learning.

The problem definition stage must also establish research parameters. At minimum, this involves determining whether the research will be conducted as the design and development is occurring or whether retrospective data will be collected on a previously developed program or set of materials. Then the scope of the study must be established. How much of the design and development process will be addressed? Will the research address:

- All parts of the design of the instruction?
- The development (or part of the development) of the instruction?
- The evaluation of the instruction? If so, will formative, and summative, and confirmative evaluation be addressed?
- The revision and retesting of the instruction?

Developmental studies often are structured in phases. For example, comprehensive Type 1 studies may have an analysis phase, design phase, a development phase, and a try-out and evaluation phase. Another organization of a Type 1 study would include phases directed toward first analysis, then prototype development and testing, and finally prototype revision and retesting. A study by McKenney (2002) is an example of this type of research. McKenney examined the development of a computer program to support curriculum materials

development in the context of secondary science and mathematics education in southern Africa. As with any traditional research project, the study was guided by predetermined questions and was embedded into a conceptual framework supported by current literature on curriculum development, teacher professional development, and computer-based performance support. The project was a careful and extensive documentation of the phases of ISD—needs and context analysis, design, development, and formative evaluation of several prototypes, and summative evaluation.

Type 2 studies may have a model construction phase, a model implementation phase, and a model validation phase. For example, Tracey's (2002) research was conducted in four phases. The first phase was a literature review that was synthesized into a multiple intelligences instructional design model. The second phase was a Delphi study that resulted in a modified model with expert approval. The third phase involved controlled testing of the model implementation. Two versions of a given instructional workshop were designed and developed, one by a pair of designers using a traditional design model and another by a design team using the multiple intelligences model. Finally, in phase four, the two instructional products were implemented and compared in a real-life training situation to complete the validation process.

Framing the Problem. Seels (1994) describes typical processes one uses to explain the goals of a developmental research project. For example, research questions, rather than hypotheses, commonly serve as the organizing framework for developmental studies. This tactic is appropriate if there is not a firm base in the literature which one can use as a basis for formulating a hypothesis. This is often the case with such research, especially if the problem focuses on emerging technologies. However, research questions are also more appropriate for qualitative research, a common developmental methodology.

Identifying Limitations. Because developmental research is often context-specific, one must be particularly concerned with the limitations or unique conditions that may be operating in a particular study. Such limitations will affect the extent to which one may generalize

the conclusions of the study. The results may be applicable only in the situation studied, or to others with similar characteristics, rather than being generalizable to a wider range of instructional environments.

THE REVIEW OF RELATED LITERATURE

Typically, literature reviews in experimental studies concentrate upon the specific variables being studied, usually the independent and dependent variables. This orientation may not prove useful in many developmental studies. The goal of the literature review, however, remains the same as with other types of research projects. It is to establish the conceptual foundations of the study.

The literature review in Type 1 developmental studies may address topics, such as:

- Procedural models which might be appropriate for the task at hand;
- Characteristics of similar effective instructional products, programs, or delivery systems;
- Factors which have impacted the use of the target development processes in other situations;
- Factors impacting the implementation and management of the target instructional product, program, or delivery system in other situations.

Literature reviews in Type 2 studies may address topics, such as:

- A description of models (either formally published or those currently in use) similar to the one being studied, including their strengths and weaknesses;
- Research on the targeted process (for example, task analysis or evaluation of organizational impact); or
- Research on factors impacting the use of a given model or process (for example, factors that facilitate the use of rapid prototyping models).

Both types of studies often address the methodology of developmental research itself in the literature review.

In developmental studies directed toward innovative instructional environments or innovative design and development processes, it would not be unusual to find little research in the literature that is directly relevant. In such cases the researcher must still identify literature that is relevant to the foundational theory of the project, even though the link may be indirect. For example, there is literature on factors that affect the use of computers and other media in instruction, but there may be little on factors related to the specific use of virtual reality as a delivery system. In developmental research the conceptual framework for the study may be found in literature from actual practice environments (for example, an evaluation report) as well as from traditional research literature directed toward theory construction.

THE RESEARCH PROCEDURES

Often developmental research occurs in natural work environments. This tends to enhance the credibility of the research, as well as create methodological dilemmas for the researcher. Nonetheless, whether the research is conducted during the design and development process or retrospectively, the best research pertains to actual projects, rather than simulated or idealized projects. For example, a study by Jones and Richey (2000) involved an examination of two actual projects of a design and development firm (one involving stand-up training and the other computer-based training).

Perhaps it is the "real life" aspect of developmental research that results in studies that frequently take even more time to complete than other types of research. There are often more changes in one's research plans and procedures as a result of unanticipated events than is typical in other types of research. Consequently, detailed research procedures and timelines are most important.

Participants. There are often multiple types of participants in a given developmental research project, and if the study is conducted in phases, the participants may vary among phases. The nature of the

participating populations tends to vary with the type of developmental research being conducted. Typical populations include:

- Designers, developers, and evaluators;
- Clients;
- Instructors and/or program facilitators;
- Organizations;
- Design and development researchers and theorists; as well as
- Learners and other types of users.

Table 1 shows the array of persons that most commonly participate in these projects and the various phases of the project in which they tend to contribute data.

Table 1.
Common Participants in Developmental Research Studies

Type of Developmental Research	Function/Phase	Type of Participant
Type 1	Product Design & Development	Designers, Developers, Clients
Type 1	Product Evaluation	Evaluators, Clients, Learners, Instructors, Organizations
Type 1	Validation of Tool or Technique	Designers, Developers, Evaluators, Users
Type 2	Model Development	Designers, Developers, Evaluators, Researchers & Theorists
Type 2	Model Use	Designers, Developers, Evaluators, Clients
Type 2	Model Validation	Designers, Developers, Evaluators, Clients, Learners, Instructors, Organizations

For example, participants in the Tracey (2002) study included researchers and theorists in model development, designers in model use, and learners and instructors in model validation. This was a Type 2 study. The participants in Jones and Richey (2000), another Type

2 study, were designers, developers, and clients. This study primarily addressed model use. McKenney's research (2002) was a Type 1 study. In the phase addressing the construction and prototyping of an electronic design tool, the participants were developers, users, evaluators, and a variety of ID experts. Then, in the phase evaluating and validating the tool, participants were users (pre-service and in-service teachers and curriculum developers, i.e., designers) and experts.

Research Design. It is not uncommon for a developmental research project to also utilize multiple research methodologies and designs, with different designs again being used for different phases of the project. Table 2 presents a summary of those research methods that are most frequently used in the various types and phases of developmental research.

Table 2.
Common Research Methods Employed in Developmental Research Studies

Type of Developmental Research	Function/Phase	Research Methodologies Employed
Type 1	Product Design & Development	Case Study, In-Depth Interview, Field Observation, Document Analysis
Type 1	Product Evaluation	Evaluation, Case Study, Survey, In-Depth Interview, Document Analysis
Type 1	Validation of Tool or Technique	Evaluation, Experimental, Expert Review, In-Depth Interview, Survey
Type 2	Model Development	Literature Review, Case Study, Survey, Delphi, Think-Aloud Protocols
Type 2	Model Use	Survey, In-Depth Interview, Case Study, Field Observation, Document Analysis
Type 2	Model Validation	Experimental, In-Depth Interview, Expert Review, Replication

This table highlights some typical methodology patterns used in developmental studies. In Type 1 studies critical design and development processes are often explicated using case study methods. Interviews, observations, and document analysis are techniques that can be used to gather the case study data, to document the processes used and the conditions under which they are employed. Corry, Frick, and Hansen's (1997) case study on the design and usability of a university Web site interviewed prospective users during the needs analysis phase, used think-aloud protocols and surveys while testing the prototype for usability. Finally, they conducted online testing of site usability.

Evaluation research techniques are often employed in Type 1 studies to determine the effectiveness of the resulting product or the particular techniques used during the design and development project. As with all evaluation research, a variety of data collection techniques are possible. In Fischer, Savenye, and Sullivan's (2002) Type 1 study, they conducted a formative evaluation of a computer-based training course directed toward the implementation of a new university financial system. In the Klein et al. (2000) Type 1 study, they conducted a needs assessment to determine the optimal content and delivery method of a graduate level educational technology course. This study involved document analysis, interviews, and surveys.

Sometimes, a full experiment is even constructed to test the product or technique. For example, Borras (1993) developed a computer-based multimedia program for improving college students' spoken French. She field-tested the program using experimental methods to evaluate the various versions of the program.

In Type 2 research, models of the full design and development process (or of a particular part of the process) are constructed in a variety of ways, including the following:

- By conducting surveys of designers and developers in regards to projects in which they have been involved, such as Shellnut's (1999) study of motivation design or Phillip's (2000) study of organizational impact evaluation techniques; or

- By synthesizing models from the literature, such as Adamski's (1998) reviews of instructional technology, human factors, and aviation literature in his efforts to devise an initial model for designing job performance aids for use in high risk settings; or
- By arriving at a consensus of respected experts in the field using Delphi techniques, such as Tracey's (2002) methods of finalizing her multiple intelligences design model; or
- By conducting experiments to validate particular design and development models, such as Tracey's (2002) and Adamski's (1998) projects.

Developmental researchers are commonly confronted by methodological dilemmas. One is the need to account for contextual variables, especially in those studies taking place in a natural work setting. For example, to what extent does the client's design experience and sophistication, or designer expertise, or time pressures impact the success of a particular project? Since it is typically not possible to control such factors in the research design, the researcher is then obligated to carefully describe (and measure, if possible) these variables in an effort to account for their impact.

Another common situation that is potentially problematic is when the researcher is also a participant in the study, for example, when the researcher is also the designer or developer. While this situation is not preferable, it is not unusual. Care must be taken to insure objectivity through consistent, systematic data collection techniques and the collection of corroborating data, if possible. Often structured logs and diaries completed by several project participants according to a regularly established schedule create a structure that facilitates the generation of reliable and comparable data.

Another frequent problem is maintaining the integrity of recall data. Many studies rely upon self-reports of past projects. Others use structured interviews of participants. Using previously prepared documents or data from others involved in the same project facilitates a triangulation process to validate the data collected.

Collecting and Analyzing Data. Data collection in a developmental study takes a variety of forms depending upon the focus of the research. The validity of the conclusions is often dependent upon the richness of the data set as well as the quality of the research design. Typical types of data collected in developmental research relate to:

- Documentation of the design, development, and evaluation tasks, including profiling the design and development context and collecting data: work time and expenses, problems encountered and decisions made, adjustments made in the original plans, designer reactions and attitudes, or records of concurrent work patterns;
- Documentation of the conditions under which the development and implementation took place, including factors such as equipment and resources available, participant expertise and background, or time and client constraints; and
- Identifying the results of pre-design needs assessments, formative, summative and confirmative evaluations, including documentation of the target populations and the implementation context, and measures of learning, transfer, and the impact of the intervention on the organization.

As with all research projects, participants must be fully informed of the nature of the research, not be coerced to be involved, and be assured that the data will be both anonymous and confidential. Not only must the participants be informed and give their consent, but often written consent from their organizations is required as well. Data may be sensitive and proprietary in nature, and researchers must be attuned to these issues and their ramifications.

Data analysis and synthesis in a developmental study is not unlike that of other research projects. There are likely to be descriptive data presentations, and qualitative data analyses using data from documentation, interviews, and observations. Traditional quantitative data analyses techniques are used as well.

REPORTING DEVELOPMENTAL RESEARCH DATA

There has been an increase in journal articles, conference papers, and doctoral dissertations reporting on developmental studies in recent years (see Richey, Klein, & Nelson, 2004 for a review). A particular issue in writing a developmental research report is deciding how much data to include. While length is typically not an issue for doctoral dissertations, data sets are often too massive even to include in a dissertation appendix. Furthermore, journals do not provide enough space for detailed documentation of developmental research data.

In response to this dilemma, some researchers are using Web sites as data repositories. For example, full results of a needs assessment may be included in a Web site, or complete copies of electronic tools can be provided, or full transcripts of designer interviews can be presented. Assuming these Web sites are stable and accurate, this solution allows for full disclosure of data that should prove valuable to practitioners and researchers alike. With full data sets, practitioners should be to apply general lessons to their own work environments. With full data sets, researchers should have opportunities for secondary analysis of data (an option seldom available to researchers in this field), as well as opportunities to fully replicate the research in other settings.

CONCLUSIONS

THE CRUX OF DEVELOPMENTAL RESEARCH is to systematically examine our products, tools, processes, and models in order to provide reliable, usable information to both practitioners and theorists. It is research, however, that is intricately connected to real world practice. It creates a loop with practice informing research and research, in turn, informing practice.

With increasing interest in instructional technologies in higher education and other settings, it is essential that we systematically collect empirical data to better inform this practice. As evidenced by the

increase in journal articles, conference papers, and doctoral dissertations reporting on developmental studies, this seems to be an increasingly common opinion. There is growing interest in this type of research.

While developmental research is only one of several types of research methods that can provide practitioners with usable data, its focus on the design, development, and evaluation of instructional products and processes is unique. We hope that this article will provide direction to scholars who want to conduct developmental research, as well as encourage practitioners to support and participate in such research. We look forward to new knowledge to guide the field whether it is based in a specific context or is generalizable to a variety of settings.

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