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The Application of Design-Based Research in the Context of Curriculum Materials Development in Sub-Saharan Africa

Abstract

Progress toward the UN Millennium Development Goal to “Achieve Universal Primary Education” by 2015 is severely limited, especially in Sub-Saharan Africa. This paper describes the application of design-based research (DBR) to this goal, specifically in the context of improving the capacity of Tanzanian teachers to produce effective curriculum materials. Using DBR strategies, the project team in Tanzania refined a prototype electronic tool for supporting curriculum materials development and tracked effects on both the professional learning of the developers and teachers and the quality of the curriculum materials that were produced. This paper focuses the capacity of DBR as a distinct research genre for contributing to theory-development while also addressing the specific needs of practitioners in the local context.

Purposes

This paper directly addresses the theme of the 2013 AERA conference, “Education and Poverty: Theory, Research, Policy and Praxis.” The second of the eight goals specified for the United Nations Millennium Development Goals is “Achieve Universal Primary Education.” The specific target set for this goal is “Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.” According to the official website for this initiative (<http://www.un.org/millenniumgoals/>), progress toward reaching this target has been thwarted around the globe, and that progress in Sub-Saharan Africa is particularly limited. Design-based research (Design-Based Research Collective, 2003) is well suited toward addressing this enormous problem at multiple levels. Design-based research (DBR) emphasizes the whole cycle of scientific inquiry, often involving sub-studies in cycles throughout the stages of problem identification, solution development, testing, and refinement. Design studies require interaction and collaboration among researchers, teachers, and other stakeholders. The proposed paper speaks to a fervent call for design researchers to share their emerging insights on how to maximize the potential and minimize the weaknesses of this powerful yet challenging research approach. It does so by looking at a case-example of technology to support curriculum materials developers and teachers in Sub-Saharan Africa.

Perspectives

Design-based research (DBR) (also referred to as development research, educational design research, design experiments, and other terms) emerged as a unique genre of educational research 20 years ago. According to Barab and Squire (2004), design-based research is “a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in naturalistic settings” (p. 2). DBR has gained momentum over the last decade (Anderson & Shattuck, 2012). Special issues of highly respected journals have addressed the potential of DBR: *Educational Researcher* (2003, 31(1)), *Journal of the Learning Sciences* (2004, 13(1)); *Educational Psychologist* (2004, 39(4)). Books devoted to the topic examine design-based research methodological considerations (Kelly, Lesh, & Baek, 2008) as well as guides for conducting design studies (Reinking & Bradley, 2008).

There is an increasing degree of consensus on characteristics of design-based research. For example, Wang and Hannafin (2005) described design-based research as pragmatic; grounded; interactive; iterative, flexible; integrative; and contextual. In their book about design research in the domain of literacy, Reinking and Bradley (2008) delineated seven characteristics of design research: intervention centered; theoretical; goal-oriented; adaptive and iterative; transformative; methodologically inclusive and flexible; and pragmatic.

Several different models for design research have appeared in the literature. Some are more conceptual, and have been used to help describe differing sequences of steps in the design research process (cf. Ejersbo et al., 2008). Others emphasize a flexible but clear process, along with varying degrees of conceptual, or substantive, support (cf. Bannan-Ritland, 2008). Figure 1

is a generic model that attempts to adequately represent the dynamic nature of DBR as the authors of this proposal have implemented it in their work for nearly two decades.

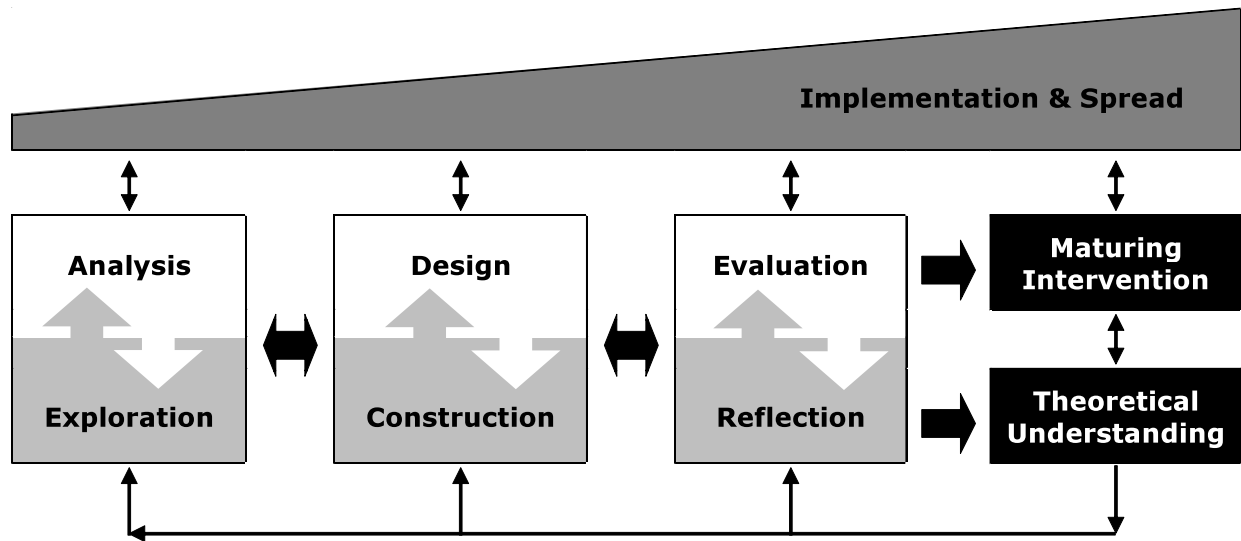


Figure 1: Generic model for design-based research.

Despite the fact that there is growing support for DBR as a viable route to increasing the relevance of educational research, the current body of international literature contains very few in-depth examples of long-term, high-quality design research. There is an extreme lack of examples demonstrating how this approach can be applied in the context of enhancing educational opportunities in Sub-Saharan Africa. The proposed paper describes each aspect in the generic model in Figure 1 and illustrates its elements through the example of a 4-year study focused on supporting curriculum development in Sub-Saharan Africa, specifically in Tanzania.

In the last few decades, the concept of Teacher Resource Centers (TRCs) has become widely accepted across Sub-Saharan Africa as an essential ingredient of a professional support structure for teachers and schools (Hoppers, 1998). Among other activities, TRCs often provide the context in which resource center staff members collaborate with local teachers to develop lesson materials exemplifying specific elements of an innovative curriculum. In such cases, curriculum development and teacher professional development are viewed as two mutually enhancing processes. This study set out to explore how technology might be able to contribute to and even enhance the synergy that exists between curriculum development and professional development, at a very natural crossroads: the creation of exemplary curriculum materials.

Many tools have been developed to provide support to curriculum developers, but at the time of this study, none were available that specifically targeted the kind of work carried out by teacher-developers working in TRCs in Sub-Saharan Africa. In addition, very little guidance was available in scientific literature that could underpin such work, by giving answers to questions like: What would a scientifically valid tool – one that contained state of the art knowledge and was internally consistent – look like? How could it be made practical for this context? What features would be necessary for it to yield high quality materials and offer learning experiences to the students in schools in Sub-Saharan Africa? Therefore, DBR was conducted to address (a) the practical problem of the need for support in TRCs; and (b) develop theoretical understanding that could serve the creation of similar tools. This study was guided by the following main research question: *What are the characteristics of a valid and practical electronic support tool that has the potential to impact the performance of teachers in the creation of exemplary lesson materials for science and mathematics education in Tanzania?*

Methods

The design study on supporting curriculum materials developers took place over four years in several phases, as shown in the generic model (Figure 1). The generic model features three boxes, or phases, in which research activities take place: 1) analysis/exploration, 2) design/construction and 3) evaluation/reflection. The interaction between design/construction and the other phases demonstrate how empirical findings feed into design. In this study, two iterations took place in the first phase, four iterations in the second phase, and two in the third phase.

Data Sources

Figure 2 shows the approaches (top of box) main data sources (bottom of box) used in each of the three phases.

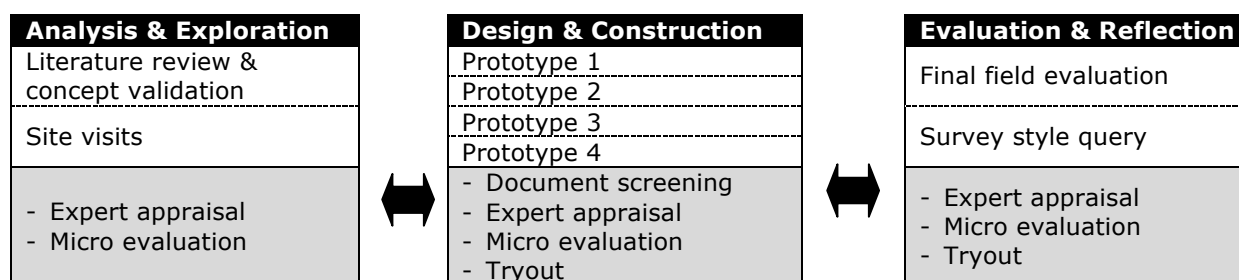


Figure 2: Approaches and methods for data collection in each phase of the study.

Results

The main findings from each phase are as follows: Based on the results of the initial literature review and concept validation, an existing electronic performance support tool for formative evaluation was translated in terms of both language and contextual appropriateness; this tool was then used as an example of how support could be structured in visits with Tanzanian curriculum developers to explore needs. Flanking research was conducted alongside multiple iterations of working prototypes to understand and refine the tool's validity, practicality and impact potential. Observations, questionnaires, logbooks and interviews helped gain insight into how curriculum developers and teachers were using the electronic tool. Analysis of the documents produced by research participants assessed the quality of the curriculum materials that the tool helped to create. Interviews, focus groups and logbooks were used to gather reflections of teachers and their supervisors on the professional learning that occurred through engagement with the support tool. During the final phase of evaluation and reflection, similar instruments were used, but the duration of engagement was longer and took place under more naturalistic conditions than some of the previous cycles.

The study concluded that the electronic tool has the potential to positively enhance curriculum development and teacher development by supporting the creation of exemplary lesson materials in Tanzania. Using the tool, participating teachers generally produced better materials than they otherwise would, and learned from this process due to the program's characteristics:

- *Content:* The tool systematically structures the materials development process and illustrates its iterative nature through analysis, design and evaluation activities that are guided by an explicit rationale.
- *Support:* The tool blends generic and tailor-made advice; internal and external tools; implicit and explicit learning opportunities; and written and verbal communication aids to assist the teacher/developer throughout the materials creation process.
- *Interface:* The tool offers the content and support through a direct, consistent and forgiving visual (and technical) representation, which grants the teacher/developer both flexibility and control over the process.

The desired quality aspects (validity, practicality and impact potential) are neither absolute nor completely objective. Rather, they are relative to the context in which the program is employed, as well as the needs, expectations and beliefs of the local participants. This study has also highlighted the importance of continuously seeking heightened contextual understanding as an integral part of the design and development process. In addition to the design principles and tool itself, this study also yielded suggestions for DBR of this nature.

Scholarly significance

The proposed paper will share additional information about the findings of the study. However, the paper will focus primarily on delineating the DBR approach, which informed the development of the tool. Such a paper speaks to the need for more examples of useful long-term design-based research in the field of education in general and in Sub-Saharan Africa in particular. This paper is highly relevant to those interested in seeing the DBR approach come to life in cooperation with local stakeholders. The example demonstrates how DBR can yield both scientific insights as well as lasting benefits for practitioners.

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