Research by Design and School Improvement: A review of literature

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This paper is divided into three major sections. The first section deals with the topic of design-based research and is divided into the following six parts: 1) introduction; 2) basic characteristics of design-based research; 3) the process of design-based research; 4) design-based research versus other research methods; 5) methodological challenges with design-based research; and 6) status of the use of design-based research. The second part discusses school improvement and is divided into four parts: 1) introduction; 2) basic assumptions of school improvement approaches; 3) the process of educational change; and 4) principles for effective school improvement. The third and final section discusses the potential for the use of design-based research in the field of school improvement and presents a couple of research findings in this regard.

**PART I: DESIGN-BASED RESEARCH**

**Introduction**

Educational research has often been criticized for not generating "usable knowledge" (Lagemann, 2002). The latter has been argued to be attributed to the "credibility gap" (Levin & O'Donnell, 1999) in educational research which has resulted from the lack of use of rigorous scientific methods (Levin & O'Donnell, 1999; National Research Council [NRC], 2002). In fact, the multidisciplinary nature of the education field (Levin & O'Donnell, 1999; NRC, 2002) has created disagreements about what constitutes quality research (Levin & O'Donnell, 1999). Others have asserted that the poor quality of educational research is due to claims arising from approaches that are detached from the problems of practice (e.g., Lagemann, 2002; NRC, 2002). Lagemann (2002) maintains that the use of scientifically controlled and valid methods is often at

the expense of fidelity to classroom learning. Therefore, although claims may be scientifically valid, they may not sufficiently explain or predict the phenomena being addressed (Sandoval & Bell, 2004). According to the NRC (2002), the multilayered nature of education necessitates the need for a research approach that takes heed of the contextual factors that often significantly influence the results of educational research. According to Levin and O'Donnell (1999), the first step in improving the quality of educational research is to enhance the credibility of its evidence. Sandoval and Bell (2004) further add that educational research that is "both usable in a practical sense and scientifically trustworthy cannot proceed without directly studying the phenomena it hopes to explain in its inherent messiness" (p. 199).

The 1990's marked the advent of a movement to develop a research methodology that addressed the issues of traditional educational research (Collins, Joseph & Bielaczyc, 2004), the pioneers of which were Brown (1992) and Collins (1992) who coined the term "design experiments". In Collins's (1992) article, she argued for the need to develop a systematic methodology of "design science" in education, similar to aerospace engineering, which aimed at determining the effectiveness of test design variants. This design would entail collaboration with teachers and would help formulate a design theory that guides the implementation of innovations (Collins, 1992). During the same time, Brown (1992) described her evolving approach to a "design experiment" in an attempt to bridge studies conducted in a controlled laboratory setting with studies conducted in the dynamically complex and ever-changing setting of a classroom. Such an approach required "engineering" a learning environment that took into consideration the inputs and outputs of the system as well as the contributions made from both theory and practice (Brown, 1992).

In the literature, many terminologies have been used synonymous to "design experiments", such as "design research", "development research" and "developmental research"; however, all these terms represent the same overarching goals and approaches (Wang & Hannafin, 2005). The Design-Based Research Collective (DBRC; 2003) chose to use the term "design-based research" in order to avoid mistaking the approach with experimental design, studies of research design and trial teaching methods. Therefore, for the purpose of this paper, the term design-based research will be used. Wang and Hannafin (2005) described design-based research as the following:

> …a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world setting and leading to contextually-sensitive design principles and theories. (p. 6)

> According to Shavelson, Phillips, Towne and Feuer (2003) design-based research is:

> …based strongly on prior research and theory and carried out in educational settings, seeks to trace the evolution of learning in complex, messy classrooms and schools, test and build theories of teaching and learning, and produce instructional tools that survive the challenges of everyday practice. (p. 25)

### Basic Characteristics of Design-Based Research

As evident from the previous definitions, design-based research is characterized by several basic features. In particular, design-based research: 1) is pragmatic since it aims to improve the problems of practice through intervention and refining theory; 2) is grounded in theory and a real-world context; 3) is an iterative and flexible process; 4) entails ongoing collaborations among researchers and practitioners; 5) uses integrative methods; and 6) produces contextually-relevant outcomes. Each of these characteristics is discussed below in turn.

*1. Design-based research is pragmatic since it aims to improve the problems of practice through intervention and refining theory*

Researchers (e.g. Anderson & Shattuck, 2012; Cobb et al., 2003; DBRC, 2003; Sandoval & Bell, 2004; Wang & Hannafin, 2005) unanimously agree that design-based research simultaneously strives to accomplish two goals: to improve the problems of practice through intervention and to refine and develop theories. In fact, in design-based research the development of theory is inextricably linked to practice (Brown & Campione, 1996). On the one hand, design-based research leads to the development and/or refinement of domain-specific learning theories (Cobb et al., 2003; Wang & Hannafin, 2005) which comprise of conceptual understandings and the means for supporting patterns of reasoning (diSessa & Cobb, 2004). On the other hand, design-based research promotes the adoption of innovations (DBRC, 2003) by generating design principles (Anderson & Shattuck, 2012; Wang & Hannafin, 2005) which provide a theoretical framework for prospective designs (Cobb et al., 2003). More specifically, design principles present a better understanding of how to adjust the context and the intervention to achieve optimal learning (Anderson & Shattuck, 2012) by putting forth the necessary elements of the design and showing why those elements work and how they function together to support learning (Cobb et al., 2003). In this sense, design-based research goes beyond designing and "perfecting" an innovation (Cobb et al., 2003; DBRC, 2003). Ultimately, the value of the explanations and principles intrinsic to these developed theories lies in the extent to which they impact and improve learning in naturalistic settings (Barab & Squire, 2004; Cobb et al., 2003; DBRC, 2003). Together, the theories generated by design-based research provide a better understanding of what Cobb et al. (2003) call a "learning ecology".

*2. Design-based research is grounded in theory and a real-world context*

As well as being a significant outcome in design-based research, theory provides an essential foundation for designing an intervention. According to the DBRC (2003), "interventions embody specific theoretical claims about teaching and learning, and reflect a commitment to understanding the relationships among theory, designed artifacts and practice" (p. 6). Collins (1992) and Sandoval (2004) further stress that the use of an underlying theory to support the framework and procedures of the design is indispensable for theory development in design innovations. Therefore, the methods chosen in design-based research should be grounded in relevant research, theory and practice (Wang & Hannafin, 2005). Prior to conducting design-based research, researchers review the literature in order to select a pertinent learning and teaching theory (Wang & Hannafin, 2005), search for available design cases and identify any gaps (Edelson, 2002) or existing issues (Cobb et al., 2003). Throughout the design process, theories are evaluated and refined and are used to determine which interventions should be implemented and which should be eliminated from practice (Wang & Hannafin, 2005). Furthermore, knowledge from prior research is used to improve the effectiveness of a particular intervention (Joseph, 2004).

Design-based research is also grounded in a real-world context (Wang & Hannafin, 2005) whereby the design process is initiated to address problems that are germane to practice (Edelson, 2002; McKenney & Reeves, 2013). Furthermore, the interventions are carried out in a real-world setting where complex social interactions occur (Collins et al., 2004; Wang & Hannafin, 2005) and a myriad of dependent variables influence the teaching and learning process (Collins, 1992; Collins et al., 2004). It is important to note here that a context may be at the level of individual students, a classroom community, a professional teaching community, or a school or school district (Cobb et al., 2003).

*3. Design-based research is an iterative and flexible process*

Design-based research is characterized by successive iterative cycles of design, implementation, analysis and redesign (DBRC, 2003) with the aim of effectively supporting the learning process (Joseph, 2004) by improving a particular activity or artifact (Shavelson et al., 2003). The iterative nature of design-based research also dictates that the design process be flexible (Wang & Hannafin, 2005). Initial designs are rarely flawless or implemented as intended (Anderson & Shattuck, 2012). Also, interventions are initially designed based on mere conjectures of a hypothesized learning process (Cobb et al., 2003) and are not detailed enough to dictate every decision of the design process (Edelson, 2002). Therefore, data gathered and analyzed during successive iterations inevitably leads to changes in both the initial design and in the theoretical framework used. The initial design is continuously adapted and improved whenever necessary in order to account for newly emerging patterns (Cobb et al., 2003; Edelson, 2002; Wang & Hannafin, 2005). Similarly, the underlying theoretical framework of the initial design may be further developed or new frameworks may emerge (Wang & Hannafin, 2005). New conjectures and emerging patterns from preceding iterations then become the new focus of investigation in subsequent iteration cycles (Cobb et al., 2003). Therefore, concurrent with the refinement of the design and the learning theory, the research questions also evolve from open-ended to more specific throughout the design process (Joseph, 2004; Shavelson et al., 2003).

*4. Design-based research entails ongoing collaborations among researchers and practitioners*

Design-based research emphasizes the importance of ongoing collaborations among researchers and practitioners throughout the duration of the design process (Cobb et al., 2003); i.e. from initial problem identification till the creation and publication of theory and design principles (Anderson & Shattuck, 2012; van den Akker, 1999). The importance of this

collaboration can be rooted in the pragmatic nature of design-based research whereby theory and practice are intricately related (Wang & Hannafin, 2005). Researchers' expertise is needed to shape a learning environment grounded in research and theory (Anderson & Shattuck, 2012; van den Akker, 1999), manage the design process, foster the relationship with practitioners and make interpretations of the research context (Cobb et al., 2003). Likewise, practitioners are needed for effectively designing and implementing an intervention (Wang & Hannafin, 2005) by providing their insight on possible local constraints (Wang &Hannafin, 2005) and on the "complexities of the culture, technology, objectives, and politics of an operating educational system" (Anderson & Shattuck, 2012, p.17). The complementary expertise of researchers and practitioners (DBRC, 2003) ensures that the "goals and design constraints are drawn from the local context as well as the researcher's agenda" (DBRC, 2003, p.6) and that emerging local issues are efficiently dealt with (Wang & Hannafin, 2005). Ultimately, this means that meaningful contextual change will occur and that the capacity for innovation will be enhanced (DBRC, 2003).

*5. Design-based research uses integrative methods*

Design-based research utilizes a wide variety of mixed-methods for data collection and analysis purposes (Anderson & Shattuck, 2012; Wang &Hannafin, 2005). McKenney and Reeves (2013) argue that design-based research draws from existing quantitative and qualitative research methods and abides by recognized standards for sampling, data collection and data analysis. Together, the data collected from multiples sources are used for ongoing assessment and evaluation of the designed intervention (Anderson & Shattuck, 2012). What sets design-based research apart from other research methods is the fact that the use of methods may vary as new needs and issues emerge and as the focus of the research evolves (Cobb et al., 2003; Joseph, 2004; Shavelson et al., 2003; Wang & Hannafin, 2005). Through the use of a combination of

different assessment methods and the triangulation of data, the objectivity, validity and applicability of the research findings are enhanced (Cobb et al., 2003; DBRC, 2003; Wang & Hannafin, 2005).

*6. Design-based research produces contextually-relevant outcomes*

Since design-based research is grounded in problems of practice and conducted in real-world contexts, the design principles and learning theories that are generated from this type of research are contextual (DBRC, 2003). On the one hand, the theories derived from design-based research should not be "grand theories" that can be uniformly applied in any given context (Anderson & Shattuck, 2012; Cobb et al., 2003). Given that various context-dependent variables influence the outcomes of design (Brown & Campione, 1996; van den Akker, 1999) "grand theories" may be too broad or abstract to be useful (Cobb et al., 2003). On the other hand, although design-based research is conducted in a particular setting, the overall intent is not merely to explore the process of learning in those particular settings (Cobb et al., 2003). Therefore, it is important that the theoretical findings of design-based research strike an intermediary balance between "a narrow account of a specific system…and a broad account that does not orient design to particular contingencies" (Cobb et al., 2003, p. 11). Design-based research should go beyond prescribing a step-by-step account of the process (Wang & Hannafin, 2005) and should view specific cases as "broader classes of phenomena" (Cobb et al., 2003) by analyzing the relationship among different elements of the context that supporting learning (Brown & Campione, 1996; DBRC, 2003). This helps guide other researchers that may want to apply the design principles in new, yet comparable, settings (Wang & Hannafin, 2005). When the findings of design-based research are validated in multiple settings and multiple areas of instruction, the generalizability of the research is increased (DBRC, 2003; van den Akker, 1999).

## The Process of Design-Based Research

Despite the importance of design-based research, the exact techniques of its methodology have not been fully articulated (Joseph, 2004). However, some researchers have illustrated the design-based research process through examples of their own work (e.g., Cobb et al., 2003) and have presented general guidelines for planning and implementing design-based research (e.g., Wang & Hannafin, 2005). Edelson (2002) summarized the design-based research process as follows:

> The design researchers begin with a set of hypotheses and principles that they use to guide a design process….the design researchers proceed through iterative cycles of design and implementation, using each implementation as an opportunity to collect data to inform subsequent design. Through a parallel and retrospective process of reflection upon the design and its outcomes, the design researchers elaborate upon their initial hypotheses and principles, refining, adding, and discarding-gradually knitting together a coherent theory that reflects their understanding of the design experience. (p. 107)

In the proceeding sections, a description of the overall phases of design-based research-planning the initial design, implementing the design, conducting retrospective analysis and reporting the design process- will be presented.

### Planning the Initial Design

As mentioned earlier, collaboration among researchers and practitioners should occur throughout the design-based research process starting with selecting and creating the initial design (Anderson & Shattuck, 2012). An essential step in planning the initial design is to clarify the general purpose of the study (Wang & Hannafin, 2005) or the theoretical intent (Cobb et al., 2003) and to specify the intended learning goals (Cobb et al., 2003; Wang & Hannafin, 2005). Since it is not possible to study everything at the same time (Wang & Hannafin, 2005), goals

should be set reasonably in order to enhance the rigor of the research (diSessa & Cobb, 2004).

These goals should also be pragmatic; i.e. they should address problems relevant to practice

(Anderson & Shattuck, 2012; Wang & Hannafin, 2005). This entails reviewing the extant

literature in order to identify any salient gaps (Cobb et al., 2003; Joseph, 2004) and to survey

available design cases (Wang & Hannafin, 2005) that are relevant to the intended topic. An

assessment of the local context is also needed to determine available resources and possible

limitations (Anderson & Shattuck, 2012; Wang & Hannafin, 2005). Wang and Hannafin (2005)

urge the need for researchers to adequately familiarize themselves with the learning environment

in order to reduce the obtrusiveness of their presence during design implementation. A review of

the literature coupled with a critical assessment of the real-world context provides researchers

with further insight on the focus of investigation (Wang & Hannafin, 2005).

Another essential element during the planning phase is to identify conjectured intellectual

and social starting points and to trace a conjectured learning trajectory consisting of the

disciplinary concepts and the reasoning required to achieve the end goals (Cobb et al., 2003).

This step also relies heavily on drawing from prior literature (Cobb et al., 2003; Sandoval, 2004).

If an insufficient amount of knowledge is available about the particular topic being addressed, a

pilot study can be conducted to determine starting points (Cobb et al., 2003). Moreover,

depending on the purpose of the design and the features of the design setting, researchers may

need to synthesize a new theoretical framework rather than use an already existing one (Wang &

Hannafin, 2005).

An initial design of the intervention is then formulated in such a way that it embodies the

learning conjectures (Cobb et al., 2003) by means of reifying the conjectures into specific tools,

materials or activity structures (Sandoval, 2004). Indeed, the design of an intervention should

accurately align with the underlying theory (Hoadley, 2004). Although the embodied conjectures at this point are generally speculative, they have a significant function in orienting the research team during design implementation (Cobb et al., 2003). More specifically, the conjectures provide researchers with predictable interactions and outcomes expected from the implementation of the design (Sandoval, 2004). This, in turn, guides researchers to selectively attend to and collect data about the significant contextual variables and design features that are influencing the learning process (Sandoval, 2004). Moreover, conjectures provide researchers with an analytic lens for which theoretical gaps can be more clearly identified (Sandoval, 2004).

Prior to implementing the initial design, researchers should set a clear, yet flexible, plan specifying the anticipated research phases and steps, the design setting, the research team members and the research methods to be used (Wang & Hannafin, 2005). In order to account for the social factors and the dynamics that inevitably affect learning and the design process itself, the design setting needs to be as representative of a typical classroom as possible (Barab & Squire, 2004; Wang & Hannafin, 2005). As for the size of the research team and the expertise of its members, this depends on the type and purpose of the study (Cobb et al., 2003). Nonetheless, the team members should collectively have the expertise to develop an initial design, conduct the experiment, and carry out a systematic retrospective analysis (Cobb et al., 2003). In addition, the committed involvement of leaders is indispensible to the effectiveness of the team (Cobb et al., 2003). With regard to the use of research methods, a description is provided in the next section, "Implementing the Design".

**Implementing the Design**

Since one of the goals of design-based research is to support optimal learning through the improvement of a particular design, it is necessary to constantly evaluate the design throughout

the course of its implementation (Collins et al., 2004). The latter requires identifying critical elements of the design and how they interact together to support learning (Collins et al., 2004). This facilitates the evaluation of a design by assisting researchers in identifying the specific elements that are working and which need to be modified or removed (Collins et al., 2004). It is important for researchers to keep in mind that the main purpose of design-based research is not only to attend to the logistics of design implementation, but also to gain a deep understanding of the learning ecology (Cobb et al., 2003) by empirically refining the conjectures of the underlying learning theory (Sandoval, 2004; Wang & Hannafin, 2005). According to Sandoval (2004), refinement of a conjecture occurs through "tracing backwards from observed outcomes, through intermediate outcomes, to features of the design" (p. 218). In cases where initial conjectures are refuted, alternative ones are generated (Cobb et al., 2003). These emergent conjectures are then manifested as modifications to the design and are tested in subsequent implementations (Joseph, 2004). The process of refining or generating conjectures, and consequently modifying the design activities, should be supported with the reexamination of available literature (Wang & Hannafin, 2005).

Systematic evaluation of the design requires systematic documentation and collection of data. A comprehensive profile must be created for each iteration (Collins et al., 2004) which consists of information about: how the design was implemented; the successful and unsuccessful elements of the design (i.e. whether those elements contributed to or hindered learning); the researchers' interpretations of the reasons for the success or failure of the design elements; and what major modifications were made to improve the design (Cobb et al., 2003; Collins et al., 2004; Sandoval, 2004; Wang & Hannafin, 2005). According to Collins et al. (2004), the evaluation of a design intervention requires looking at multiple layers: the cognitive level, the

interpersonal level, the group or classroom level, the resource level and the institutional or school level. For instance, describing climate variables such as cooperation and engagement requires data from field notes and observations, describing learning variables such as content knowledge and skills requires a pretest/posttest and describing systemic variables such as ease of adoption and sustainability require interviews or surveys (Collins et al., 2004). Therefore, collecting and documenting data from multiple sources is imperative for design-based research (Cobb et al., 2003; Collins et al., 2004; Wang & Hannafin, 2005). Also, as mentioned earlier, the research methods vary with the change in focus of investigation (Cobb et al., 2003; Shavelson et al., 2003; Wang & Hannafin, 2005). For example, continuous documentation throughout the entire design process is needed for retrospective analysis and for generating design principles (Shavelson et al., 2003) while formative evaluation methods are usually used when assessing intermediate design goals (Wang & Hannafin, 2005). It is important to note here that researchers should be meticulous in choosing valid measurements and sound research methods as this strongly influences the veracity of the conclusions drawn from the data (Barab & Squire, 2004; Cobb et al., 2003).

By simultaneously collecting and analyzing data, the design is improved and the researchers' understanding of the phenomenon under study is enhanced (Cobb et al., 2003; Wang & Hannafin, 2005). Each major change in the design indicates a new iteration (Anderson & Shattuck, 2012; Cobb et al., 2003; Collins et al., 2004). Collins et al. (2004) further emphasize that "any changes to one aspect of the design need to be compatible with other aspects of the design" (p. 19).

Throughout design implementation and evaluation, an ongoing relationship among practitioners and researchers should be maintained (Cobb et al., 2003). Cobb et al. (2003)

suggest the use of regular debriefing sessions in which earlier events and prospective plans are communicated and discussed. The DBRC (2003) argue that such collaborative partnerships are valuable for future enactments of the intervention since they highlight the numerous variables that influence classroom learning and help in modifying the key elements of an intervention.

**Conducting Retrospective Analysis**

A primary aim for conducting a retrospective analysis is to place the idiosyncrasies of a local design implementation into a more broad and coherent theoretical framework (Cobb et al., 2003). This is achieved by comparing the analyses done during the course of the design process to the design context, previous events and available literature (Cobb et al., 2003; Wang & Hannafin, 2005). This presents a challenge in design-based research since an extensive amount of data is collected over long periods of time (Cobb et al., 2003). Therefore, it is necessary to involve members from diverse levels of expertise and backgrounds in the analysis process in order to ensure that alternative perspectives and interpretations are taken into consideration and consequently, that the credibility of the claims made by the researchers are enhanced (Cobb et al., 2003; Joseph, 2004).

Another purpose of retrospective analysis is to provide an account of the design history in order to have the results generalized to other contexts (Barab & Squire, 2004; Cobb et al., 2003). In fact, a central challenge to retrospective analysis is to balance the local applicability of a design with its generalizability to other settings (Wang & Hannafin, 2005). The more relevant and detailed the design process is, the more other researchers will be able to understand and critique the findings (Cobb et al., 2003; Collins et al., 2004) and the more readers will make accurate decisions about the potential of implementing the intervention in their own contexts (Anderson & Shattuck, 2012; Wang & Hannafin, 2005). At the same time, a detailed trace of the

design process presents anticipated outcomes in future designs (Cobb et al., 2003; Edelson, 2002) and may offer added insight into the unarticulated techniques of design-based research (Edelson, 2002; Joseph, 2004).

In the end, retrospective analyses in design-based research result in the development of useful and generalizable theories (Cobb et al., 2003; DBRC, 2003) which, according to Edelson (2002), can be either of three types: domain theories, design frameworks and design methodologies. Domain theories are descriptive in that they provide a characterization of the learning situation in terms of those involved in the learning process and the interactions among them (Cobb et al., 2003; Edelson, 2002). Domain theories can be of two types: context theory and outcomes theory (Edelson, 2002). The former presents the challenges and opportunities of a particular design context while the latter provides a set of predictable outcomes associated with the intervention (Cobb et al., 2003; DBRC, 2003; Edelson, 2002; Sandoval, 2004). As for design frameworks, they lay out a set of guidelines for a design product to achieve its intended goals (Anderson & Shattuck, 2012; DBRC, 2003; Edelson, 2002, van den Akker, 1999). Finally, design methodologies delineate the techniques of design-based research such as the design process, the expertise required and the roles played by those involved (DBRC, 2003; Edelson, 2002; van den Akker, 1999).

**Reporting the Design Process**

Similar to any other research endeavor, design-based researchers are responsible for presenting their results to the public (Cobb et al., 2003). Collins et al. (2004) and Wang and Hannafin (2005) outlined the essential components for a design-based research report: 1) A purposes and goals section which includes a review of relevant literature and a statement of the purpose and goals of the design; 2) A design framework section which provides a detailed

description of the framework used including its origin, its elements and how those elements

interact to achieve the intended goals; 3) A design settings section which includes a description

of the specific context in which the design was implemented as well as a description of the larger

system (e.g., school environment and culture); 4) A design process section which presents a

description of each iteration including the changes made, the rationale behind those changes and

data collection and analysis methods; 5) An outcomes section that is supported by evidence; and

6) A "lessons learned" or "design principles" section whereby the principles that transcend the

local setting are provided in addition to the possible limitations and failures of the

implementations and outcomes.

### Design-Based Research versus Other Research Methods

**Design-Based Research and Traditional Experiments**

According to Collins et al. (2004), design-based research differs from traditional

experimental and quasi-experimental designs in several aspects. First, traditional experiments are

conducted in well-defined and socially-isolated laboratory settings where only a few independent

and dependent variables are taken into consideration while all other variables are controlled for.

On the other hand, design-based research is conducted in "messy" real-world contexts whereby a

complex array of contextual variables, including social interactions, influences the dependent

variable(s) of interest. Also, while traditional experiments usually focus on one dependent

variable, design-based research typically involves many dependent variables. Furthermore,

laboratory experimentations follow a fixed procedure that is meticulously documented and can

be easily replicated whereas design-based research begins with a tentative design that is refined

and improved throughout successive cycles of implementation and documentation. In line with

the controlled nature of traditional experiments, researchers are responsible for designing the

experiment and for collecting and analyzing the data. Alternatively, in design-based research, researchers and participants of various areas of expertise collaborate in creating, implementing and evaluating the design. Finally, the ultimate goal of laboratory experiments is to systematically test one or more hypotheses by varying the learning conditions. However, design based research aims to develop learning theories and design principles for the purpose of improving practice. (Collins et al., 2004)

**Design-Based Research and Action Research**

Anderson and Shattuck (2012) argue that design-based research and action research have similar epistemological, ontological, and methodological underpinnings. Also, in their comparison of the two methods, Cole, Purao, Rossi and Sein (2005) found that both methods share a common "meta-paradigm", namely pragmatism, in that they aim to address problems occurring in real-world contexts. However, design-based research and action research differ in two main aspects. First, design-based research has a further goal which is to generate learning theory and design principles in order to solve authentic problems (Cobb et al., 2003). Second, although both methodologies involve collaborations among researchers and participants, the roles that participants and researchers play in each of the methods differ (Anderson & Shattuck, 2012; Wang & Hannafin, 2005). In action research, participants take the initiative to pursue a particular improvement to practice and usually carry out the procedure alone with researchers acting as mere facilitators (Anderson & Shattuck, 2012; Wang & Hannafin, 2005). In contrast, researchers and practitioners in design-based research work jointly to identify the problems of practice and to create and evaluate the design of the intervention (Wang & Hannafin, 2005). Therefore, in addition to their regular roles, educators in design-based research also play the role of researcher (Anderson & Shattuck, 2012).

**Design-Based Research and Formative Evaluation**

Both design-based research and formative evaluation aim to improve a particular innovation within a naturalistic setting through a series of iterations whereby data is collected to make necessary revisions to an ongoing design (Barab & Squire, 2004; DBRC, 2003; Wang & Hannafin, 2005). However, formative evaluation is mainly concerned with *testing* an existing theory without accounting for more generalizable models of learning (Barab & Squire, 2004; DBRC, 2003). On the other hand, unlike formative evaluation, design-based research aims at theory development by building on and refining existing theories or even creating new ones (Barab & Squire, 2004). Consequently, design-based research is considered a "research paradigm" rather than an "evaluation method" (Barab & Squire, 2004; Wang & Hannafin, 2005). In reality, formative evaluation is considered a method subsumed within design-based research (van den Akker, 1999). Moreover, "for some research questions the context in which the design-based research is being carried out is the *minimal ontology* for which the variables can be adequately investigated (implying that we cannot return to the laboratory to further test the theoretical claims)" (Barab & Squire, 2004, p.5, original emphasis).

**Methodological Challenges with Design-Based Research**

Issues of objectivity, validity and reliability are central to conducting rigorous scientific methods that warrant credible and trustworthy claims (DBRC, 2003). However, the very characteristics that define design-based research and make it advantageous over other types of research, also pose methodological issues.

One of the main issues of design-based research relates to the objectivity of the researcher (DBRC, 2003; O'Donnell, 2004), which in turn influences the validity and reliability of the research outcomes (Barab & Squire, 2004). Since researchers play a dual role as

researchers and designers (Wang & Hannafin, 2005), it is often a challenge to balance between making the intervention "work" in a complex setting while simultaneously controlling the experiment (DBRC, 2003; Sandoval & Bell, 2004). Design-based researchers are not only observers of interactions but are also the "cause" of those interactions (Barab & Squire, 2004). However, in altering the context, the findings and claims tend to become "more artificial and less naturalistic" (Barab & Squire, 2004). Therefore, it is often difficult to determine when it is appropriate for researchers to intervene and make manipulations during design implementation (Barab & Squire, 2004).

Another potential concern pertaining to researcher objectivity is the researcher's inclination to select data that is consistent with their claims, a phenomenon that Brown (1992) refers to as the Bartlett effect. In design-based research, an extensive amount of data is collected from various sources throughout the entire process (Collins et al., 2004; Wang & Hannafin, 2005). Dede (2004) maintains that out of the large amount of data collected in design-based research, a considerably small portion of it is used to report findings. This further exacerbates the issue of biased data selection (O'Donnell, 2004) since researchers usually choose evidence that supports their underlying theoretical stance (Brown, 1992). As a result, data selection continues to be an issue in design-based research (Dede, 2004).

The highly contextual and iterative nature of design-based research also creates issues in the validity, reliability and generalizability of its findings (O'Donnell, 2004). In order to produce credible evidence in research, the outcomes produced by an intervention should be replicable, a direct relationship should exist between the intervention and the outcome, and alternative explanations should be ruled out (Levin & O'Donnell, 2004). On the one hand, the methodological alignment among theory, design and practice contributes to the production of

credible evidence in design-based research (DBRC, 2003; Hoadley, 2004). However, there

remains a significant dilemma with the issue of *causality* (DBRC, 2003; O'Donnell, 2004;

Sandoval & Bell, 2004). Design-based research is conducted in real-world settings where various

variables inadvertently influence the outcomes of the intervention (Brown, 1992; DBRC, 2003)

and a noteworthy amount of modification decisions are made throughout the design process

(DBRC, 2003; O'Donnell, 2004). Therefore, it becomes difficult to demarcate the variables that

are influencing the outcomes of the phenomenon being addressed (Brown, 1992; Collins et al.,

2004; DBR, 2003; O'Donnell, 2004) and to rule out alternative explanations (O'Donnell, 2004).

This also makes precise replication in other settings and across different participants difficult

(Barab & Squire, 2004; DBRC, 2003; O'Donnell, 2004) since it is not plausible for other

researchers to manipulate the new context in which they aim to implement the design in

(Hoadley, 2004). Therefore, there is a challenge to produce "flexibly adaptive theories" (Barab &

Squire, 2004) which provide "usable knowledge" that is valuable within a local context as well

as developing more global knowledge for the field (DBRC, 2003).

Furthermore, a common criticism of design-based research is the Hawthorne effect is, a

term used in the literature to describe the fact that the positive outcomes of an intervention are

highly dependent on the researcher's continuous control and support (Brown, 1992). According

to O'Donnell (2004), the local context in which design-based research is conducted in cannot be

considered "natural" since the conditions of that context are not representative of what typically

occurs in a school and classroom setting. Thus, the refinement of a design to "maximize its

success" is at the expense of the generalization of its findings (DRBC, 2003). For this reason,

Brown (1992) asserts that after the removal of the researcher's support, long lasting effects

within the same local context, as well as widespread adoption across different contexts, is difficult to attain.

Several issues of feasibility may obviate the use of design-based research methods and the enactment of their resulting interventions across multiple contexts (Wang & Hannafin, 2005). First, the implementation of interventions requires fundamental changes in the roles of teachers (Brown, 1992) and requires the presence of researchers in classrooms which schools or even teachers may perceive as an imposition or distraction (Wang & Hannafin, 2005). Therefore, schools and/or teachers may not be willing to be involved in the research design process (Brown, 1992; Wang & Hannafin, 2005). Second, maintaining a productive collaborative relationship among participants and researchers is challenging as it requires a long-term commitment from both parties (DBRC, 2003). Third, conducting design-based research involves a large amount of time and resources and therefore requires the involvement of many participants whose roles need to be efficiently coordinated (Collins et al., 2004). Along the same lines, the many iterations of design-based research necessitate an extensive amount of time for implementation, a commodity that schools do not usually have (O'Donnell, 2004). Finally, a large endeavor such as design-based research requires a sufficient amount of funding (Wang & Hannafin, 2005).

Finally, and more importantly, a critical problem with design-based research is the lack of consensus as to the exact techniques of its methodology (Shavelson et al., 2004; Wang & Hannafin, 2005). O'Donnell (2004) argues that although the adoption of design-based research has become widely accepted, little has been written about the methodology itself since the seminal works of Brown (1992) and Collins (1992). In line with this, Kelly (2004) claims that "design studies to data have been described primarily using a set of process descriptors" (p. 118) rather than a set of procedures or steps to

follow. In fact, till now it is unclear whether design-based research can be considered a single methodology or an amalgam of multiple methods (Kelly, 2004). Furthermore, Dede (2004) argues for the need to establish set standards regarding the minimum criteria needed for beginning the implementation of a design, when to continue or stop iteration cycles and how to go about selecting data.

## Status of the Use of Design-Based Research

Design-based research has become widely used in the field of education. Although all forms of design-based research have the same pragmatic goals, the designs differ in their scope and purpose (Cobb et al., 2003). According to Cobb et al. (2003), design-based research has been conducted in one of the following design settings: 1) One-on-one (teacher/researcher and student) designs that aim to gain an in-depth understanding of a small-scale version of a learning ecology; 2) Classroom experiments in which a research team collaborates with a teacher; 3) Pre-service teacher development experiments; 4) In-service teacher development studies that support the development of a professional community; and 5) School and school district restructuring experiments whereby a research team collaborates with various stakeholders to promote organizational change. (Cobb et al., 2003)

Recently, Anderson and Shattuck (2012) conducted a systematic analysis of the design-based research articles published between the years 2002 till 2011 in order to determine the progress made in design-based research. Their initial search generated 1940 articles. Frequency counts revealed that the number of articles increased considerably across the years indicating the growing acceptance of design-based research as a research method. Due to reasons of feasibility, the researchers narrowed down this collection of articles to the top five most cited articles in each of the years between 2002 and 2011. Their analysis of these articles revealed several

important findings. First, a third of the selected articles were philosophical and expository while two-thirds of them were mixed-methods empirical studies. In addition, a majority of the philosophical articles were written in the years 2002 to 2006 while a majority of the empirical studies were conducted in 2007 to 2011 indicating that there has been a move away from theory toward adoption of design-based research. A second finding was that a majority of the first authors were from the United States; however, between the years 2008 and 2011 about half of the articles were written by authors outside the United States. The latter suggests that design-based research has become more globally accepted. Third, all of the studies were conducted in educational contexts where the primary emphasis was on the scientific discipline and on K-12 age groups. Fourth, over half of the empirical studies reported two or three iteration cycles. Fifth, a third of the empirical studies stated that their interventions led to increases in student learning and a third of the articles claimed that their interventions led to new understandings about educational phenomena. Finally, of the empirical studies, a third of them dealt with a particular type of instructional method (the most common of which was "integrated teaching models") and two-thirds of them dealt with technological or instructional design interventions (the most common of which were multi-user virtual environments, educational software and games). (Anderson & Shattuck, 2012)

McKenney and Reeves (2013) recently wrote an article in response to Anderson and Shattuck's (2012) study. In their article, they concurred with the importance of assessing what the past decade of design-based research has brought to the field of education. However, they believe that there were several methodological limitations, particularly relating to data selection, which weaken the conclusions of Anderson and Shattuck (2012). The major limitations included: using the term "design-based research" to search for articles rather than other synonymous

terminologies, relying on the analysis of the most cited articles, omitting books and book chapters from the analysis and relying on abstracts to draw conclusions about the findings of design-based research. More importantly, McKenney and Reeves (2013) assert that despite the fact that Anderson and Shattuck (2012) implicated that design-based research has led to improvements in practice, such a conclusion is preliminary since most of the studies are still at the beginning phases of revision. Thus, the studies are only able to demonstrate *potential* impact rather than *actual* impact on practice. Finally, given that a major goal of design-based research is to contribute to theory, McKenney and Reeves (2013) also emphasize the need for an analysis on what design-based research has contributed to theory rather than just to practice. Similarly, diSessa and Cobb (2004) argue that theory development in design-based research has generally been underdeveloped. (McKenney & Reeves, 2013)

## PART II: SCHOOL IMPROVEMENT

### Introduction

The field of school improvement has passed through various historical phases. Large-scale reform initiatives began as early as the mid-1950s and 1960s. Fullan (2005, 2009) labeled this period as the "adoption era" whereby a slew of innovations were naively implemented by schools and, consequently, resulted in no improvements at the classroom level. During the 1970s, the term "implementation" became associated with school reform and a number of research studies indicated that the implementation of innovations was failing. The significant pressure on schools to be innovative and to reduce the inequality gap in education resulted in surface implementations of reforms since schools did not have the capacity to implement such reforms. Even with the introduction of accountability schemes in the 1980s, the stagnant status of large-scale reform efforts persisted. Potter, Reynolds and Chapman (2002) described reform initiatives during the 1970s and 1980s as "free floating" as they did not represent a systematic and coherent approach to school change. (Fullan, 2005, 2009)

Despite many previous efforts at large-scale reform, little progress was made until its re-emergence in the mid to late 1990s. Fullan (2005, 2009) called this time the "change capacity era" where the need for transforming individuals and systems into those that can effectively adapt to external changes became acknowledged. From 1996 to 2002, school reform efforts attempted to draw on lessons from previous attempts at school improvement (Potter et al., 2002). Nevertheless, the field still lacked "explicit strategic action" for whole-system reform. It was not until after 2002 that work in the field became more action-oriented and analytical. (Fullan, 2005, 2009)

Why put all this emphasis on school improvement? Nowadays, educational systems are expected to produce citizens who can survive in and contribute to a global society (Fullan, 2009). According to Fullan (1993), education has a moral purpose "to make a difference in the lives of students regardless of background, and to help produce citizens who can live and work productively in increasingly dynamically complex societies" (p. 4). In addition, educational standards have risen due to increases in international competition (Hargreaves & Hopkins, 1994). This, in turn, has made teachers, in specific, and schools, in general, more accountable for enhancing student achievement (Hargreaves & Hopkins, 1994). Therefore, there is a need for a paradigm shift in how school organizations operate (Dalin, Rolff & Kleekamp, 1993) – one that digresses from the status quo of traditional schools to one that develops schools capable of adapting to the ever changing needs of society (Fullan, 1993).

Fullan (1993) argues that the answer to more effective school improvement does not lie in better reform strategies, but rather in adopting a new mindset of change. This mindset entails transforming educational systems into learning organizations that are capable of dealing with change as a way of life rather than as a response to transient reforms (Dalin et al., 1993; Fullan, 1993). In fact, Hopkins, Ainscow and West (1994) defined school improvement as a "strategy for educational change that enhances student outcomes as well as strengthening the school's capacity for managing change" (p.3). Similarly, in the OECD sponsored International School Improvement Project (ISIP), school improvement was defined as:

> a systematic sustained effort aimed at change in learning conditions and other internal
> related conditions in one or more schools, with the ultimate aim of accomplishing
> educational goals more effectively. (Van Velzen et al., 1985, p.48)

These definitions emphasize two aspects central to school improvement: enhancing student achievement and developing internal school conditions that support this achievement.

27

The latter requires making changes to teaching approaches and the school curriculum and, more importantly, enhancing the organization's capacity to support that change. In this sense, school improvement focuses on both process and outcomes. It is this emphasis on the change process and school culture (Hopkins, 1994) that sets current school improvement approaches apart from previous initiatives which generally ignored the influence of local practices, beliefs and norms (McLaughlin, 1990). (Hopkins, 1994)

**Basic Assumptions of School Improvement Approaches**

In order to understand the basis of school improvement strategies, it is first necessary to discuss the underlying assumptions of school improvement approaches. A number of researchers (e.g. Dalin et al., 1993; Fullan, 1993; Hargreaves & Hopkins, 1991; Hopkins, 1994) agree that there are several basic assumptions that characterize approaches to school improvement. First, school improvement approaches are *action and developmentally oriented*. Change is a process - not an event - that may take up to several years (Dalin et al., 1993; Fullan, 1993, Fullan, 2007; Hopkins, 1994). Also, the school is a complex system that is influenced by a wide array of mutually interdependent external and internal variables (Dalin et al., 1993). As a result, the journey towards school improvement inexorably brings about unexpected changes (Fullan, 1993) especially during the initial phase of change which is usually characterized by ambiguity and anxiety (Fullan, 1985). As such, there is no single recipe for successful school improvement; rather, it is an evolutionary process in which planning and implementation occur simultaneously (Dalin et al., 1993; Fullan, 1985, 1993).

The second assumption is that in school improvement the *school is the unit of change*. Regardless of whether change efforts are spurred by external policies or internal needs, ultimately these efforts materialize in the school itself (Dalin et al., 1993). It is in individual

schools that change will be carried out and that the impact of change will be manifested (Dalin et al., 1993). Each school is a separate entity and cannot be treated with the same "ready-made" solutions (Dalin et al., 1993; Harris, 2000; Hopkins, 1994). The key to change is capacity building (Fullan, 2007; Hopkins, 1995) which, in turn, involves cultivating the "internal conditions" of the school - such as organizational structures, teaching and learning activities, resources, policies and procedures - to support change (Hargeaves & Hopkins, 1997; Hopkins, 1994).

Intimately tied with the school as the unit of change is the third assumption of school improvement, which is the *emphasis on school culture* (Dalin et al., 1993; Hopkins, 1994). It is almost impossible to make significant changes in education without changing the culture of the school organization (Fullan, 2007; Hopkins, 1994; Hopkins & Harris, 1997). Thus, it is important to consider how the changes will affect the mores of the school and vice versa (Dalin et al., 1993). Ultimately, an emphasis on culture ensures that the skills and understandings acquired by change become an integral part of the daily life of all school members (Hopkins, 1994).

The fourth assumption is that school improvement approaches *adopt a multi-level perspective*. Improving schools requires making changes at various levels of the organization, including the school level, the classroom level and the individual level (Harris, 2000). Educational systems are also influenced by external variables so collaboration with parents and other members of the community, including other schools, is essential (Dalin et al., 1993; Harris, 2000). Fullan (1993) maintains that making connections with the wider environment is necessary for creating better learning organizations especially since, as previously argued, schools play an active role in contributing to the larger society.

The fifth assumption of school improvement approaches is that they *integrate both "bottom-up" and "top-down" strategies* (Fullan, 1993, 2007; Hopkins, 1994). On the one hand, centralization provides a framework for policy aims, overall strategy and operational plans (Hopkins, 1994); however, too much of it leads to overcontrol (Fullan, 1993). On the other hand, decentralization involves local diagnosis, goal setting and implementation and broadens the view of decision-making (Hopkins, 1994); however, in extremes, decentralization leads to chaos (Fullan, 1993). Consequently, finding a reciprocal relationship between centralization and decentralization is crucial for striking a balance between pressure and support (Fullan, 1993; Harris & Young, 2000).

Finally, the sixth assumption of school improvement is that it ultimately aims to *achieve educational goals more effectively*. Educational goals are not only restricted to student achievement but may also include, for example, student developmental needs, teacher professional development and community needs (Hopkins, 1994). These goals are achieved more effectively by strengthening the problem solving capacity of the whole organization (Dalin et al., 1993) and by creating "relatively autonomous" schools (Hopkins, 1994). According to Fullan (1993), this requires each and every member of the organization to become an influential change agent, which he defines as:

> being self-conscious about the nature of change and the change process. Those skilled in change are appreciative of its semi-unpredictable and volatile character, and they are explicitly concerned with the pursuit of ideas and competencies for coping with and influencing more and more aspects of the process toward some desired set of ends. They are open, moreover, to discovering new ends as the journey unfolds. (p.12)

**The Process of Educational Change**

Researchers (e.g. Berman & McLaughlin, 1976; Fullan, 2007; Huberman & Miles, 1984) have described the process of educational change as occurring in three phases: initiation, implementation and institutionalization/incorporation. Each phase involves different activities and decisions and different roles of significant actors (Berman & McLaughlin, 1976; Fullan, 2007). Fullan (2007) asserts that change is a non-linear process such that events and outcomes in one stage provide feedback for previous stages. In addition, the boundaries between one phase and the other and the time frame of each phase are blurry and arbitrary (Fullan, 2007). In the sections that follow a description of each of these phases along with the major factors influencing each phase is briefly discussed.

**Phase One: Initiation**

The initiation stage consists of the process of deciding on making or adopting a particular change (Fullan, 2007), beginning to conceive a plan for this change (Berman & McLaughlin, 1976) and developing commitments to the process (Huberman & Miles, 1984). The initiation phase directly impacts the success of later phases (Fullan, 2007) and is the key for institutionalization to occur (Berman & McLaughlin, 1976). Fullan (2007) identified eight main variables from the literature that provide the impetus for change: existence and quality of innovations or ideas; access to innovations; advocacy from central administrators and/or school principals; teacher advocacy; external change agents in regional, state or national roles; community pressure/support/apathy; new policy and funds; and problem-solving or opportunistic motivational orientations. Change is brought on by an interaction of a combination of these sources and can range from a simple idea at the school level to a broad-mandate (Berman & McLaughlin, 1976; Fullan, 2007). Despite the influence of many external factors, local factors

have precedence on the implementation and institutionalization of change (Berman &
McLaughlin, 1976; McLaughlin, 1990).

**Phase Two: Implementation**

The implementation phase is the process of transitioning from the initially conceived plan
to executing the activities in practice (Berman & McLaughlin, 1976; Fullan, 2007). The quality
of the process of implementation is significant (Fullan, 2007; McLaughlin, 1990) since it is
during this phase when schools begin to acquire the skills and understandings of the change
process (Huberman & Miles, 1984). As Fullan (1985) stated, "the most fundamental
breakthrough during implementation occurs when people can cognitively understand the
underlying conception and rationale with respect to "why this new way works better"" (p. 396).
It is important to bear in mind that implementation is an organizational process (Berman &
McLaughlin, 1976) influenced by a system of overlapping variables (Fullan, 2007). Hence,
implementation requires much more than a mere step-by-step realization of a plan (Fullan,
1993). The initial plan must be adapted to fit the shifting needs of the school and at the same
time individuals need to adapt to the change itself (Berman & McLaughlin, 1976).

According to Fullan (2007), there are nine factors that influence implementation and they
can be divided into three major categories: those relating to the characteristics of change, those
relating to the local context and those relating to the external context. More positive outcomes
are ensured when the biggest number of these factors supports implementation (Fullan, 2007).

**Factors related to the characteristics of change**. Need, clarity, complexity and
quality/practicality are four characteristics inherent to change that may influence
implementation. First, whether or not the change addresses local needs or priorities is an
important determinant of the success of implementation (Berman & McLaughlin, 1976)

32

especially during the early phases (Huberman & Miles, 1984). Individuals, especially teachers, tend to be more motivated and committed when the change meets a professional or personal need (Hargreaves & Hopkins, 1991). Second is the issue of how clear the goals and means for change are. Precise goals are often not clear at the beginning but become clearer throughout the process of implementation (Fullan, 1993). In addition, flexibility in goals and means is necessary to efficiently cope with unexpected problems (Berman & McLaughlin, 1976). Hence, although having a relatively clear goal to achieve is necessary, it is important not to oversimplify the goal for change by attempting to apply a set of prescribed solutions (Fullan, 2007). Third, the complexity of change refers to the difficulty and extent of the change required of the individuals carrying out the implementation (Fullan, 2007). For instance, McLaughlin (1990) found that ambitious, yet reasonable, efforts were needed to stimulate and sustain involvement and interest from teachers and administrators. Finally, the quality and practicality of the proposed change is important in determining whether or not the change is implementable specifically with regard to availability of resources, budget, materials and other practical considerations (Fullan, 2007).

**Factors related to the local context.** The implementation of change is influenced by four local factors: the school district, the community, principals and teachers. School districts that have had positive experiences with innovation and change are more likely to be open to new changes. Furthermore, district administrators have a significant role in understanding and managing the set of factors influencing the change processes. As for the role of the community, all successful schools have indicated the importance of parental and community involvement in promoting student learning. Moreover, principal involvement, or lack thereof, has a significant impact on the outcomes of change. More specifically, effective schools are those have principals playing an active and supportive role in the change process. Finally, Fullan (2007) indicated that

33

both individual teacher characteristics and collective factors influence implementation outcomes. On the one hand, the psychological state of teachers such as personality and readiness for change influences their willingness to participate in change. However, this state can be changed with an appropriate climate of positive interaction and collaboration. (Fullan, 2007)

**Factors related to the external context.** External factors include those found in the context of the broader society. These factors vary from one country to another but typically include government agencies such as the ministry of education and nongovernment agencies such as universities. External agencies are sources of initiation of reform; however, they do not necessarily lead to implementation. This is due to a major gap between the world of policy and the local context in which there is often miscommunication and misinterpretation about goals, roles and expectations. (Fullan, 2007)

**Phase Three: Institutionalization**

Institutionalization or incorporation is the third and final phase of the educational change process where one of two fates may occur: either the change becomes an ongoing and integral part of the organization's routine and patterns of behavior (Berman & McLaughlin, 1976; Fullan, 2007; Huberman & Miles, 1984) or the change gradually disappears whether intentionally or unintentionally (Fullan, 2007). Institutionalization depends on whether or not the change: gets embedded or built into existing practices and school structure; generates a critical mass of administrators and teachers who are skilled in and committed to the change; and establishes procedures for continuing assistance, specifically in terms of supporting new teachers and leaders (Berman & McLaughlin, 1976; Fullan, 1985; Huberman & Miles, 1984).

## Principles for Effective School Improvement

Successful school improvement depends on the contingencies of local contexts (Berman & McLaughlin, 1976; Earl & Lee, 2000; Fullan, 2007; Hopkins, 1994). Moreover, as was evident from the previous discussion, a multitude of factors affects the outcomes of school improvement. It is this complexity and intractability of the change process that makes it difficult to identify specific strategies for going about change (Fullan, 1993). However, several researchers have reflected on successful and unsuccessful school improvement efforts and accordingly derived general principles or guidelines for effective school improvement (e.g., Berman & McLaughlin, 1976; Earl & Lee, 2000; Guhn, 2009; Harris, 2000; Harris & Young, 2000; Hopkins, 1995; McLaughlin, 1990). Fullan (2007) warns that these findings should not be used as a "blueprint for action" (Harris, 2000) but rather as tools to guide practitioners in planning, implementing and monitoring change.

### Conducting a "Critical Assessment" of the School

For successful school improvement to occur, establishing context specificity is imperative during the initiation phase of change (Hopkins, 1995; Rutherford, 2007). This requires a "critical assessment" of the context (Fullan, 2007) by carrying out a school-wide audit (Hargreaves & Hopkins, 1991) for the purpose of exploring the contextual variables that may influence the change process as well as the organization's capacity and level of commitment to change (Rutherford, 2007). According to Hargreaves and Hopkins (1991), the ultimate goal of a school-wide audit is to compare where the organization currently is to where it strives to go. Together, the information gathered during the school assessment provides a basis for choosing potential planning priorities (Hargreaves & Hopkins, 1991; Hopkins, 1995).

Carrying out a school audit entails taking a comprehensive account of the influence of external factors such as political, economic and social forces and internal factors such as the organization's strengths and weaknesses (Bryson as cited in Rutherford, 2007; Hargreaves & Hopkins, 1991). Assessing the internal school context requires digging beyond specific organizational variables and into the organization's dynamics (Rutherford, 2007) such as leadership and relational factors (Hopkins, 1995). In addition, Hargreaves and Hopkins (1991) argue that a constant revision of the school's management arrangements, namely frameworks, roles and responsibilities, and collaborative structures, is necessary for planning successful change. These arrangements are responsible for transforming the school culture into one that supports school improvement (Hargreaves & Hopkins, 1994).

Another important aspect of context assessment is an examination of the organization's capacity to change (Rutherford, 2007). This, in turn, includes an understanding of: the proposed change (Rutherford, 2007), the need for change (Guhn, 2009) and the change process itself (Fullan, 1993; 2007). Determining organizational capacity also requires exploring the organization's readiness to change (Rutherford, 2007). Although this is a difficult task, ideally, readiness is when "open communication is common, cooperation is accepted, school leadership accepts change and innovation, staff knows where they want to go and have successful experiences in the change process" (Dalin et al., 1993, p. 49). Hargreaves and Hopkins (1991) warn that there must be a balance in determining readiness because starting too soon leads to failure and waiting for ideal conditions leads to stagnancy.

Closely tied to the organization's capacity to change, is the organization's level of commitment toward the change process which involves both the emotional desire to change and the feasibility of implementation (Fullan, 1997; Rutherford, 2007). The emotional desire to

change is relates to the need for the change and the rationale behind the change (Rutherford, 2007). For instance, McLaughlin (1990) found that schools tended to have one of two motivational orientations: opportunistic or problem solving. Schools of the opportunistic motivation type tended to view school improvement as a result of mandatory federal policies and therefore were less interested and committed to change; consequently, little improvement occurred. Alternatively, schools with a problem-solving orientation viewed federal policies as a means to support locally identified needs and were therefore associated with stronger commitment. Developing a critical mass of support and commitment is more likely to lead to successful implementation (Berman & McLaughlin, 1976). However, trying to get everyone on board at the beginning is fruitless since ownership is a process that evolves as implementation proceeds (Fullan, 1993).

Two final points are worth noting about the assessment of the school context. First, Hargreaves and Hopkins (1991) argue that since carrying out a full audit may not be feasible, it is more efficient to focus on small-scaled audits in major areas of the school. Second, since successful school improvement requires a change at the level of the whole school, it is important to involve all stakeholders in diagnosing, identifying and defining the issues for the change effort (Rutherford, 2007). Hargreaves and Hopkins (1991) further suggest clarifying the roles that each participant will carry out during the auditing process.

**Establishing a Shared Vision**

Effective school improvement is characterized by a shared school vision among all the significant stakeholders (Fullan, 1993; Harris, 2000). This vision needs to be shared and regularly reconfirmed throughout the course of the change process (Harris, 2000). The absence of a clear vision has been shown to lead to confusion, demoralization and failure (Harris, 2000).

Despite the importance of establishing a shared vision, this does not come at the very beginning of the planning process as Fullan (1993) asserts:

> Visions come later for two reasons. First, under conditions of dynamic complexity one needs a good deal of reflective experience before one can form a plausible vision. Vision emerges from, more than precedes, action. Second, a *shared* vision, which is essential for success, must evolve through the dynamic interaction of organizational members and leaders. This takes time and will not succeed unless the vision-building process is open-ended. (p.28)

Since school improvement is a school-wide effort, in establishing a clear vision, it is important to consider the needs of the organization as a whole; individual needs should be looked upon in relation to organizational needs (Dalin et al., 1993). In an analysis of Bruce Joyce's work, Hopkins (1994) realized that there were five main "doors to school improvement" that schools generally take: collegiality (developing professional and cohesive relationships within and outside the school); research (using research findings on effective school practices or alternative instructional activities); site specific information (collecting and analyzing data about student progress); curriculum initiatives (changes within or across subject areas); and instructional initiatives (studying teaching skills and strategies). Hopkins (1994) further adds that a change in the school's culture requires a synthesis of these five different elements. In the end, school improvement efforts should strive toward achieving a vision in which all members of the school community become both learners and contributors (Hopkins & Harris, 1997).

Establishing a shared vision facilitate the identification of goals and priorities for the improvement effort (Hargreaves & Hopkins, 1991). Identifying the specific needs to be addressed can be a challenge since these needs are not static; they change as schools learn more about their organization and the nature of the change process (Dalin et al., 1993). Thus, it is

38

important that the needs are flexible and open for modification (Dalin et al., 1993) and that decision-making and implementation occur concomitantly (Hopkins, 1994). Hargreaves and Hopkins (1991) also emphasize the importance of prioritizing since it is not realistic to tackle everything at the same time. Too much change can cause overload and stagnancy (Hopkins, 1994) since it makes teachers feel overwhelmed which, in turn, leads to poor management (Hargreaves & Hopkins, 1991). Therefore, these researchers suggest identifying priorities that need to be dealt with immediately during the first year (no more than 3 or 4) and long-term priorities that can be postponed for the coming years (these are briefly outlined). Deciding on the priorities should be guided by two main principles: manageability (doing too much too quickly) and coherence (logical sequenced). In cases where the change is initiated by external forces, "consonance" should be taken into consideration, i.e. the extent to which internally identified priorities coincide or overlap with external pressures for reform (Hopkins, 1995). Also, when selecting priorities, it is important to take into account the context assessment and perspectives from everyone (Hargreaves & Hopkins, 1991).

**Focusing on Specific Student Outcomes**

A focus on achieving specific student outcomes is the main feature of highly effective school improvement programs (Harris, 2000). Therefore, it is important to focus on specific learning goals or outcomes rather than broad aims such as "improve exam results" (Harris, 2000; Harris & Young, 2000; Hopkins, 1995; Hopkins & Harris, 1997). Hopkins (1995) found that schools that were more successful at managing school improvement were those that began with specific student learning goals. It is important to note that learning need not be strictly academic. For instance, successful schools have been found to attend to enhancing student self-esteem or promoting problem-solving and teamwork skills (Earl & Lee, 2000).

**Differentiating School Improvement Strategies**

When deciding on specific strategies for improvement, schools can choose to get an external perspective, use an existing model or design their own approach (Hargreaves & Hopkins, 1991). Regardless of which strategies are chosen, the school must bear in mind the findings of the local assessment. There is no universally correct starting point because the effectiveness of strategies depends on where the school currently is in terms of the change process (Harris, 2000; Hopkins, 1995). McLaughlin's (1990) research indicated that locally selected implementation strategies dominated the outcomes of federally supported change agent projects. Nevertheless, in case ready-made school improvement programs are chosen, schools should select the program that most closely matches their individual needs (Harris, 2000).

**Developing a Plan**

In order to monitor implementation and evaluate progress, it is necessary to write up an action plan which consists of the following elements: 1) targets or concrete objectives for each of the previously identified priorities; 2) tasks that lead to the target; 3) success criteria and performance indicators; 4) time frame; 5) fixed meetings; and 6) resource allocation (Hargreaves & Hopkins, 1991). Fullan (1985, 2007) advises that the plan be developed in line with the basic assumptions and principles of school improvement and with an understanding of the change process and the factors that influence it. Fullan (1985) claims that formulating a plan does not occur within a set point in time. Furthermore, despite the importance of planning, the time between implementing action and planning should be minimized (Fullan, 2007). Fullan (2007) endorses the "ready-aim-fire" mindset meaning that once key problems and conditions are established, it is necessary to immediately go into action since the change process involves ambiguity and ambivalence that can only be clarified through reflective practice.

Hopkins (1995) asserts that there are two important aspects to consider for planning. The first is to distinguish between strategies - a framework for problem-solving - and tactics (specific operational activities to put the strategy into effect). The second aspect of planning is to differentiate between development activities and maintenance activities (Hargreaves & Hopkins, 1994; Hopkins, 1995) in order to ensure that a balance between change and stability is maintained (Hargreaves & Hopkins, 1991).

**Adopting an Extended View of Leadership**

Adopting an extended view of leadership has two implications in school improvement: redefining the roles of those in formal leadership positions (mainly the school principal) as well as promoting informal leadership roles.

A few researchers (e.g. Berman & McLaughlin, 1976; Hargreaves & Hopkins, 1991; Harris & Young, 2000) have indicated that the quality of school leaders (principals) is the most important factor for successful implementation of school improvement. The significant role of the school principal can probably be attributed to their administrative position which gives them the power to determine the fate of change and puts them in a position to be positive role models for change (Guhn, 2009). According to Fullan (2001), positive change requires five mutually reinforcing elements of leadership: 1) having a moral purpose in which the ultimate aim is to make a positive difference in the lives of students through certain means; 2) understanding the complexities involved in the change process; 3) building relationships with diverse groups of people and engaging in purposeful interaction; 4) fostering knowledge building; and 5) making coherent sense of the emerging patterns of the changing culture. Fullan (2001) further adds that these five elements need to be done with energy, enthusiasm and hope in order for effective leadership to occur. "The litmus test of all leadership is whether it mobilizes people's

commitment to putting their energy into actions designed to improve things" (Fullan, 2001, p.9).

On a similar note, Hargreaves and Hopkins (1991) posit that effective leaders of change are those

that:

> inspire commitment, coordinate the work of the school, are actively and visibly involved in
>
> planning and implementation, know how to listen and respond positively, are skilled
>
> communicators, have the capacity to stand back from daily life, care passionately for the school,
>
> emphasize the quality of teaching and learning and have high expectations, are enthusiastic about
>
> innovation, and keep paperwork to a minimum. (p. 20)

Although administrators have an important role in school improvement, they are not

sufficient to make it happen (Earl & Lee, 2000; Harris & Young, 2000). School improvement

efforts should adopt a novel view of leadership in which teachers and managers are both viewed

as leaders and decision-makers (Hargreaves & Hopkins, 1991; Harris, 2000; Harris & Young,

2000). In their analysis of the schools involved in the Manitoba School Improvement Program,

Earl and Lee (2000) found that successful schools were those that involved informal and formal

leadership roles whereby teachers, other staff members and even students were encouraged to

assume leadership roles. Similarly, Guhn's (2009) study indicated that when many people were

involved in decision-making, the resistance to change was reduced during the beginning stages

of school improvement. However, this does not mean that everyone is in charge but merely that

everyone has a sense of ownership (Earl and Lee, 2000) and empowerment (Hargreaves &

Hopkins, 1991).

**Conducting Formative Evaluation**

Formative evaluation is an integral component during the implementation of school

improvement as it provides the feedback needed to adjust practice and to maintain efforts

directed toward program goals (Guhn, 2009; Harris, 2000; Hopkins & Harris, 1997). Lack of

regular evaluation and assessment has been found to be associated with poor implementation quality and fidelity (Guhn, 2009). Consequently, it is necessary for all staff members to monitor and evaluate the impact of change regularly rather than rely on post hoc evaluation (Harris & Young, 2000; Hopkins & Harris, 1997; McLaughlin, 1990). Both quantitative and qualitative data should be collected for evaluating classroom and school processes and outcomes (Hargreaves & Hopkins, 1991; Potter et al., 2002). Fullan (1985) suggests addressing three strategic tasks for data collection: 1) the type of information to be collected (state of implementation, factors affecting implementation, outcomes); 2) the degree of formality (surveys, interviews) or informality (peer interactions); and 3) and the use of the information.

The collection and analysis of data as part of the daily routine of school staff members has been shown to have a positive impact on the quality of teaching and learning (Hopkins & Harris, 1997). This may be due to the fact that the process of formative evaluation requires inquiry and reflection which both create the energy and momentum for further development (Harris & Young, 2000; Hopkins & Harris, 1997). Evaluation is in reality a tool for learning and growing at the individual and organizational level (Dalin et al., 1993). According to Earl and Lee (2000), the process of collecting and analyzing data over extended periods of time lead to the acquisition of inquiry and reflection skills in which staff members became actively involved in collecting and interpreting data and using their interpretations to make informed decisions about modify their plans or practices. In the end, engaging in inquiry and reflection enhances the school's capacity for change (Earl & Lee, 2000).

**Engaging in Ongoing Staff Development**

A number of studies have indicated that staff development or training is an essential component of successful school improvement (e.g., Berman & McLaughlin, 1976; Fullan, 1985;

Guhn 2009; Harris & Young, 2000). Staff training plays an important role in helping to overcome the resistance to change by allowing school members to feel more comfortable with handling change (Guhn, 2009). High quality training promotes competence (Dalin et al., 1993; Guhn, 2009) and commitment (Fullan, 2007; Harris & Young, 2000) and ensures that techniques and procedures are uniformly implemented (Harris, 2000). Moreover, staff development is a means for fostering a collaborative work culture (discussed in the next section) since it encourages open dialogue (Dalin et al., 1993) whereby a common language and purpose is shared, different problems and solutions are discussed and staff members have the chance to exchange experiences (Guhn, 2009).

Research findings suggest several guidelines for carrying out effective training. First, training is most beneficial when it is explicitly aligned with and responds to the aims of the change effort (Berman & McLaughlin, 1976; Earl & Lee, 2000) specifically in terms of needs assessment, process, outcome goals and formative evaluation (Guhn, 2009). Second, it is more effective to use a variety of training methods which include both event training (workshops, seminars, professional development days) and ongoing assistance (one-to-one discussions) (Fullan, 1985). Third, the staff's responsiveness to training depends on the type of training given and who is giving the training. For instance, it has been shown that teachers preferred experiential workshops given by experienced local personnel rather than lecture-type workshops given by outside technical assistants (Berman & McLaughlin, 1976). Fourth, training by itself is not sufficient to cause effective change; those undergoing the training should be given ample opportunity to apply what they have learned (Fullan, 1985). Fifth, individuals usually express anxiety and confusion at the beginning stages of change and, as a result, should be given as much assistance as possible during this time (Fullan, 1985). For instance, Earl and Lee (2000) found

that continuous provision of workshops about evaluation of evidence enhanced the staff's inquiry and reflection skills with time, which in turn had a positive effect on school improvement. Sixth, training may be provided by program facilitators, collaborating universities or community service partners (Guhn, 2009) or by the teachers themselves through professional learning communities inside or outside the school (discussed in the next section) (Harris & Young, 2000).

Finally, it is worth noting that staff development should involve all those that are part of the implementation process. Teacher training that involves specific teaching skills as well as curriculum content (Hopkins, 1994; Hopkins & Harris, 1997) is necessary since student learning is intimately tied to teaching practices (Hopkins & Harris, 1997). Successful schools are those in which teachers discuss teaching since it empowers practice (Hopkins and Harris, 1997) and enhances teachers' professional judgment (Hargreaves & Hopkins, 1991). The significant role of principals in supporting school improvement was emphasized earlier. Consequently, another aspect of staff development is principal training which is necessary to enhance their capacity as school improvement leaders (Fullan, 1985). By also attending the teacher training, principals can become more supportive of their teachers by gaining better insight into teaching practices and pedagogy and curriculum content (Berman & McLaughlin, 1976). Finally, Guhn (2009) adds that sometimes parents or even students may need training if implementation is to be carried out appropriately.

**Establishing a Collaborative Work Culture**

Schools should seek to develop structures and conditions that encourage collaboration (Hopkins & Harris, 1997) since the latter is an essential condition for school improvement and staff development (Hopkins, 1994). It is unreasonable to expect everyone to accept change so it is more important to create conditions that will increase the number of supporters (Fullan, 2007).

Successful relationship building requires time and frequent opportunities of interaction in a positive environment that is characterized by openness, trust and respect (Fullan, 1993; Guhn, 2009). One method of collaboration is to form professional learning communities. Kruse, Louis and Bryk (as cited in Fullan, 2007) mentioned five elements critical for effective learning communities: reflective dialogue, deprivatization of practice, collective focus on student learning, collaboration and shared norms and values. Fullan (2007) further adds that these elements require specific structural conditions such as time, space and communication structures as well as "social and human" conditions including a culture characterized by openness, trust, respect, cognitive skill base and supportive leadership.

Since multiple perspectives and realities are brought together during collaboration, conflict and disagreement become inevitable (Fullan, 1993, 2007). However, conflicts are fundamental to successful change (Fullan, 2007) as they provide an opportunity for learning by provoking new insight and providing a chance for clarifying issues, tackling unresolved problems and listening to and understanding different points of view (Dalin et al., 1993; Fullan, 1993). As such, conflicts should not be seen as opportunities to point fingers or impose points of view (Fullan, 1993). In addition, avoiding conflict leads to frustration and low productivity (Dalin et al., 1993) while learning to cope with problems enhances problem solving in complex situations and helps in coming up with creative solutions (Fullan, 1993).

Another issue to consider with collaboration is finding equilibrium between individualism and collectivism. It has already been argued that collaboration is important for school improvement. Albeit, in extremes, collaboration may lead to "groupthink" which is a "uncritical conformity to the group" whether it is to do the wrong thing or the right thing. The capacity to think and work independently is in fact crucial for successful school improvement.

This can be attained by encouraging personal reflection and inquiry and respecting personal

visions and opinions. (Fullan, 1993)

**Drawing on Lessons from Research and Theory**

Harris (2000) suggests that, at a practical level, findings from school effectiveness

research can provide useful insight for school improvement efforts. Hopkins and Harris (1997)

also recommend the use of theory, research and practice for formulating strategies based on

sound rationales.

**Building Community and University Partnerships**

Building productive partnerships between schools and universities can be difficult due to

their cultural, social and professional differences (Goldenberg, 2004; Fullan, 1993). In these

partnerships it is often difficult to determine who has the power and control (Goldenberg, 2004).

It is for these reasons that school-university relationships tend to be characterized by hostility

and mistrust (Goldenberg, 2004; Fullan, 1993). Nonetheless, research (e.g., Guhn, 2009;

Hopkins, 1995) has revealed that positive functional support provided by community and

university partnerships facilitates school improvement. Through his work on a school

improvement project that aimed to promote literacy achievement in Latino students in an

elementary school, Goldenberg (2004), a university professor, described four necessary

conditions for successful school-university partnerships: 1) inclination, time and opportunity for

the researcher to commit to a long-term project; 2) agreement on the basic goals of the project

from both the researchers and the practitioners; 3) use of a productive change model; and 4)

regular collaborations in stable settings for the purpose of accomplishing specific tasks. Another

important partnership to build is with other members of the community, especially parents.

Fullan (2007) claims that parental involvement is imperative for promoting student achievement

since parents know their children best and are fully committed to helping them. However, parents often tend to be skeptical about collaborating with teachers. Therefore, Fullan (2007) advises that teachers and principals find ways to reach out to parents in an empathetic and non-threatening way.

**PART III: USING DESIGN-BASED RESEARCH FOR SCHOOL IMPROVEMENT**

As was discussed earlier, a couple of researchers (Harris, 2000; Hopkins & Harris, 1997) have suggested the use of research and theory to support practical implementations of school improvement strategies. In fact, Hopkins (1995) and Harris (2000) both argue that the field of school improvement lacks the use of systematic methods for collecting data and for empirically testing the link between theory and practice in a natural setting. Hopkins (1995) also adds that the school improvement field needs to generate theories about how schools undergoing improvement develop in terms of structural and cultural adaptations. Given the contextual, process-oriented and theory-generating nature of design-based research, it can be argued that its use may prove valuable for the field school improvement. In fact, the DBRC (2003) claims that design-based research has the potential to increase human capacity for educational innovation. However, research that uses design-based research methodology for school improvement is almost nonexistent. Only a handful of studies have used design-based research to deal with one particular aspect of school improvement. A summary of these studies is provided below: two of the studies deal with teacher development while two of them deal with leadership preparation.

Walker, Recker, Robertshaw, Olsen, Leary and Sellers (2011) aimed to test the use of a teacher professional development method that combined integrating technology in the classroom and designing problem-based learning (PBL) activities using that technology. The researchers reported two implementation cycles. Data collected from the first phase indicated that teachers

found learning about technology skills and PBL skills concurrently was too difficult. Using this information and drawing on professional development theory, a second cycle of implementation was conducted in which technology skills were taught prior to PBL skills. The findings of this study indicated that teachers gained significant knowledge and confidence in technology integration in their classrooms.

In another study, Onguko (2013) aimed to determine the effectiveness of JiFUNzeni, a blended learning approach that combines the use of technology and face-to-face instruction, as a means for professional development of teachers working in challenging educational contexts. Using design-based research methodology, the approach was field tested for one year. The study revealed several findings. First, providing teachers with professional development in the context of their own schools and classrooms was associated with longevity in terms of applying what they had learned in their own classrooms. In addition, teachers who transferred their knowledge of the approach by providing professional development to other teachers found it easier to use blended learning in their own classrooms. The researcher also claimed that this provided teachers in a challenging educational context with a sense of empowerment. Finally, Onguko (2013) emphasizes the importance of taking contextual considerations into account when it comes to professional development needs. For instance, he found that teachers in some geographic areas were more in need of professional development on teaching large class sizes while in other areas they required professional development on assessment.

Myran, Sanzo and Clayton (2011) and Sanzo, Myran and Clayton (2011) reported on a first year account of the implementation of a university leadership program in partnership with a school district. Based on a design-based research methodology, they found that embedding leadership preparation in practice had a substantial influence on allowing students to experience

the relationship between theory and practice within an authentic context. These authentic experiences provided students with a realistic perspective of the requirements and challenges of educational leadership positions. For instance, students learned that the pressure of accountability and high stake testing are sometimes at the expense of building leadership capacity. The study also showed that the iterative nature of the research design, which required regular debriefing and follow-up sessions, helped cultivate positive relationships, enhance trust and engage in continuous improvement through reflective practice.

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