Continuance of an Interventional Change Management Project For Grade 4 Math Students- An Executive Position Paper (EPP)

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Dedication

This dissertation is dedicated to the people in my family who shared with me the sacrifices necessary to see it to completion. My wife, Kristin Eklund-Rorke, provided continuous support and unconditional love during my doctorate studies. My children, Kristofer and Olivia, provided unceasing love and inspiration (even when their father was less available than they would have preferred). My loving wife and children complete me and make me the person I want to be, though they accept me for who I am.

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ABSTRACT

The purpose of this executive position paper (EPP) is to inform the decision-making process of the school's planning council, persuade the decision-making body to favor continuance of a math intervention initiative and propose changes to the design, implementation and evaluation of the math intervention program. The proposed continuance of the interventional strategies program builds upon the initiatives of the years prior, while retaining a systems perspective of organizational change and outlining program evaluation guidelines to gauge the effects of the actions proposed. An overview (Section I), a justification for implementation (Section II), and recommendations aimed at eliminating or reducing the problem, while evaluating the change management (Section III) is presented as the past, present, and proposed future of the school as a dynamic, living organization involved in self-study and corrective action. An exploration of the literature related to the history and context of the problem, and information and analysis that guided the study, is provided including: federal policies that provide education funding for reform contingent upon scientifically-based, rigorously researched practices; Adequate Yearly Progress (AYP) as a requirement; organizational change management; systems theory and systems-thinking; distributed leadership; collaborative strategic planning; Accreditation For Growth (AFG) as change management; action research in education and the iterative approach. Multiple perspectives on the relevant data and inference to the best explanation are suggested as a decision-making logic. Recommendations include: (1) continued use of action research for ongoing, evidence-based interventional program implementation and organizational improvement; (2) insinuation of a quasi-experimental research design to test the effectiveness of the innovation; (3) systems-thinking to fully articulate with AFG implementation teams and related sub-committees; (4) employment of the Kotter change model to formatively evaluate the process and summatively determine the permanence of organizational change; and (5) on-going professional development to provide faculty with a systematic approach to action research and the intervention program. The action research-systems-thinking nexus has provided a coherent framework for school improvement thus far. Advancing the research design in the near term to a solid causal-comparative quasi-experimental design satisfies the organization's school improvement needs and federal standards of scientific research and evidence.

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Section I- Overview

Introduction

This executive position paper (EPP) promotes and supports the position that continuance (with modifications) of a math intervention initiative for fourth graders at Buckingham Elementary School (BES) will enable skill-specific, student-specific instruction, and consequent improvement (Shapiro, 2004) as measured by local assessment tools and the Maryland State Assessment (MSA). This study and program explication will contribute to the school organization by informing the decision-making process of the Buckingham Elementary School Planning Council (BES-PC), including the administration, and the math implementation team at BES through an overview (Section I), a justification for implementation (Section II), and recommendations aimed at eliminating or reducing the problem, while evaluating the change management (Section III).

Organizational Improvement Goal

There is a problem facing the school organization: Not all fourth grade math students have reached proficiency according to the Maryland State Assessment (MSA). The state test categorizes student performance as *Basic*, *Proficient*, or *Advanced*. A lack of proficiency, or representation in the *Basic* category, is an indication that not all students have reached *Proficient* as mandated by No Child Left Behind (NCLB), the Maryland State Department of Education (MSDE), and the

Worcester County Public Schools' (WCPS) Master Plan. In the near term, the school's improvement plan calls for this issue to be addressed through collaborative planning and implementation.

The most contemporary plan of implementation being deliberated is simply an informal reiteration of what went before. This organizational problem is further compounded by the need for continuous improvement as reflected in the summative school *report card* released yearly by the MSDE. In the long term, federal legislation mandates that all students meet or exceed proficiency in all areas by the year 2014. Hence, there is both tactical and strategic necessity for the organization to reduce, and ultimately eliminate, any Buckingham student representation in the *Basic* category of state assessment through a formal interventional change management plan with modifications to design and evaluation.

Position

An initiative using action research to carry out a program of interventional strategies for Grade 4 math students in the 2007 – 2008 school year at BES should be implemented. The interventional strategies program being proposed would build upon the action research initiatives of the years prior (2005 – 2006 and 2006 – 2007) and retain a systems perspective of organizational change, while outlining program evaluation guidelines to gauge the effects of the actions.

In the 2005-2006 school year a broad-based approach was taken to improve written expression in mathematics for Grades 2-4. In the 2006-2007 school year an action research team assembled to identify a problem, develop interventional

strategies (Lentz, Allen & Ehrhardt, 1996), then test the intervention based on an evolving set of objectives, in a "scientific method of problem solving" (McKernan, 1991, p. 16). It was determined that a change in approach was necessary to address individual learning needs. This action research team designed a more targeted approach for math intervention using a diagnostic tool (that was individualized on a per-pupil, as per student needs, basis by the team members) and a system of student progress monitoring. The change in approach was necessary to address the individual learning needs of students and to mitigate the sense of urgency established by way of the 2006 state assessment data for Grade 4 mathematics at Buckingham Elementary School. Comparing Grade 4 scores from 2006 to those of the year before, the *Basic* category (representing Grade 4 math students not meeting testing standards) increased by 7.4%, while the categories of *Proficient* and above decreased by the same amount. The problem of student representation in the *Basic* category persisted, so a more diagnostic and responsive approach was decided upon. The goal of the problem solving action research for the 2006-2007 school year was a reduction in the *Basic* category, specifically for grade four math students at Buckingham through an intervention program. Improvement for all students as measured by the MSA is paramount to the school organization, and so it was decided that decisions about the continuance of the interventional program should be based on MSA student achievement data.

The general goal of the project was overall performance improvement in Grade 4 math on the 2007 MSA. Performance improvement for individual students

was defined as upward movement from one state testing category to another (e.g., movement from the lowest category indicating need for remediation, *Basic* to *Proficient*; or movement from the *Proficient* category, indicating performance at grade level specified by the content standards, to *Advanced*, indicating above grade level performance).

More broadly, the action research team decided that if the bulk of the Grade 4 MSA scores showed categorical improvement while the remainder mostly showed maintenance, rather than regression, this program would be a success. The most specific goal of the problem solving action research project was a reduction in the *Basic* category, specifically for grade four math students at Buckingham. The action research team used the data-informing-instruction feedback loop to some apparent success.

The position of continuance with modifications is based upon, and informed by, considerations having to deal with federal, state and county compliance, sound organizational and educational decision-making, and measurable organizational value. More broadly, it is the position of this author the intervention program requires a systems-thinking, collaborative strategic planning perspective and action research problem solving approach to provide an action plan, progress monitoring and flexibility of the improvement plan proposed (in Section III).

Innovations to (1) rationale for continuance (i.e., analyses determining the impact of the 2006 – 2007 program), (2) research design (i.e., transitioning from the pre-experimental design of the most contemporary interventional program to a causal-

comparative design in the future), (3) the synthesis of organizational change principles and systems-thinking (i.e., school improvement as organizational change management underpinned by systems theory), and (4) action research methodology (i.e., a more comprehensive educational action research approach) make the proposed continuance with modifications markedly different from the interventional strategies program slated for implementation as is, should continuance be granted.

Explanation of Information and Analysis That Guided the Project

Educational practices are affected by education policy requirements. School improvement efforts are shaped ultimately by larger external influences, ranging from federal (Department of Education) to local (Board of Education) in scope. Relatively new policies that provide education funding for reform practice contingent upon scientifically-based, rigorous research have important consequences for educators (Slavin, 2003). Evidence is the force that drives change through decisions based upon the results of rigorous research. In education reform, Slavin contends rigorous research has played a relatively minor role:

> Untested innovations appear, are widely embraced, and then disappear as their unrealistic claims fail to materialize. We then replace them with equally untested innovations diametrically opposed in philosophy, in endless swings of the reform pendulum. (2003, p. 12)

Before education reform related to scientifically-based and rigorous research became policy, the Comprehensive School Reform Demonstration legislation of 1997 encouraged schools to adopt proven and comprehensive reform designs (United

States Department of Education, 1998). The office of Comprehensive School Reform came to define "proven" as being grounded in "scientifically-based research" (USDE, 2002a, p. 16; UDSE, 2002b) and "evidence of effectiveness" (USDE, 1998, p. 6; USDE, 2002b), which had already been defined as "proven methods to improve teaching and learning that are based on reliable research and effective practices that have been replicated successfully" (USDE, 1998). Furthermore, it was suggested that research-based models provide evidence along four dimensions:

> (1) theoretical or research foundation for the program; (2) evaluation-based evidence of improvements in student achievement; (3) Evidence of effective implementation; and (4) evidence of replicability (USDE, 1998, p. 6).

The Improving America's Schools Act of 1994 (P.L. 103-382), reauthorized the Elementary and Secondary Education Act of 1965.

Federally Mandated Scientifically-Based Research

The most recent reauthorization of the Elementary and Secondary Education Act emphasizes accountability for results, expanded parental options, local control, and reform based on scientific research. (NCLB, 2002). Title IX, Part A, Section 9101(37) of the No Child Left Behind Act defines scientifically-based research as research that "involves the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs" (2002) and includes research that:

> Employs systematic, empirical methods that draw on observation or experiment; involves rigorous data analyses that are adequate to test the stated

> hypotheses and justify the general conclusions drawn; relies on measurement or observational method that provide reliable and valid data across evaluators and observers, and across studies by the same or different investigators; is evaluated using experimental or quasi-experimental designs in which individuals, entities, programs, or activities are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest, with a preference for random-assignment experiments, or other designs to the extent that those designs contain within-condition or across-condition controls; ensures that experimental studies are presented in sufficient detail and clarity to allow for replication or, at a minimum, offer the opportunity to build systematically on their findings; and has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review (2002).

The No Child Left Behind Act mentions *scientifically-based research* more than 100 times in reference to school improvement programs (Slavin, 2003). This redundancy is an advertisement for a change in the culture of education to embrace school reform using scientific evidence on the effectiveness of educational programs. Making the connection that the changing of school culture is inextricably linked to education reform, the MSDE described NCLB thusly:

> The *No Child Left Behind Act of 2001 (No Child Left Behind)* is a landmark in education reform designed to improve student achievement and change the culture of America's schools (MSDE, 2003a, ¶ 1).

History and Context of the Problem

The publication of A Nation at Risk by the National Commission on Excellence in Education (1983) served as a stimulus for school reform across United States (Sergiovanni, Kelleher, McCarthy, & Wirt, 2004b). Public schools have used principles of systems change and collaborative strategic planning for school improvement (Cook & Friend, 1991). Federal legislation reauthorizing the Elementary and Secondary Education Act of 1965 led to changes in education policy.

Federal, State, and Local- Adequate Yearly Progress

Educational practices are still affected by education policy requirements. The most recent reauthorization of the Elementary and Secondary Education Act (USC 115, STAT. 1426), popularized as No Child Left Behind (NCLB, 2002), mandated that schools must provide a high quality education for all students. Most notably, the use of evidence-based practices and instruction by highly qualified teachers are some of the mandated changes. Evidence that a sound education is provided for all students must be demonstrated to the U.S. Department of Education through state agencies. Schools are required to establish timelines of current and forecasted benchmarks demonstrating that 100% of their students make *Adequate Yearly Progress* (AYP) in all academic subjects by 2013 – 2014 (NCLB, 2002; USDE, 2004; WCPS, 2003; WCPS, 2006), as measured by statewide achievement tests (NCLB, 2002; MSDE, 2002). The purpose of state assessments under NCLB is to provide an independent insight into school and student progress. The Maryland School

Assessment (MSA) "is a test of reading and math achievement that meets the testing requirements of the federal No Child Left Behind Act" (MSDE, 2003b, ¶ 1).

A shift from holding schools accountable for providing services, federal education policy now holds schools accountable for improving educational outcomes for all students with an emphasis on scientifically-based research and reform through improvement programs. This policy shift has made access to the body of research on effective educational practices (Shinn, Walker, & Stoner, 2002) and an understanding of the systems change principles needed to facilitate accommodation of educational practices in a specific schools' culture (Carnine, 1999) essential. The systems-change and school improvement model must accurately identify a problem (Bergan & Tombari, 1976; Zuber-Skerritt, 1996), then accommodate a fit between the implementation of the research-based practices and the realities of each school setting where implementation is sought (Fullan & Miles, 1992; Hall & Hord, 1987; Miles & Louis, 1986; Mintz & Yun, 1999; Hord, Rutherford, Huling-Austin & Hall, 1987).

Emphasizing the importance of research-based practices that work in real settings, Senge (1990) recognized the need to transition from strategies that work in a controlled experimental setting (inventions), to strategies that can be implemented effectively in different settings (innovations). Senge's distinction is furthered by Calhoun's (1994) description of innovations as "actions that faculty members identify - or create - from their experience and their study of the professional literature" (p. 94). Both descriptions of strategies that work in the form of innovations that are component parts of larger initiatives speak to the real need for teacher practices that

go beyond, but are based on, theory. Concerted action for directed organizational change is necessary for school improvement (Ahearn, 1998; Curtis & Stollar, 2002; Senge, Kleiner, Roberts, Ross & Smith, 1994). Furthermore, school improvement as educational change requires change management.

Organizational Change Management

For educational change to endure it is imperative that it be initiated, implemented, and sustained through institutionalizing the change (Argyris, 1982; Beckhard & Pritchard, 1992; Curry, 1992; Hall & Hord, 2001; Senge, 1990). This aspect of change management is a process of unfreezing and refreezing changes (Lewin, 1951) that can fix the innovation(s) in the organizational culture, or result in "anchoring new approaches in the culture" (Kotter, 1996, p. 145). The apparently linear Lewinian change-process insists upon the sequence of (1) unfreeze, (2) transition (changing or moving), then (3) refreeze; the last of which is reiterated as the final anchoring phase of Kotter's "Eight-Stage Process of Creating Major Change" (1996, p. 21). Kotter, a contemporary of Lewin, also discusses the importance of sequence, while allowing for the flexibility of operating in "multiple phases at once" (1996, p. 23). Kotter additionally warns that "simple, linear" change management projects for organizations "almost always fail" (1996, p. 25) because forced, mechanistic change is incompatible with dynamic problem solving. According to Hendry, who provides a nexus between Lewin's and Kotter's organizational development work with organizational learning theory:

> Scratch any account of creating and managing change and the idea that change is a three-stage process which necessarily begins with a process of unfreezing will not be far below the surface. Indeed it has been said that the whole theory of change is reducible to this one idea of Kurt Lewin's (1996, p. 624).

Schein's work (1996) suggests a contemporary understanding of Lewin's change process informed by cognitive restructuring; Schein considers the process in terms of a thinking organization engaged in the problem solving cycle seeking equilibrium in tension with group norms and organizational culture. The apparent linearity of the change model is mitigated by the complexities of an organization actually living the change process for problem solving and improvement.

Considering change from the perspective of organizational development, change is "a set of behavioral science-based theories, values, strategies, and techniques aimed at the planned change of the organizational work setting for the purpose of enhancing individual development and improving organizational performance, through the alteration of organizational members' on-the-job behaviors." (Porras & Robertson 1992, p. 723) Though improvement of the individual and organization are not guaranteed events, Lewin's concept of resistance to change in renewal efforts as developed by O'Toole (1995) shows the improvements are more likely when the change is incremental rather than radical, and developmentally appropriate to an organization's scale. The issues of resistance to change and scalability relate to the distinction articulated by Watzlawick, Weakland, and Fisch (1974) and Bateson (1972) as first-order change (continuous,

developmental and intentional) and second-order change (radical, episodic, and discontinuous, but still intentional). Large scale change, like that in an educational setting, requires continuous (evolving and cumulative) change for continuous (cyclical problem solving) improvement.

When an organization lives the cyclical problem solving process there is a promising potential for the development of a problem solving ethos that drives members of the organization to continually improve their performance, synergistically learning to solve problem after problem (Corey, 1953; Joyce 1991; Schaefer, 1967; Sirotnik, 1987). Organizational changes (i.e., initiatives and innovations) become evident at the structural level simultaneously with procedural changes (Fulmer, 1997), followed by cultural changes. The dynamic, living organization involved in self-study and corrective action can perceive the culmination of an initiative as either the termination point in the organization's life cycle of the change event (Cameron & Whetten, 1984) or the event horizon of a new iteration of the organization's action learning (Bray, Lee, Smith & Yorks, 2000; Calhoun, 1994).

The latter perspective is preferred for a systems-thinking action research approach to organizational sustainability, as much of the literature about organizational change and innovative organizations includes the concept of innovative organizations as learning organizations (Argyris 1982; Beckhard & Pritchard 1992; Senge, 1990). Even school renewal and improvement initiatives mandated by legislation can fail if the organization members who must implement them lack an understanding of, and a commitment to, the new procedures (Fullan,

1997; Fullan & Miles, 1992). A systems perspective for understanding the change initiative is integral to comprehending how it is interrelated with other aspects of the organization and its success (Curtis & Stollar, 2002; Senge, et al., 1994).

Systems Theory, Systems Thinking

The application of organizational change principles and systems theory to schools has been explored in the contemporary literature (Curtis & Stollar, 2002; Senge, et al., 1994). Subsequently, an understanding of essential elements for effective change efforts has improved (Fullan, 2001; Senge, 1990). This literature indicates that school change efforts are more likely to succeed when (1) there is a visionary leader who effectively disseminates a vision and elicits a mission, (2) a common vision is shared (Fullan, 2003; Stellar, 1988), (3) the innovation is designed with the particular school's culture in mind (Kame'enui & Simmons, 1998; Ringeisen, Henderson, & Hoagwood, 2003), and (4) when faculty, staff, and community stakeholders are concerned with the problem the school change is intended to address (Hall & Hord, 2001).

Systems theory has been used as a framework for analyzing and solving problems in schools for decades (Curtis & Stollar, 2002). School improvement sub-committees with the goal of a single desired outcome that interface with relevant grade level teams, which, in turn, report to district or intermediate agencies that report to the State Department of Education are examples of subsystems within systems that make systems theory both complex and powerful. The systems perspective holds that it is the reciprocal and interdependent influence within and between systems that

allows for a synergistic domino effect (causal-predictive change) or butterfly effect (unintended consequences). The more technical notion of this cascading effect in non-linear and dynamic organizations is known as *sensitive dependence on initial conditions* (Hilborn, 2004, p. 425) and speaks to both the inherent and potential chaos in dynamical systems (Brodnick & Krafft, 1997). When based on a construct of *order through fluctuations* (Sawada & Caley, 1985, p. 15), new understandings of synergistic creativity and change from uncertainty, in the universe and in educational settings, can be developed. In light of these complex and powerful possibilities inherent to systemic change (Bloom, 2000; Doll, 1997; Doll, 1986; Doll, 1989a; Doll, 1989b; Iannone, 1995), systems change management must be guided for desirable synergistic, rather than unintended, outcomes. Regarding outcomes of education programs, Glickman, Gordon & Ross-Gordon (1995) determined there are two types of products that evaluators and decision-makers can measure: (1) intended outcomes-- the intervention program goals and objectives, and (2) unintended outcomes-- the unforeseen results. Systems theory applied to change management that is guided by unwavering vision can mitigate these complexities and uncertainties.

Systems change management requires visionary leadership (Kotter, 1996), commitment to (or compliance with) the change, a comprehension of how organizational change management is inextricably linked to school improvement (Curry, 1992) and an institutionalization of the purposeful change (Curry, 1991; Kotter, 1996). A discussion of the indispensability of visionary leadership in the change management context (Goleman, 1998) does not necessitate a formal and

extensive unpacking of the history of leadership and concomitant leadership theories. However, it is important here to note that critical to the sustainability and growth of any organization is its leadership (Bennis & Goldsmith, 2003; Goleman, 2002). Education organizations, particularly public schools, are susceptible to the adoption of trendy, stylistically-charismatic, and sometimes conflicting, leadership methods (Harris, 2006). Distributed leadership is a method by which leadership emerges through a breaking down of organizational barriers so that leadership is not bound by role, but rather inspired by purpose (Sergiovanni, Kelleher, McCarthy, & Wirt, 2004a). This is the leadership theory in practice at the school-level for teachers involved in the institution of desired changes through organizational change and participatory action (Goleman, 2002). Curry (1992) asserts that institutionalization of desired change is achieved with varying degree over time and involves several levels of implementation. These levels relate to the structure, procedure, and the school culture.

At the structural level, an educational innovation can be represented in many ways throughout a school: assigning, creating or negotiating new roles and responsibilities; involving teachers as leaders; scheduling that is conducive to team planning and collaboration; and routinely training the faculty and staff in the innovation and ways of systems-thinking for systemic change.

Procedurally, implementation of a change initiative requires a dynamic or *living plan* (Calhoun, 1994, p. 94) for concerted action. The action plan specifies both how the organization will improve student learning and how that logic of inquiry

will proceed. Therefore, the action plans need to provide for concurrently running modes of evaluation: student progress-monitoring and implementation status of the innovations and changes (Calhoun, 1994; Koshy, 2005).

Culturally, change management requires building commitment or eliciting compliance. Regarding building commitment to change, Hubbard (1988) notes when change is forced upon members of an organization change is interpreted as done *to us* rather than *by u*s (p. 33). The response is frequently resistance, rejection, or sometimes deliberate sabotage of the imposed change. Regarding compliance, innovations endure only with a significant role from leaders. And the term *leader* is not limited to administration in the education organization:

> There are many leaders, not just one. Leadership is distributed. It resides not solely in the individual at the top, but in every person at entry level who in one way or another, acts as a leader. (Goleman, 2002, p.14)

Distributed Leadership

Teacher-leaders actively involved in the change management process can show even reluctant teachers the benefits of participation in the change process (Ackerman Donaldson & Van Der Bogert, 1996). Successfully engaging in collective, distributed, leadership action can ready a culture for change through what has become known as "Deweyan *learning by doing*" (Calhoun, 1994, p. 95) and result in a more intelligent, adaptive organization (Allix & Gronn, 2005) with improvement-oriented professional communities (Little, 2003).

Many researchers assert that teaching and learning are strengthened when teachers act as leaders and collectively question ineffective teaching routines, examine new methods of teaching, find productive, egalitarian ways to prevent, acknowledge, and respond to conflict, and engage actively in professionalism and continuous professional growth (Achinstein, 2002; Grossman, Wineburg, & Woolworth, 2001; Gutierrez, 1996; Hopkins, 1985; King & Newmann, 2001; Little, 1999; Louis & Kruse, 1995; Stokes, 2001; Westheimer, 1998; Witziers, Sleegers, & Imants, 1999). Judith Warren Little confirmed the importance of teachers as actively involved leaders in her synthesis of intensive case studies (2003); however, deeper questions remained. Calling the many researchers' assertions an "optimistic premise" with some "serious limitations" (2003, p. 914), Little sought to bring clarity to the debate over how classroom teaching practice comes to be known, shared, and developed among teachers through their interactions. These as yet unspecified interactions in the areas of teacher knowledge, practice, and learning came to represent what Little called the *black box* (2003, p. 915). Little determined the importance of teachers seeing themselves as leaders "engaged in improvement-oriented professional work" cooperatively, seeing this as the key to unlock the *black box* (2003, p. 915) through teaching as learning (McNiff, 1993). The systems-minded collaborative strategic planning framework and the action research mode of inquiry for problem solving allow for the intellectual, social, and material growth of a professional community.

Collaborative Strategic Planning and Problem solving

The structural, procedural, and the cultural considerations of today's complex schools require leadership-sharing, problem solving oriented, collaborative strategic planning. Just such a systems theory of organizational change management can be found in the Accreditation for Growth (AFG) process, when coupled with sound organizational leadership that is distributed at the transactional level, guided by vision and mission at the transformational level, and underpinned by an understanding of the complexity paradigm (Bloom, 2000; Bloom, 2004; Brodnick & Krafft, 1997; Doolittle, 2000) of *order through fluctuations* (Sawada & Caley, 1985, p. 15). It is this understanding of the complexities of change (Fullan, 1997) and model of complex constructivism (Doll, 1986; Doolittle, 2000) that is the nexus for participatory action research and intervention evaluation.

Accreditation for Growth as Change Management

AFG is an accreditation process that uses strategic planning as a means of school improvement and growth in student performance. The process for elementary school accreditation developed by the Middle States Commission on Elementary Schools (CES) of the Middle States Association of Colleges and Schools (MSACS) provides a system of action planning to connect various planning and school improvement efforts. The Middle States Association (2004) defines the process thusly:

> Accreditation is a voluntary process whereby a school commits to continuous school improvement and evaluation by peers. Accredited status indicates that a school has clearly defined appropriate objectives, has established conditions under which they can be achieved, is working toward achieving the objectives now, and should be able to continue to do so for the foreseeable future (¶ 1).

Conceptually, AFG has its origins in the quality movement that focuses on performance excellence criteria organizations can use to improve overall performance.

The Quality Movement- Demming, Baldrige & AFG

The quality movement began in the United States in response to international competitors challenging American manufacturing superiority in the 1970s, particularly Japanese industry. The success of Japanese enterprise was attributed to increases in the quality of production and management implemented by Japanese business leaders (Bonstingl, 2001; Dobyns & Crawford-Mason, 1994). Paradoxically, the management and productivity model used by the Japanese that focused upon cooperation and downplayed competition resulted in a competitively superior Japanese presence in the global economy. Ironically, this Japanese focus on increasing quality was American in origin.

W. Edwards Deming, an American statistician credited with the rise of Japan as a manufacturing nation and with the innovation of the tenets central to *Total Quality Management* (TQM), served as a consultant to the Japanese government in the early 1950s, designing a census of the Japanese population. While there, he taught

statistical process control to Japanese engineers-- a set of techniques which allowed them to manufacture high-quality goods without expensive machinery and provided lectures to Japanese captains of industry on revolutionary management processes. In 1960, he was recognized by the Japanese Emperor for his services to Japanese industry before returning to the Unites States.

Deming spent some years in obscurity before the publication of his book *Out of the Crisis* (1982) in which he formalized 14 points for efficiency management:

1. *Create constancy of purpose towards improvement,* replacing reactionary responses with long-term strategic planning.

2. *Adopt the new philosophy with greater uniformity*, where management actually adopts the philosophy, rather than merely expecting the workforce to do so.

3. *Cease dependence on inspection*, because if variation is sufficiently reduced, there is no need to inspect manufactured items for defects that do not exist.

4. *Move towards a single supplier for any one item* (or service), because variation and unnecessary complexity detract from efficiency.

5. *Improve constantly and forever*, always striving to reduce variation.

6. *Institute training on the job,* because inadequately trained people will not all work with uniform efficiency, and this will introduce variation into the process.

7. *Institute leadership,* where a distinction is made between leadership and

mere supervision (the latter being quota-based).

8. *Drive out fear,* where management-by-fear is seen as counter-productive in the long term, preventing workers from acting in the organization's best interests.

9. *Break down barriers between departments,* the same as the TQM concept of *internal customer,* where each department serves the other departments that share outputs, rather than serving management.

10. *Eliminate slogans,* also central to TQM, promoting the notion that it's not people who make most mistakes, but rather the process they are working within. Harassing the workforce without improving the processes they use is counter-productive.

11. *Eliminate management by objectives,* wherein Deming saw production targets as encouraging the delivery of poor-quality goods for the sake of meeting delivery dates.

12. *Remove barriers to pride of workmanship,* where the problems outlined thus far reduce worker satisfaction, having an overall deleterious effect on the process.

13. *Institute education and self-improvement,* which has been explained already.

14. *Make the transformation* (of the organization and its efficiency) *everyone's job*. (pp. 7-18)

Deming believed his approached could be applied to American manufacturing industry with the aim of extricating the U.S. from Japanese hegemony, if not global manufacturing dominance.

Although Deming does not use the term *Total Quality Management* in his book *Out of the Crisis* (1982), it is credited with launching the movement, as most of the central TQM ideas are found to be derivative of his model (Ruben, 2007). The Deming approach is predicated on continuous improvement of work processes, which are the core operating functions of an organization, and is underpinned by the understanding that improving processes is the key to improving quality and that workers want to achieve excellence. (Bonstingl, 2001; Dobyns & Crawford-Mason, 1994; Hackman & Wageman, 1995). Deming believed managers should work with employees to gather information and implement process improvements. Instead of blaming individuals for errors, the focus is on improving the process that caused the error. Furthermore, in the Deming model, employees are provided with training on how to prevent errors like redundancy and variation and are encouraged to seek further education to assist in improving the modes of production. All leadership, management, and effort are directed toward ensuring quality through continuous improvement (Bonstingl, 2001; Dobyns & Crawford-Mason, 1994).

American captains of industry investigating how Japanese production and management methods could prove useful in this country determined that Deming's practices were the foundation of Japan's business success (Gabor, 1992). Since the early 1970s United States' manufacturers have been applying the approach to

American enterprise, leading to the quality movement gaining momentum nationally and becoming known as *Total Quality Management*.

The United States' adoption of quality methods culminated in the establishment of the Malcolm Baldrige National Quality Award in 1987 (Dobyns & Crawford-Mason, 1994; Garvin, 1991; Seymour, 1994). Named for the late Secretary of Commerce under President Reagan (Garvin, 1991), the awards are based on an organization's ability and approach to implementing criteria in seven categories: leadership; strategic planning; measurement, analysis and knowledge management; process management; and results (Council on Competitiveness, 1995; National Institute for Standards and Technology, 2003).

The National Institute for Standards and Technology (NIST) drafted the categories, devised the scoring schemata, and oversees the award. It quite intentionally did not adopt a particular approach, but rather strove to incorporate aspects of several approaches while maintaining a focus on quality, data-driven decision making, and results. Applicants are expected to describe their processes and measurements for each of the seven categories and are assessed on the fidelity of the described processes (Garvin, 1991; NIST, 2003).

The adaptation of the Baldrige criteria to education is largely a translation of the best-practices, language and basic concepts of business excellence to those analogue requirements of excellence in education (Karathanos, 1999; Siegel, 2000). In the early 1980s the quality revolution inspired business leaders to re-engineer corporate structures that focus on high quality processes; concurrently the quality of

American education was coming under increasing fire, as per *A Nation at Risk: The Imperative for Educational Reform* (NCEE, 1983). The growing quality movement in industry was receiving such publicity (Gabor, 1992), political and education leaders began investigating the application of quality principles to education through a focus on school core operating processes (i.e., teaching, learning, administration, operations, and personnel). The National Malcolm Baldrige Education Criteria for Performance Excellence were piloted, and education was adopted as a category for the Malcolm Baldrige National Quality Award. The Baldrige Education Criteria for Performance Excellence embody eleven core values, from which all methods, criteria, and measures in any implementation derive: visionary leadership; learning-centered education; organizational and personal learning; valuing faculty, staff, and partners; agility; focus on the future; managing for innovation; management by fact; public responsibility and citizenship; focus on results and creating value; and systems perspective (ACT, 2002; Baldrige National Quality Program, 2007).

The adaptation of Baldrige to education began when some districts translated and applied the criteria in their own organizations (Shipley & Collins, 1996). This use of the Baldrige framework in educational settings gained momentum as states began to include educational institutions in the eligibility for state quality awards based on the aforementioned criteria (Johnson, 1996).

The Accreditation For Growth process, while ultimately derivative of the Deming model, has its origins in the Baldrige framework; they provide criteria for excellence and a systems perspective for understanding performance management.

Baldrige and AFG have in common validated practices against which an organization can measure itself; both are data-driven and results-oriented; both focus on improving organizational practices; both promote alignment of the components of the system; both use systems-thinking for alignment of efforts with the aim of improving student performance.

Dr. Brent Ruben, professor and executive director of the Center for Organizational Development and Leadership at Rutgers University, conceptually established this Baldrige framework-- AFG accreditation compatibility in "Linking Accreditation Standards and the Malcolm Baldrige Criteria" (2007). Ruben blends the Baldrige and accreditation frameworks to illustrate how the integrated model can be used for "ongoing assessment, planning, and improvement within individual administrative, service, student life, and academic departments and programs, as well as for an entire institution" (p. 80).

Differing slightly from the reasoning Deming and Baldrige used to develop their processes, AFG is a primarily inductive method whereby school districts improve student and organizational performance through the protocols for accreditation guided by an organizationally democratic vision, mission, and formal set of beliefs. Accreditation provides a systematic process that requires a district to question why it exists, to establish a vision of its future and to determine specific objectives, or steps, for reaching that vision. Schools establish priorities for improvement thorough data collection and an analysis that leads to a needs assessment. Already engaged in the AFG process, Buckingham Elementary School

has established objectives for improving student performance based on a vision of a preferred future for the school. AFG commitment for BES was formalized on November 19, 2002, with active planning beginning in the summer preceding the 2003-2004 school year. The school improvement protocol requires continuous review of programs and services, and of student performance (BES-AFG, 2004).

The AFG process calls for each school in the participating district to identify student performance objectives that require school-wide student improvement. Each school designates a planning council which identifies major objectives for the school. The planning teams conducting self-evaluations of student performance, facilities, educational programs, student activities, student services, learning media services, finance, school staff and administration utilizing criteria established by the Middle States Association of Colleges and Schools (MSACS, 2004).

AFG enables school organizations to meet state educational requirements while integrating components from the district strategic plan (i.e., the Master Plan) to meet district and school-specific goals. Committees and subcommittees are established to address school-specific needs, and entire school systems can participate in district-wide accreditation through cooperation with yet larger regional councils. The district administration and school planning council examine and revise the district's mission statement, vision statement, and beliefs. The committees and subcommittees, as action teams, then cooperate in the development and implementation of action plans for continuous improvement.

This type of strategic and tactical collaborative planning process offers a viable framework for the culture of a specific school to adopt a desired practice (or innovation) because collaborative strategic planning is a team-based approach (Cook & Friend, 1991; Knoff, 2002) that uses systems-thinking planning and problem solving to address system-level issues or teacher-student concerns (Curtis & Stollar, 2002; Deno, 2002; Gutkin & Curtis, 1990; Tilly, Reschly & Grimes, 1999). Research indicates effective use of the process builds the problem solving capacity of the organization and enables it to address issues at the individual school, district, region, or state level (Curtis & Stollar, 2002; Knoff, 2007; Senge, 1990). The collaborative strategic planning process is based on a cyclical problem solving model (Deno, 2002; Tilly, 2002; Tilly, et al., 1999). As a living practice, (Sumara & Davis, 1997) the action research process is continual and perpetuated beyond the implementation of one procedure, strategy, or innovation. The process re-cycles until selected interventions reduce or eliminate the original problem (Allen & Graden, 2002). The AFG philosophy is that the application of the problem solving process to system-level issues in schools is useful as a framework for analysis of the overall quality of the school system. Similarly, the school-level of analysis for problem solving considers the issues that prevent improved outcomes for its student population. Problem solving is guided by the core components of systems that have been found in the literature to have an effect on student performance: data-driven decision making, leadership, scientifically-based research, and quality instruction (Bonstingl, 2001; Henning, 2006; Middle States Commission, 2006). Systems that function using these

features are more likely to be successful at implementing and sustaining innovations that produce students which achieve at higher levels (MSACS, 2004). When the core problem solving components are analyzed as variables that create school environments that support and sustain innovations, priorities for action planning can be elicited. Engaging in collective, distributed, leadership action can ready a culture for change through what has become known as "Deweyan *learning by doing*" (Calhoun, 1994, p. 95) and result in a more intelligent, adaptive, action-oriented organization (Allix & Gronn, 2005).

Action research lends itself particularly well to the AFG school improvement problem solving model and is considered to be the most appropriate interventional analysis and implementation process for education organizations (Elliott, 1983; Dick, 1997). Many scholars advocate an action research approach for school restructuring, renewal and systems planning of the educational organization (Holly & Southworth, 1990; Lieberman, 1988; McLean, 1995; Oja & Smulyan, 1989; Zuber-Skerritt, 2001).

Educational Action Research as Problem Solving

Educational action research from its beginnings had been merged with collaborative, participatory planning and collective inquiry of educators (McTaggart, 1991). Its foundations can be traced to the writings of John Dewey. The progressive American educational philosopher who believed that professional educators should become involved in community problem solving found adherents in educational institutions focusing on curriculum development, professional development, and applying learning as practitioner-researchers.

Dewey, defying the laws of tradition, challenged the orthodoxy of the scientific research methods current in the field of education (Burns, 1999). Dewey recognized the opportunity for continuous, collective learning in all institutions and organizations when he wrote: "Every social institution is educative in effect" (Dewey, 1916, p. 12). Specifically regarding education, Dewey proposed:

> (1) Educational practices provide the data, the subject matter, which form the problems of enquiry… These educational practices are also (2) the final text of value and test the worth of scientific result. They may be scientific in some other field, but not in education until they serve educational purposes and whether they really serve educational purposes can be found out only in practice (as cited in Hodgkinson 1957, p.138).

Origins of Action Research

Kurt Lewin is credited with coining the term *action research* to describe work "that did not separate the investigation from the action needed to solve the problem" (McFarland & Stansell, 1993, p. 14). Lewin, considered the "father" of action research, was concerned with social problems and problem-resolution. He focused on participative group processes for addressing conflict, crises, and change, generally within organizations (Schein, 1996). Interestingly, the German experimental psychologist was affiliated with the Center for Group Dynamics at MIT in Boston. Lewin first coined the term *action research* in his 1946 paper, "Action Research and Minority Problems," characterizing action research as "a comparative research on the conditions and effects of various forms of social action and research leading to social

action," using a process of spiral steps "each of which is composed of a circle of planning, action, and fact-finding about the result of the action" (Lewin, 1946, p. 39). Lewin applied his recurrent-pattern research to systemic change in, and between, organizations postulating the principle that decisions are best implemented by those who help make them through participatory action:

> We should consider action, research and training as a triangle that should be kept together for the sake of any of its corners. (Lewin, 1946, p. 42)

Ronald Lippitt was a student and collaborator of Lewin's. Lewin's and Lippitt's ideas were adopted and applied to the educational arena by Stephen Corey, Dean of Teachers College, Columbia University. Corey encouraged teachers to use action research to improve their classroom practices (McLean, 1995, p. 4). Corey published on the justification of action research as a methodology, focusing mainly on procedural aspects of the process (Corey, 1953).

Definitions of Action Research

Action research evolved to become a 6-step procedure: "identification of problem, analysis of problem, formulating ideas or hypotheses to solve the problem, gathering and interpreting data about the problem, implementation of action to remedy the problem, and evaluation of the results of action" (Taba & Noel, 1957, p.12).

Definitions of action research are numerous and varied:

- Action research is the name given to a series of procedures teachers can engage in either because they wish to improve aspects of their teaching, or because they wish to evaluate the success and/or appropriacy [*sic*] of certain activities and procedures (Harmer, 2002, p. 344-345).
- Teacher-initiated classroom research which seeks to increase the teacher's understanding of classroom teaching and learning and to bring about improvements in classroom practices. Action research typically involves small-scale investigation projects in the teacher's own classroom (Richards, Platt & Platt, 1992, p. 38).
- Action Research can be defined as a combination of the terms *action* and *research*. Action research puts ideas into practice for the purpose of self-improvement and increasing knowledge about curriculum, teaching, and learning. The ultimate result is improvement in what happens in the classroom and school (Kemmis & McTaggart, 1982, p. 5).

Essentially, action research in education is concerned with improvement of personal and professional growth, student learning, or the teaching profession (Johnson, 1995) via research methods that include a procedural approach and empirical measurement.

Carr and Kemmis (1986) asserted one of the most important reasons for conducting action research is that it "is a form of self-reflective inquiry undertaken by participants (teacher, or principals, for example)" (p. 182). Self-reflective teacher-leaders are the most capable problem solvers in the educational setting (Johnson,

2005). Tanner contends in "The Social Consequences of Bad Research" (1998) that it is the school practitioners and teacher-researchers who are best able to "to evaluate the efficacy of educational research and to guide their own practice through a commitment to the best available evidence" (¶ 36). Tanner furthered the concept of teacher-practitioners as qualified empirical-analytic action researchers suggesting "school practitioners can test research findings for practicability and generalizability more effectively than some of the editors of the leading educational research journals" (¶ 36). Tanner's review of the journals (circa 1998) revealed that most of the articles failed to "meet the tests of practicability and generalizability" (¶ 36).

John Dewey, writing on developing a science of education, encouraged the use of educational practices as the "source of the ultimate problems to be investigated if we are to build a science of education" (1929, p. 33). Dewey further clarified that the behavior sciences inform, but do not define, the educational problems faced. Therefore, professional communities must "operate through their own ideas, plannings, observations, judgments" (Dewey, 1929, p. 76) and problem solving perspective, because to do otherwise in the school setting "is to surrender the education cause" (p. 74).

Even in an interdisciplinary perspective, action research is associated with improvement in professional practice (Hart & Bond, 1995): The researcher is immersed in the situation; the work unfolds in response to the situation and not to the researcher's requirements; the questions, problems and solution strategies are specific to the local context; descriptions and theories are inductive by way of iteration within

the context and are tested within the situation; and there is close collaboration between researchers and stakeholder-participants, (Argyris, Putnam, & Smith, 1985; Baskerville & Wood-Harper, 1996; Burrell & Morgan, 1979; Lincoln & Guba, 1985; Robson, 1993; Whyte, 1991).

Most teacher-practitioner action research is not an isolated endeavor (Cross & Steadman, 1996, Robinson & Lai, 2005). Participatory action research is research which involves all relevant stakeholders in the active examination of current action in order to change and improve it. The participant-researchers engage in action which is researched, modified, and researched again, until the problem is understood and mitigated, remediated, or solved (Hughes, 1999). Though Wadsworth (1989) contends that participatory action research, and action research more generally, is not well-suited conceptually for organizational change, because it is a democratic, non-coercive process, participatory action research has emerged in recent years as a significant methodology for intervention and change within organizations.

Action Research as an Approximation of Experimental Research

Action research is a recognized approximation of experimental research (Dick & Swepson, 1994) that focuses on the effects of the researcher's direct actions of practice within a participatory community with the goal of improving the performance quality of the community or an area identified as problematic (Dick, 2002; Hult & Lennung, 1980; McNiff, 2002; Reason & Bradbury, 2001; Reason & Bradbury, 2006). Bodner and MacIssac (1995) go so far as to characterize causal empirical-analytic action research as one of the two most prevalent research

methodologies in a discussion of "causal models of educational interventions" (p. 4). The causal empirical-analytic method is pre-experimental in design, as is any action research model that involves planning for actions based on observation and formative evaluation determined by empirical measurement.

Oquist (1978) claims the social and subjective elements of action research are strong enough to make it consistent with empiricism (or logical positivism). This concept of empiricism, that evidence comes from direct observation, is central to experimental research and action research of the analytic type. It is, according to Oquist, a viable process for pragmatism and dialectical materialism to the extent that action research can practically address worldly concerns. Action research can focus on naturally occurring and experimentally elicited phenomena (Larsen-Freeman & Long, 1991), and it is this flexibility that makes it a prevalent research process, specifically in education.

Action research, more generally, involves utilizing a systematic cyclical method of planning, taking action, observing, evaluating and critical reflecting prior to planning the next cycle (McNiff, 2002). The actions have a set goal of addressing an identified problem in the workplace, for example, improving student understanding through the use of new interventional approaches and strategies (Quigley, 2000). Action research is a collaborative planning method to test new ideas and implement action for change; it is a way to increase understanding of how change in one's actions or practices can mutually benefit a community of practitioners (Carr & Kemmis 1986; Kemmis & McTaggart, 1990; Kemmis & McTaggart, 2000;

McNiff, 2002; Reason & Bradbury, 2001) and therefore an organization; it involves direct participation in a dynamic research process, while monitoring and evaluating the effects of the researcher's actions with the aim of improving practice (Checkland & Holwell, 1998; Dick, 2002; Hult & Lennung, 1980). This causal-empiric analytical perspective of action research, termed *the scientific-technical view of problem solving* (McKernan, 1991, p. 16) has the researcher in this approach "test a particular intervention based on a pre-specified theoretical framework," with collaboration between the researcher and the practitioner being primarily technical (Holter & Schwartz-Barcott, 1993, p. 301). The researcher identifies the problem and a specific intervention, and uses a procedural approach and empirical measurement to test the intervention (Cooke & Cox, 2005). It is in this sense action research is an approximation of experimental research (McCutcheon & Jurg, 1990). Action research in education seeks confirmation or denial of a causal relationship between an intervention and post-intervention evaluation to guide future iterations of an intervention, is pre-experimental in design, and thus is an approximation of experimental research.

Educational Action Research

Educational action research is currently the most prolific area of action research publication (Dick, 2006); however, recent literature in educational action research is frequently found under different labels. Many action research journal articles convey the idea that practicing teachers conducting action research has gained support (Hubbard & Power, 1993; Zuber-Skerritt, 2001) because it is inquiry that

applies scientific thinking to real life problems, (Shannon, 1990) to increase instructional effectiveness and an understanding of how actions affect outcomes (Noffke & Stevenson, 1995). Van Lier (1994) sees action research as *small scale intervention* (p. 1) in the functioning of the real world and a close examination of the effects of such an intervention. *The Handbook of Action Research* (Reason & Bradbury, 2001) reinvigorated the process of action research in education making quality a primary concern, and defined *action research* as the umbrella term for participatory and action-oriented approaches.

School Improvement as Action Research

A change-oriented improvement process has always been with public schools. The history of public education is one of recurrent alternations between centralization and decentralization of power and authority (Cuban, 1990; Darling-Hammond 1988). Some call it site-based management while others simply call it *school improvement*; either way, these terms express some form of action research. The action research could be conducted in the interests of empirical-analytic (technical), hermeneutic (practical), or critical (emancipatory) understanding.

Empirical-analytic action research relates to means-to-an-end approaches to organizational improvement (Zuber-Skerritt, 1991), or getting things accomplished effectively by following a positivist paradigm. Hermeneutics is a more interpretative science approach related to practical interests and centers upon pragmatic decision-making in situations. Critical science is emancipatory in its interests and involves

extricating people from organizational determinism, or even determination of habit and custom at the level of individuals (Slentz, 2003).

Most schools employ an empirical-analytic approach oriented towards functional improvement measured in terms of its success in changing particular outcomes of practice (Kemmis, 2001; O'Brien, 2001). Examples of empirical-analytic action research in the literature aim to increase or decrease the incidence of a particular outcome. Iterations of empirical-analytic action research often develop through the use of hermeneutics. Examples of hermeneutical action research provide a similar theoretical framework to that of the empirical-analytic type. Referring to this approach to practical action research as *action learning* (Carr & Kemmis, 1986, p. 23), the focus more often than not is social transformation through personal understanding (Dick, 1997). Adoption of one action research method is rarely to the entire exclusion of all others.

There is little in the way of standardization of action research nomenclature (Altrichter, Kemmis, McTaggart & Zuber-Skerritt, 2002) however Worcester County public schools have adopted a formalized change-oriented school improvement process in the form of the Middle States Association Committee on Institution-Wide Accreditation. The school improvement process of Accreditation for Growth (AFG) at the individual school-level is a part of this accreditation process for Worcester County. AFG can be understood as a commitment to the public to make continuous improvement of student performance. It is a process by which the school conducts self-studies to draw conclusions about school improvement and student achievement

from data. These data-driven decisions then inform instruction to meet student needs. School improvement initiatives are determined by the self-studies of each school, and ultimately an accreditation body reviews the plans and progress of each school to award the county certifications. Though AFG and action research are not interchangeable terms, they are ways in which schools meet goals of school improvement.

Research Paradigms Considered

AFG has already been defined in general terms as a type of action research. However, this general comparison lacks the level of detail to be truly descriptive of Worcester County's approach. Therefore, a consideration of research paradigms currently employed in education research is necessary. Elliott (1983) concluded four modalities of research suited the education field: functionalist, phenomenological, social reproductionist, and action research. Elliott claimed the functionalist model of systems analysis to be attractive to many because it appears to provide the foundation for a truly empirical-analytic science of society, free of value bias. Conversely, Barber (2006) states that Alfred Schutz's phenomenological analysis model is one in which processes are viewed as the social constructions of individuals possessing autonomy. The student data that ultimately informed instruction in the 2005-2006 and 2006-2007 initiatives was derived via student-participants who possessed no autonomy beyond the discrete ability to participate in the initiative. The teacher-researchers, however, had the autonomy to participate with varying degree. This most likely has to with the distributed leadership necessitated by the AFG process.

Demetrion (2000) points out that Jürgen Habermas offers an action-research model specific to education that is based on the assumption that social processes rely on the existence of subjectively shared rules of interpretation for translating social norms and values. This assumption of shared organizational-cultural norms and mores is important as well, reflecting the character and nature of the change management ethos of the 2005 – 2006 and 2006 – 2007 projects, much like community–based action research and the way it "draws on an explicit set of social values and was seen as an inquiry process" (Slentz, 2003, p. 40) and seeks to alter the socio-personal dynamics of the research situation (Stringer, 1999). This is an approach that synthesizes well with Kotter's change management principles. Until an organization has agreed upon a set of shared values, a vision cannot be communicated and ultimately realized. Social reproductionist theory (Elliott, 1983) purports that all subjective meanings (i.e., the project goals) expressed in the social action of change (i.e., change management) are influenced, if not biased, by their economic function. The intervention project for Grade 4 math students at Buckingham Elementary School involves more of a wise use of resources rather than additional economic expense, thereby relating to the measurable organizational value established in Section II and the recommendations set out in Section III. These research paradigms above were considered by the action research team for which fit best with the aim of improved student learning and consequent improvement in the Maryland State Assessment scores.

From the consideration of research paradigms in education explored above, the organization concluded in May of 2007 that it was the action research model that

best supported the educational change management project-- specifically the empirical-analytic modality, influenced by the practical interests of hermeneutics. In an oversimplification that offers the clarity of minimalism: measurable functional improvement through the empirical-analytic action research orientation (Bodner & MacIssac, 1995; Kemmis, 2001) is the methodological approach to be taken in the 2007 - 2008 school year, should continuance of the interventional math initiative be granted. This is a sound approach; however, this researcher proposes that the organization go beyond the initial working description of the action research framework of Bodner and MacIssac (1995) consulted in October of 2005. Bodner and MacIssac noted that:

> The action research framework is most appropriate for participants who recognize the existence of shortcomings in their educational activities and who would like to adopt some initial stance in regard to the problem, formulate a plan, carry out an intervention, evaluate the outcomes and develop further strategies in an iterative fashion (1995, p. 7).

The Buckingham Elementary School (BES) organization is ready to transcend the initial stance-taking of rudimentary action research and the individual-centric roles of action learning that make the action research framework result in a soft-systems approach (Checkland & Scholes, 1990). This statement about the readiness of BES to engage in more demanding and complex action research is more than mere assertion; it is a point supported by the research. Gottfredson (1986) described two recurring features of effective schools: (1) the use of a system to monitor performance

and data to assess progress, and (2) collaborative planning for action. AFG and action research are the analogue to Gottfredson's features of effective schools. Before making any recommendations, however, a recapitulation of relevant school improvement efforts at BES is in order.

The Iterative Approach

What follows is the iterative approach (Knock, 2003), documenting separately the first (2005-2006) and second (2006-2007) change management efforts, reflecting, and finally forecasting future iterative solution strategies in the conclusion of Section II. The 2005-2006 initiative, in retrospect, could be described in action research terms as *pre-iterative*, as the nascent action research committee followed a very minimalist version of the action research cycle that was primarily dependent upon this researcher and the school administration employing the Kotter principles of organizational change as an evaluation of progress tool. The 2006-2007 initiative (i.e., the most contemporary interventional strategies initiative to date) followed a more detailed action research cycle and paid less attention to the Kotter process. For the sake of simplicity of recapitulation and reflection, the major features and accomplishments of the 2005 – 2006 and 2006 – 2007 action research cycles and stages of the Kotter model accomplished are reviewed separately in Sections I and II accordingly.

Section III culminates in a set of recommendations aimed at eliminating or reducing the problem, which necessitates a discussion of strategies for implementation of the recommendations. The recommendations are a set of

purposeful changes that go beyond the issue of continuance. These changes require an understanding of change management, systems thinking and leadership; hence their inclusion in Section I. Additionally, an understanding of change management principles, systems theory and distributed leadership is essential to the discussion of collaborative strategic planning and problem solving through action research at BES. Prior to a description of the most contemporary interventional program (2006 – 2007), the first relevant initiative (2005 – 2006) is detailed to provide the reader sufficient background on school improvement efforts that shaped the most contemporary practices through Kotter-process change management, systemic-planning and practice, educational action research and a coupling of visionary and distributed leadership. In Section II multiple perspectives on the data are provided, including a consideration of the gross features of the data; a correlation analysis where the 2005 – 2006 math scores of third grade students serves as the pretest data, and the 2006 – 2007 math scores of the same students in fourth grade serve as the posttest scores in the analysis of the single group and multiple variables (Gay & Airasain, 2000); and a statistical representation of the categorical MSA data analyzed as either at *Proficient* (or above) or *Basic*, pre-treatment and post-treatment, that shows intervention efficacy. This further necessitates a description of both the most contemporary intervention in Section II and the past initiative here, because future outcomes (as results of recommendations set out in Section III) are dependent upon initial conditions (Brodnick & Krafft, 1997; Hilborn, 2004).

2005 – 2006 Initiative

The 2005 – 2006 initiative proposed the creation of a minimalist, student-friendly rubric for written expression in mathematics tasks, a standardizing of the written expression format that would provide students with format familiarity on the Maryland State Assessment (MSA) test and make the written expression in mathematics template accessible to teachers on a daily basis. The written expression in mathematics format, called a BCR (brief constructed response) is essentially a short essay format requiring students to answer a question and explain the steps taken and their thinking.

The Kotter process of change was employed for the BCR initiative at Buckingham Elementary. The initiative was in compliance with county instructional and accountability mandates. The program goals were administration approved and AFG compatible. Furthermore, the practices of reform and change were systematic and grounded in the literature (Fullan & Miles, 1992; Hall & Hord, 1987; Hord, Rutherford, Huling-Austin, & Hall, 1987; Kotter, 1995). The works of Covey (1990), Kotter (1996), and Larson (1992) guided this change agent's professional communication and change strategy to promote educational change. Leadership influences included those of Sergiovanni, who provided optimism in the application of transformational leadership (1990).

Approach in Response to a Shrinking Advanced Category

Buckingham Elementary School is located in Berlin, Worcester County, Maryland. Buckingham has a student population of 460 students in grades PreK-4.

Notable best-practices are institutionalized at Buckingham Elementary School: (1) the AFG improvement plan (made up of more specific action plans) focus on student performance and school growth, (2) the use of an externally validated process leads the strategic planning, and (3) the analyses determining success in the areas of student performance and organizational growth, or a lack thereof, are systemic and assure alignment with school and district philosophy, mission, vision, beliefs and objectives. Formative and summative measures and assessments are used to track progress. Data for each measure of progress is recorded, analyzed and compared with the baseline data; this system drives modification of the plan by the implementation teams and is what Chandler calls "change-specific" (1995, p. 12).

Since the inception of the contemporary Maryland School Assessment (MSA) in 2003 Buckingham Elementary School has met *Adequate Yearly Progress* (AYP) as established by the Maryland State Department of Education. The Maryland State Department of Education holds schools accountable for performance through a determination of student proficiency on the state assessment. Acceptable proficiency standards for the MSA are either *Proficient* or *Advanced*, and any students not performing at acceptable levels are determined to occupy the *Basic* category.

The public release of the 2005 Maryland Report Card via the Maryland State Department of Education showed that MSA achievement levels experienced only marginal improvement in Grade 4 mathematics scores at Buckingham Elementary School, Worcester County Public Schools. This was an indication that some Grade 4

students performed below the set standards. The standards are "measures of performance against which yearly results are compared" (MSDE, 2005a, ¶ 5).

The student performance standards are key to the examination of the mathematics instructional program at BES and in late September of 2005 helped to guide efforts toward school improvement, specifically in the area of written expression in mathematics. The *Advanced* category suffered a 4.8% decrease in Grade 4. The *Advanced* standard is the highest of three in Maryland (i.e., *Basic*, *Proficient* and *Advanced*) and is described as indicating that students at the *Advanced* level can regularly solve complex problems in mathematics and demonstrate the ability to reason mathematically (MSDE, 2005b).

Any decline in a performance level standard is evidence of a problem to be addressed. The fact that this decline was in the highest grade level served at Buckingham Elementary was of particular concern, as Grade 4 "student performance represents the culminating and cumulative efforts of the school to educate the students assessed" (Ahearn, 1998, p. 7). Based on teacher input and a consideration of the test results, at the outset of the 2005 – 2006 school year, an initiative of organizational improvement had been undertaken to improve the quality of written responses in mathematics Grades 2-4 at BES, with a focus upon using formative data to inform instruction and consequent student achievement.

During the 2005 – 2006 school year the formative data collection process was a whole-group, but skill-specific, effort whereby every student in Grades 2-4 received instruction and feedback on written expression in mathematics. Though many

students had different strengths and weaknesses in mathematics, it was the determination of the AFG committee that the entirety of the school body, in Grades 2-4 would benefit from a broad-based approach of written expression best practices for math with some degree of progress monitoring. This progress monitoring led to the solution strategy of the problem addressed through Kotter's Leading Change model.

The Kotter Process of Change: 2005 – 2006

The model of transformation effort employed to realize the vision of improved targeted performance was the 8-stage process of creating major change, the Kotter model of Leading Change (1996, p. 21). Kotter provides a framework for change and insights into inciting broad-based action (1995).

Establishing a Sense of Urgency

The urgency of this problem was that the cumulative efforts of the school in the area of mathematics, the fourth grade MSA scores, still had student representation in the Basic category. This marked a learning gap. The establishment of a sense of urgency was made simple by the publication of the BES report card in 2005, which revealed all tested grades had a common area of weakness: written expression in mathematics. A guiding coalition was formed to track the progress of change management. This group, a sort of pre-iterative action research group made up of this author and the administration, capitalized upon and amplified the existing urgency through an examination of instructional and student learning realities and a discussion

of the opportunity to use the data to modify and improve instructional and learning practices in the area of written expression in mathematics.

Creating the Guiding Coalition

Any group with enough power to lead the change in instructional practices would, as a matter of institutional practicality, have to involve the school administration and key staff. The administration can avail to the staff the time and resources necessary to implement the vision. Also, there is a recognition of authority by the faculty which comports credibility to the initiative by the mere inclusion of school administration. Pragmatically speaking, empowerment requires the authority to empower (Goffee & Jones, 2000, p. 63).

Developing a Vision and Strategy

To direct the change effort, Dr. Gaddis and the author discussed the issue of a vision that could realistically be brought to fruition. Gaddis noted the importance of maintaining continuity between the vision for this initiative of targeted instruction and compliance with best-practices: "Our AFG plan calls for addressing achievement gaps. The drop in MSA achievement in math is just such a gap, a content gap if you will. And because we do not want the gap to widen, we'll modify instruction" (J. Gaddis, personal interview, November 15, 2005). Regarding the specifics of best-practices, Dr. Gaddis shared that the WCPS system makes use of strategic, long-range and operational planning to continuously improve education services through proven best-practices.

The formal strategy in use to improve student performance in the area of written expression in mathematics was to make weekly measures and assessments of all students to track progress. The author instructed students as to BCR strategies using a standardized format. Data for each measure of progress was recorded, analyzed and compared with the baseline data. These measures of improvement were formalized in reports that cumulatively contrasted the most contemporary math BCR scores with the Week 1 scores. Said data was reviewed by the guiding coalition in the form of frequency distribution comparisons of BCR scores and a needs assessment was generated. These documented needs then drove and modified instruction.

Secondly, the involvement of the sub-group committee (created under AFG to include faculty in the transformation effort of school improvement) and a series of subsequent projects that were ongoing (having been formulated by the author, then presented to and accepted by the administration). This second wave strategy was inclusive and participatory, involving diverse members of the AFG committee. The sub-group committee, originally created to consider student achievement data through descriptive statistical analysis (like disaggregated data reports), had tasked itself with inferential analysis. Through this inferential analysis the author devised projects that improved vertical articulation, making BES a more intelligent organization and nearly resulted in the anchoring of new approaches in the school culture.

Communicating the Change Vision

The vision of improved written expression in mathematics was communicated through the insinuation and exercise of the author's projects that contributed to vertical articulation within BES. Reproduced here is a portion of a memo, including some approved projects that contributed to the realization of the change vision:

> To facilitate vertical articulation in such a way as to bridge achievement gaps and assist our educational leaders, we [the sub-group committee/guiding coalition] should: (1) Provide *access to experts* in house as needed in a timely manner. This can be done by sub-group committee coverage with approval from administration. This would mean that we would fill-in for teachers who need to see each other when the need arises, as with the Math BCR Project. We could spend our time facilitating vertical articulation rather than put a lot of time into a resource book few might access. (2) Think-tank *best practices* as requested by the faculty. This would require considering the Sub-group committee to include any school or county expert required to serve to solve a problem or develop best-practices to bridge gaps. Members from the core of the sub-group committee would facilitate these meetings and record minutes. (3) Provide substitute teachers for *shadowing*. Subs [*sic*] are available for many good reasons and are often approved for use if their purpose is to contribute to school improvement, specifically AFG. Teachers and other professionals who serve our students may not understand how their roles compliment each other in the servicing of our students. Shadowing for half-

> days is one way to foster a more complete understanding of the way we can work together smarter, not harder, to best serve our BES pupils and realize our vision. (4) Assemble *ad hoc research teams* as needed. On an as-needed basis we should provide the research answers to the teachers with questions related to targeted sub-groups and targeted skill projects (like math BCR improvement) so that we could better make research-based educational practice decisions. Also, this research team would be the data team we all discussed that would confirm achievement gaps by analysis of disagreggated data sets and periodically update the record as to which groups require targeting, and for what skills. AFG is about becoming a more intelligent organization through, in part, access to in-house experts via vertical (and horizontal) articulation (S. Rorke, personal communication, November 22, 2005).

The modest, but consistent, success of the initiative was due to efforts in communicating the vision to administration through interpersonal communication and memoranda, then simultaneously to students through new symbols and practices and to faculty through vertical articulation.

Kouzes and Pozner (2002) note the importance of reinforcing a visionary message through symbols and artifacts:

> Leaders pay heed to the informal channels by which organizational messages are conveyed. Foremost among these are the symbols and artifacts of workday life. Posters, pictures on walls, objects on desks, and buttons and

> pins on lapels can be much more than decorative items. Each can serve as a visible reminder of some key organizational goal. (p. 97)

This method of dissemination and reinforcement of a message was already in practice at BES in the form of AFG iconography. The icons serve as instantaneous reminders of core BES values central to the school's AFG process. Fully exploiting the already automatic recognition of the main AFG symbol by the students required that a variation on the established theme be created. The math BCR symbol came to represent a host of written expression strategies in mathematics through an archetypal mode of communication (Appendix A).

Empowering Broad-Based Action

Capitalizing on the ability of students to use pneumonic devices was but one method of empowerment for the targeted student population; another was the process of BCR assessment. Rather than using a covert tool of assessment, like a score key never revealed to the assessed, this initiative continued to encourage a self-assessment step in the progress monitoring and student achievement improvement strategy. The author had converted a rather lengthy and daunting rubric into a simple and easy to use checklist. The checklist remained true to the essence of the MSDE-sanctioned rubric in that the choices are categorical and discrete (i.e., either the student meets criteria and can check the rubric item or cannot). This self-assessment tool, in conjunction with opportunities for reflection, empowered the student in ways not ordinarily experienced in the regular classroom environment.

In the school environment, there are at least two major constituencies to appeal to for broad-based action in transformational change: students and teachers. This is especially the case in matters that pertain to student achievement and teacher instruction, as this matter did. Both parties constituted one half of an equation that resulted in empowerment for purposeful change within the school.

As for the empowerment of teachers to take action to realize the vision of improved written expression in mathematics, the format of the math BCR was standardized and formalized by the author. To further anchor this change of approach to math BCR instruction, the BCR format and student self-assessment checklist was made accessible to teachers via a computer desktop icon. The icon opened a pre-formatted document onto which teachers could simply type their math question of choice and then print (Appendix B).

This strategy had the advantage of creating not only the continuity required for meaningful and reliable comparison of BCR responses across grade levels, but also the advantage of providing a path of compliance that is less resistant than non-compliance. To clarify, non-compliance with the initiative would have been more difficult, or at least require greater effort than compliance, because non-compliance would have required the creation of an alternate BCR format by the non-compliant party rather than using the provided and approved BCR format accessible via the personal computer desktop icon.

The ultimate empowerment of the faculty, however, came not in a path of least resistance, but in the doing away with the ambiguity of the math BCR format that used to be a routine matter of contention among the faculty.

Generating Short-Term Wins

Recognizing improvement in the targeted student population, as per the frequency distribution reports (i.e., the mode of students earning the top rubric score, a 2 out of 2, the mode earning a 1 out of 1, and so on), was the main focus of the initiative. The students made the wins possible, and every opportunity was taken to reward marked improvements. The most visible recognition of these wins was conducted at awards ceremonies.

Consolidating Gains and Producing More Change

This stage of the Kotter process had not been realized. Plans to affect this stage included reinvigorating the process with a hands-on faculty meeting event during which a math BCR format "make-and-take" occurred. The intention of this event was to encourage the use and display of the formalized and standardized Math BCR process.

Anchoring New Approaches in the Culture

This stage, too, had not been realized, though steps to ensure the anchoring of the BCR best practices were brainstormed among the guiding coalition. The ultimate anchoring, it was thought, could come when a complete program of targeted improvement in written mathematics expression is so fully engrained as to be the

norm. This total inculcation and shift, it was thought, would be the correlate of the effectiveness of the visionary program, both of which were dependent upon a valid solution methodology (Lagemann, 2000; Lefton, 1985).

The mechanics of the solution strategy included the use of ex post facto (MSA) data to identify an initial needs assessment in the area of written expression in mathematics, generating in-house data as baseline and comparative measures, and refining the visionary program aligned with the Kotter 8-Stage Process of Creating Major Change. Regarding the scoring of the written selections and data collection: 6 BCRs per class per day were selected as a representative and randomized sample (this was decided upon for logistical, not statistical, reasons); the BCRs were scored using the MSA Math BCR Rubric (MSDE, 2005b) and its simplified adaptation approved by the guiding coalition; only the written response portion (Step B) was scored, as the functional mathematics portion (Step A) was modeled.

Data Analysis and Solution Strategy of the 2005 – 2006 Initiative

The 2006 MSA report card served as an indicator of the limited success of the 2005-2006 school year initiative, however there continued to be some concerns. Although the Grade 4 mathematics scores in the Advanced performance level standard improved (an increase from 12.3% in 2005 to 25.4% in 2006), the *Basic* level population expanded from 22.2% in 2005 to 29.6% in 2006, while the *Proficient* level population experienced a decline from a healthy 65.4% of fourth graders in 2005 to 45.1% of the fourth graders tested at BES in 2006 (MSDE, 2006).

Essentially, the *Basic* category representing Grade 4 math students not meeting testing standards grew by 7.4%, while the categories of *Proficient* and above decreased by the same amount, with a 20.3% decrease to the *Proficient* category alone. A sense of urgency was developed in part by the understanding that the 2005 Grade 3 MSA math scores represented the proficiency levels of the current 2006 Grade 4 math group. The Grade 3 math MSA report of 2005 showed that 38.6% scored *Basic*, resulting in the lowest at or above proficiency rating since the reporting of the MSA data starting in 2003. The notion of the success of the 2005-2006 initiative was based in part on the apparent association between the interventional efforts for Grades 2-4 and the 2006 MSA report. This showed a reduction in the *Basic* category for the Grade 4 students. This means when comparing the lowest performing group of students to themselves (third graders in the 2004 – 2005 school year who became fourth graders in 2005 and took the 2006 MSA) a 9% improvement was made to the *Basic* category (38.6% of the third graders in 2005 scored *Basic*, then 29.6% of fourth graders scored *Basic* in 2006).

A contributing data set informing the notion of success of the 2005 - 2006 math BCR strategies initiative was the student data collected in-house. A student-friendly MSA rubric was adapted from the MSDE public release rubric. The MSA mathematics BCR rubric is a scoring system used to determine if a student response demonstrates a complete understanding and analysis of a problem (a score 2), a minimal understanding and analysis (a score 1), or a complete lack of understanding (a score 0).

On a weekly basis BCR data was collected and scored using the adapted rubric. If modes showed a trend toward more score 1s transitioning to score 2s, and score 0s to score 1s, then an upward trend was thought to be established and assumed to reflect effective change. A downward trend, it was thought, showed just the opposite. Using the in-house frequency distribution reports (Appendix C) and the MSA report card, a school-improvement data-driven decision was made in 2006 to restructure the 2006-2007 initiative from a broad-based best-practices approach to a more formal action research problem solving methodology. The more targeted approach focused primarily on fourth grade mathematics through the creation and use of a diagnostic tool (Appendix E) that enabled instructors to translate assessment data into per-pupil instructional plans that facilitated skill-specific, flexible grouping based on individual student position in a data set (Sorensen & Hallinan, 1986) relative to the *Basic* and *Proficient* and above markers.

Section II- Justification for Implementation

In the 2006-2007 school year an action research team including this researcher designed a more targeted approach for math intervention using per-pupil/per-student diagnostic tools and a system of teacher accountability and student progress monitoring, piloting the interventional program in Grade 4. The change in approach was necessary to address the individual learning needs of students and to mitigate the sense of urgency established by way of the 2006 state assessment data for Grade 4 mathematics at Buckingham Elementary School. Comparing Grade 4 scores from 2006 to those of the year before, the *Basic* category representing Grade 4 math students not meeting testing standards grew by 7.4%, while the categories of *Proficient* and above decreased by the same amount. The problem of student representation in the *Basic* category persisted, so a more diagnostic and responsive approach was decided upon. The goal of the problem solving action research for the 2006-2007 school year was a reduction in the *Basic* category, specifically for grade four math students at Buckingham through an intervention program. The action research team used the data-informing-instruction feedback loop to some apparent success. The interventional program was in compliance with county instructional and accountability mandates. Instructional considerations included flexible grouping from Grade 4 heterogeneous classes for skill-specific interventions. Flexible grouping is a strategy that varies depending on instructional goals, student interests, and student learning needs (Radencich & McKay, 1995; Slavin, 1993). Heterogeneous classes

are made up of children of similar ages but varying abilities (Brophy, 1986). The purpose of heterogeneous grouping at the school-level is to coordinate the relatively even distribution of students of different abilities, as well as different educational and emotional needs, among grade-level classes. Skill-specific interventions are interventions which focus upon the specific learning needs of each student (Tieso, 2005) in a content area, such as math. The math skills focused upon for this intervention were standards of performance, and therefore performance indicators that defined exactly what students should have been able to do in mathematics. The standards were, and continue to be: knowledge of algebra, patterns, and functions (Standard 1); knowledge of geometry and measurement (Standards 2 and 3); knowledge of statistics and probability (Standards 4 and 5); knowledge of number relationships and computation/arithmetic (Standard 6); and processes of mathematics (Standard 7) where students ultimately applying reasoning to solve problems and express their findings (MSDE, 2004). Accountability mandates, too, were a consideration at the outset. The systems-thinking approach helped to incorporate a method of documentation of the standards addressed for each student served.

The program goals were administration approved, and AFG compatible. Furthermore, the beneficial practices of flexible grouping (Barbour, 1990; Good, 2006; Kulik & Kulik, 1987; Masso, 2004; Slavin, 1992; Slavin, 1993; Tieso, 2003; Tieso, 2005) of heterogeneous classes (Brophy, 1986) and skill-specific interventions based on continuous assessment in math (Castle, Deniz & Tortora, 2005; Tieso, 2005) to both remediate and challenge students alike (Cardelle-Ellawar, 1992; Grouws &

Cebulla, 2002; Radencich & McKay, 1995; Valentino, 2000) are research-based and grounded in the literature. Studies and a variety of research demonstrates and shows flexible grouping either produces or is correlated with positive effects on mathematics achievement (Auber, 1994; Bierden, 1970; Flood, Lapp, Flood & Nagel, 1992; Gentry & Owens, 1999) in Grade 4 (Taylor, 1989). The decision to use action research for math score improvement, too, was research-based in that Gottfredson's study of Maryland schools (1986) showed an increase of 11% in math scores due, in part, to the procedural and empirical approach of action research.

This section provides justification for intervention program continuance, and introduces the need for modifications to design, implementation, and evaluation. Through a recapitulation of the 2006 - 2007 interventional math program from an action research and change management perspective, insights into the value of the program can be gleaned (Schmuck, 1997). The action research iterations are reviewed, summary and analysis is provided (Herr & Anderson, 2005), multiple perspectives on the ex post fact MSA data are considered as educationally significant, and *inference to the best explanation* is offered as a decision-making logic. This section concludes with the need for continuance with modifications and forecasted iterative solution strategies.

2006-2007: The Contemporary Interventional Program

This section presents the iterative approach of the 2006-2007 intervention program, documenting separately the first and second major iterations, with

reflections, then finally addressing the Kotter process so far as it was employed informally as a system of progress monitoring of the action research by this author.

Action Research Iteration 1

The first action research iteration included a review of the BCR initiative of the previous school year, the decision to change the scope of the program, and the proposed creation of a more specific per-pupil diagnostic tool. After reflection by members of the administration and the planning council (i.e., the guiding coalition members), separate committees responsible for initiatives tailored to the math needs of Grade 2, 3, and 4 learners were created. The action research team included all Grade 4 teachers, this author and administration. The BCR initiative of the prior year thereby became amended to include the development of a student-and-skill specific diagnostic tool that would serve as a math plan to be individualized with target dates for learning accomplished prior to the next county benchmark assessment in math.

Plan

The action research was responsive and was employed to develop hypotheses, investigative research, problem diagnoses, and evaluation (Dick, 2000). The plan was therefore dynamic, and led to structural changes. A review of the most contemporary formative data collected specific to written expression in mathematics and functional problem solving guided the plan, as did the summative 2007 MSA report. These data sources showed that each grade level had differing areas needing improvement. This led to a division of grade level sub-committees with greater autonomy to focus upon

grade-level specific student learning needs. The Grade 4 student learning needs in mathematics remained solely within the purview of the committee (there are separate programs to address other content area skills); however, a shift in focus from predominantly written expression in mathematics to a skill-and-student specific focus was necessitated by the data. The plan, in its broadest sense, was to ultimately use individualized tools to diagnose and serve as a system of accountability. To this end, the action research team developed a diagnostic tool for math interventions by student, by skill, with a means to document services delivered.

Act

This phase of action research consisted primarily of the development of the aforementioned intervention tool intended to serve as a needs assessment tool by student, by skill, in given time constraints. The first version of the interventional strategy tool did not include a brainstormed novel-services menu of options for teachers to choose from when planning for instruction and flexible grouping students by skill (Appendix D).

Observe

The observation phase of this iteration consisted of making note of any areas needing improvement for the action research teams' initial use of the intervention tool. This was an observation of the procedural changes attempted. The primary area of concern was the lack of a menu of intervention options that could be chosen from by teachers.

Reflect

It was determined the tool developed required a set of actual instructional-interventional strategies. These would be novel approaches not yet attempted, and would reflect an understanding of the students learning styles and needs. To this end, consensus among the action research team was reached that the second iteration would mainly focus upon integrating the indicators with a menu of interventions that correlate with skills listed. Each student then having an intervention report, by skill, with target dates of completion, indicating the means of remediation was the product this process sought.

Action Research Iteration 2

The second iteration required the development of a student-and-skill specific tool that could be adapted to the needs of the teacher and learner alike. A major challenge was to make this tool purposeful and effective without the hindrance of being labor intensive for the teacher.

Plan

The action research team committed to streamline the design of the data informing instruction and consequent student achievement feedback loop in the areas of access to and use of the intervention tool. The diagnostic tool, it was planned, would be anchored in a familiar software platform (i.e., Microsoft Word®). This would alleviate many potential issues of technophobia, and the delayed implementation of the tool's use due to the learning curve of a new software product.

Regarding the use of the tool, it was decided that an agreed upon menu of service options for each skill should be generated.

Act

A menu of novel strategies was generated. Monitoring of the implementation was continuous (Elliott, 1987). The diagnostic tool was made more user-friendly with the inclusion of an interventional strategies menu in a central column for use with the high-lighting function in Microsoft Word® (Appendix E). This was sent as an email attachment to the action research team after being finalized by the author. The tool was in use immediately following its modification (based on action research team input) and dissemination.

Observe

The most pertinent observations of this iteration was that the diagnostic product enabled instructors to translate assessment data into per-pupil tools that facilitate skill-specific, flexible grouping based on individual student position in a data set relative to the *Basic* and *Proficient* markers. In addition, the column on the diagnostic tool used to document the date an intervention took place served as a record of services delivered, thereby satisfying county 'accountability' requirements.

Reflect

Regarding revising the plan, the diagnostic tools just as well suited implementation with *Proficient* students near *Advanced*, as they did with *Basic* students near *Proficient*. Even though the MSDE state test data protocol of

interpretation does not recognize the transition from *Proficient* to *Advanced* as improvement, this is clearly in the best interest of the learners served. Regarding maintaining this action, weekly common planning time of the action research group was scheduled to meet and review the interventional strategies tool, and perceived effectiveness and growth. Meeting time was also used to update the interventional strategies tool and monitor dates of services delivered as compared with post-delivery assessment (achievement) data from county benchmark exams and less formal in-house measures.

Action Research Evaluation: Kotter Redux

This action research provided the systematic inquiry for future iterations of change management specific to this interventional project. As this was the organization's first formal attempt to use the action research process based on a literature search conducted by this author, a greater understanding of the problem could have been developed were an exploratory stance adopted at the outset. This lack of reconnaissance in tandem with the creation of the general plan had arguably delayed the full development and implementation of the action research (Elliott, 1978); however, it was a "process of learning by doing-- for better of for worse" (Kemmis & McTaggart, 1988, p. 34).

As previously noted, an adapted Kotter change management model was employed as a matter of WCPS best practices for transformation efforts, like this action research. The author maintained the use of the Leading Change steps (Kotter, 1996, p. 21) in this action research at the Grade 4 level only. The following analysis

and reflection will come by way of an accounting of the aforementioned process: establishing a sense of urgency; creating the guiding coalition; developing a vision and strategy; communicating the change vision; empowering people to act; generating short term wins; consolidating gains; and anchoring new approaches in the culture. The first four stages of the Kotter process helped to defrost a hardened status quo, while the subsequent stages sought the fixing of changes in the organization.

Establishing a Sense of Urgency

Urgency was palpable in July of 2006 when it was reported not all fourth grade math students have reached proficiency according to the Maryland State Assessment (MSA). Furthermore, upon an initial comparison of the Grade 4 students to themselves it could be noted that the *Basic* category had expanded (MSDE, 2007).

Creating the Guiding Coalition

The action research team assembled in mid-November 2006 and worked toward complete iterations of the action research cycle. Two full iteration cycles were completed, as were the initial goals set by the team: improvement of the data informing instruction feedback loop, the creation and use of an interventional tool, and ultimately and evaluation of the intervention using summative MSA data.

Developing a Vision and Strategy

The change vision was one of data informing instruction for improved student learning, as measured by school, county and ultimately state assessments, through action research. The use of multiple data sources beyond those employed in the

original research design would strengthen the character and nature of the action research, and serve as a strategy for realization of the vision.

Communicating the Change Vision

The change vision was communicated through the vertical and horizontal articulation of the committees and sub-groups in the AFG school improvement process. The action research team reported to the math implementation team, the subcommittee that analyzed sub-groups based on data, and to the faculty at gatherings. On-going communication among the action research team was fostered throughout this process that came to be informally termed *Strategies for Success*.

Empowering People to Act

AFG school improvement is an empowering process by virtue of its bottom-up nature of change influence. Specific to the interventional strategies action research project, teacher and student participants alike were empowered by way of the diagnostic tool that simplified the process of using data to inform instruction. Reflection shows this empowerment process to be akin to the reflection-in-action that Schön described (1983), requiring participants to provide the tension between the means and ends so that the research is the practice, and the practice is the research. Empowerment, in this context, then was marked by the moment when the distinction between knowing something and doing something was blurred by constant analysis and reflection. This was a process "designed to empower all participants in the

education process with the means to improve the practices conducted within the educational experience" (Bodner & MacIssac, 1995) and should continue to be.

Generating Short-Term Wins

Recognizing improvement in the targeted student population, as per the formative data, was the main means of generating short-term wins for student participants. Furthermore, the action research team perceived these wins as their own; this is evidence of the "unconstrained dialogue between 'researcher' and the participants" Elliott spoke of (1978, p. 357).

Consolidating Gains and Producing More Change

Affecting this stage were common planning blocks and county level professional development inservices (at which this author presented on the development and use of the diagnostic tool). Follow-up in-services on the use of the interventional strategies diagnostic tool continued until May of 2007. This encouraged the use of the formal process of data informing instruction in mathematics, thereby consolidating gains and allowing change to be emergent through the action research process.

Anchoring New Approaches in the Culture

The permanence of changes is as yet undetermined; ultimate anchoring will come when the complete program of targeted improvement in mathematics is so fully engrained as to be the norm. This total inculcation and shift will be the correlate of the effectiveness of the visionary program, both of which are dependent upon action

research praxis, whereby action research is intended to be "the reflective counterpart of practical diagnosis" (Elliott, 1987, p. 153).

Summary, Analysis, and Reflection

Future change management iterations of this action research are to follow, as per the recurring nature of the cyclical action research model (Kemmis & McTaggart, 1988), whether continuance is granted or not. This is the perpetual and uncertain nature of action research (Cook, 1998). This research will proceed, even if under a different name, uncertain as it is, devoid of any verisimilitude to the comfort one finds in the precision of purely experimental research. Reflection upon this insight brings confidence in the process: "Vague beginnings can move towards better understanding and practical improvement through the critical analysis of the information, the interpretation of it and the methods used" (Dick, 2000, ¶ 14). It is in that spirit of balance between critical reflection and flexibility that this author offers final points of reflection and critique of the causal empirical-analytic action research process undertaken in the 2006-2007 school year before a recapitulation of data related to the efficacy of the interventional program.

Action Research Strengths

The strengths of the most contemporary action research undertaken were:

- The action research was carried out by the educators as practitioners, rather than solely by academicians;

- The causal empirical-analytic research was done to solve practical problems of instruction and student learning (achievement).
- The overarching strength of the action research approach was its flexibility while maintaining some semblance of rigor through the procedural approach and empirical measurement. Glickman, et al. (1995) contend the objectivity and rigor of action research "can be questioned by classical researchers, but the benefits of the process for students and teachers seem to outweigh the loss of experimental purity" (p. 396).
- This was fundamentally good research because it used a *causal-empirical analytic methodology* (Bodner & MacIssac, 1995) that fit the situation and goals pursued (Dick, 2001).
- Furthermore, the action research undertaken was ambitious, but methodical and worked well with larger organizational development goals and best practices.
- Lastly, the action research was successful and the intervention effective, when the goals of the original design is the scale used.

Action Research Weaknesses

The fundamental weaknesses of this research were:

- It had general, open-ended expectations and definitions of effectiveness and success that were categorical rather than specific and statistical.

- It had a pre-experimental research design with no comparative measure insinuated into the project post-hoc.
- The soft-systems methodology simultaneously revealed the strength inherent in this approach (flexibility), and its fundamental weakness: causal assumptive reasoning.

In light of the federal mandates for scientifically-based research and program evaluation, these weaknesses to design must be addressed.

Multiple Perspectives on the Data

A few approaches can be taken to interpret the available MSA data. Gross features of the data can be considered, with an eye toward discerning general improvement when comparing the Grade 4 MSA scores of 2006 with those of 2007. The data can also be considered in terms of comparing the Grade 4 group that received the intervention to itself, using the Grade 3 MSA scores of 2006 as the pretest data and the Grade 4 2007 MSA scores as the posttest scores. The approaches are always dependent on the original research design, available data, and viable analyses.

Gross Features of the Data

The data from the Maryland State Department report on schools by grade level (MSDE, 2007) provides gross features of the Grade 4 math MSA data and shows an overall categorical trend of improvement (namely a 13.7% reduction in the *Basic* category). This Maryland State Department of Education method of comparing

Grade 4 math scores year-to-year, though not as sound as comparing students to themselves to gauge improvement, is how the state determines if a school's yearly progress is adequate or not. Therefore, when the data is framed in terms of how the state considers *Adequate Yearly Progress*, the results are favorable to the position of continuance. Also favorably, the *Advanced* category grew (by 16.1%).

Though limitations of this analytical approach to the data were many, it can now be concluded whether a change in the outcome (or dependent variable) has taken place. What cannot be said is if this change would have occurred even without the intervention (or independent variable), because it is possible that an intrinsic factor like maturation caused the change in MSA data and not the application of the treatment itself.

Correlation Analysis

The design of any experiment (or pre-experiment) is always dependent on its feasibility. The best approach is to control for as many confounding variables as possible in order to eliminate or reduce errors in the assumptions that can be made. As many threats to internal or external validity as possible should be mitigated. Making this problematic was the fact that the action research team was working within the constraints of time and situation, resulting in conditions that limited the design choice to one of pre-experimental design. The pre-experimental design approach follows the basic experimental steps but fails to include a control group. In this research a single group is studied but no comparison between an equivalent non-treatment group is made. This is called a One Group Pretest Posttest design.

Examples of pre-experimental design are: (1) the One-Shot Case Study- a type of treatment is applied and then the outcome measure is made; (2) the One Group Pretest Posttest Study- one group is chosen, a type of treatment is applied, then a posttest score is calculated to measure the difference, after treatment, within the one group; (3) the Static Group Comparison Study- two groups are chosen, one of which receives the treatment and the other which does not. A score is then calculated to measure the difference, after treatment, between the two groups. (Johnson & Christensen, 2004)

The purpose of this EPP is to inform the decision making process of the school's planning council (i.e., the Buckingham Planning Council) and administration, persuade the decision making body to favor continuance and propose changes to the design, implementation and evaluation of a math intervention program. The research purpose, therefore, was to determine evidence of causality, or a lack thereof, between an interventional program and state test scores.

The recommendation of program continuance was to be contingent upon the results of ex post facto research to determine whether a cause and effect relationship could be said to exist between the Grade 4 math intervention program of the 2006-2007 school year and Maryland State Assessment (MSA) scores. This approach to continuance contingency was introduced post-hoc, as it was not part of the original design, in an attempt to harden the soft-systems approach as a sort of patch-up design (Evans, 1975) to the initially open-ended expectations that were not statistically, but rather categorically, defined. The variables were voluntary state curriculum indicators

(i.e., specific math skills). The treatment was not manipulated, as it had already occurred. Campbell and Stanley (1963) state "Securing scientific evidence involves making at least one comparison" (p. 6). A single-group pretest-posttest analysis on several variables (the math indicators) with the aim of determining if a causal relationship existed between the 2006-2007 math intervention and MSA math scores was to allow for pretest-posttest comparison(s) and determine if statistically significant differences in scores existed (Kogan, 1954). The pretest was the 2006 MSA scaled scores, and the posttest was the most recent 2007 scaled scores. As "causal-comparative studies involve two or more groups and one independent variable, while correlational studies involve two or more variables and one group" (Gay & Airasian, 2000, p. 364) a correlational analysis technique was selected because it most closely approximated the conditions of the research.

The research question posed post-hoc was ultimately unanswerable: Is there a statistically significant difference between the pre and posttest Maryland State Assessment scores of 79 Buckingham Elementary School students who were subject to a mathematics intervention program in 2006-2007? Due to the weak research design the SPSS® statistical analysis was essentially inconclusive, with correlation that was not significant. Although the result of this one analysis was not statistical significance "it does not mean that there was no relationship or effect in the population, especially if the sample size for the study was small" (Utts, 1999b, p. 623), as was the sample size in this single-group pretest-posttest design. That being said, the analysis was, none the less, inconclusive. However one final perspective on

the data-- accounting for post-intervention state testing categories at the scale level (*Basic*, *Proficient* and *Advanced*) and determining if there was progression upward categorically, no change from the pre-intervention category, or categorical descent-- reveals student performance results that cannot be ignored.

Categorical Analysis: At Proficient or Above versus Basic

Given the available rank-order data, the remaining application of analytical reasoning is to divide the 2007 MSA data for the 79 math students discretely. The first discrete cluster is students who experienced a progression upward in category or whose category remained unchanged (56 out of 79 students); the second cluster is students who experienced a decline in MSA category (23 out of 79 students). The type of data making up the first cluster, for example, is a student who scored *Proficient* on the 2006 and 2007 MSA or a student who scored *Basic* on the 2006 MSA but scored *Proficient* on the 2007 MSA. The type of data for the second discrete cluster is any student who scored a lower category on the 2007 MSA than on the 2006 MSA in math. The data is then converted to percentages for ease of interpretation.

Given the assumptions of the action research team that improvement for all students is paramount to the school organization and that decisions about the continuance of the interventional program should be based on MSA student achievement data, the inevitable conclusion is that post-intervention, 71% of the students saw either no decline or improvement categorically while 29% saw regress. Given all the available analyses and evidence, it would be logical to infer that the

intervention was, for the most part, beneficial to student progress or categorical maintenance. There is no competing model using the same data, analyses and reasoning that is superior. For example, there is no ground for arguing that the intervention either retarded student progress or did not improve the categorical lot of MSA scores. This sort of reasoning for decision-making should be familiar to the reader, as all scientific reasoning is ultimately based on a principle called *inference to the best explanation* (Douven, 1999; Elfin & Kite, 1996; Lipton, 2004), a type of causal-inference model of induction (Rappaport, 1996). Regarding program evaluation for effectiveness, Epstein advised that "good evaluations make intuitive sense" while at the same time approach a decision about efficacy "in logical ways" (1988, p. 12). The logical formalism of *inference to the best explanation* is just such a logical approach. Considering statistical versus educational significance, Glickman, et al. (1995) proposes that "decisions about educational significance can be aided greatly by knowledge of statistical significance, but human judgment must be used to weigh the overall benefits" of an intervention (p. 275).

Inference to the Best Explanation

Inference to the best explanation is a method of judgment and reasoning employed in the sciences in which scientists elect that hypothesis which best explains the relevant evidence and/or phenomena. *Inference to the best explanation* "corresponds approximately with 'the method of hypothesis'" (Harman, 1965, p. 88). When *inference to the best explanation* is used, decision makers infer a conclusion by

deciding that it comprises the best explanation for the evidence under consideration (Douven, 1999; Harman, 1965).

Recent work in the philosophy of science has shown that those hypotheses that qualify as *best explanations* typically provide simple, coherent, and causally adequate explanations of the evidence or phenomena in question (Douven, 1999; Elfin & Kite, 1996; Lipton, 2004). Historically, this decision-making tool for conclusion-building was formalized by John Locke according to Harman:

> When we use inference to the best explanation, we infer a conclusion by showing that it comprises the best explanation for the evidence under consideration, as Locke showed in his *Essay Concerning Human Understanding*. (1965, p. 89)

More recently, inference to the best evidence has been championed by Lipton (2004) and his contemporaries, Douven, Elfin and Kite, and Okasha among others, as a distinctive kind of inductive inference, that when even broadly understood, "has the dual attributes of doing justice to the actual workings of science and the demands for its rational justification" (p. 61). While Peter Lipton's model of *inference to the best explanation* (2004) may not represent an advance over the *causal-inference model of induction* (Rappaport, 1996), the former is a scientifically sound decision-making model. In an exploration of scientific reasoning using *inference to the best explanation* Eflin and Kite (1996) confirm the usefulness of this model through the testing of empirical findings and hypotheses for accuracy or falsity of conclusions made using a system of formulae, showing that *inference to the best explanation* is an

accurate method of decision making and interpretation. Though inductive in nature, *inference to the best explanation* differs from pure induction in primarily one way: *inference to the best explanation* can be concerned with singular events and the corresponding evidence, while pure induction is forming generalizations from a large number of instances or events (Rappaport, 1996).

Inference to the best explanation fits as a decision making model for the continuance of the math intervention program because it involves the selection of the best explanation for a particular event or phenomenon, given the available evidence (Tanner, 1998). As has already been show, when inconclusive analyses are set aside (i.e., correlational analyses by math-skill indicators), the best explanation that can be inferred for the evidence that 71% of the post-intervention MSA scores in 2007 remained static or improvement categorically while only 29% regressed is that the intervention was beneficial. Also, when gross features of the data are analyzed for overall student performance improvement in the 2007 MSA the bulk of the Grade 4 MSA scores showed categorical improvement while the remainder mostly showed maintenance, rather than regression.

This begs the inference: the best explanation is the program was a success. There is always the chance that further future evidence will undermine this inference in favor of some other explanation. This conclusion is, therefore, provisional and available for revision in the face of new evidence (hence the necessity for program continuance, and a future design that includes revision upon the collection of such evidence in the 2007-2008 school year, particularly the 2008 Grade 4 MSA).

The planning council (BES-PC) and administration, not having the luxury of extended data trends with revisions to decide for or against program continuance, must make an action decision at this juncture. Action decisions are "a combination of valid on-the-spot-decisions and intuition" (Fullan & Stiegelbauer, 1991, p. 107).

Rationale for Intervention Program Continuance Established

The rationale for continuance of the intervention program is grounded in sound educational decision-making regarding organizational change theory and practice, collaborative planning and problem solving using educational action research, intervention and flexible-grouping literature, and evaluation. A summative evaluation of an intervention is traditionally the basis for a decision about program continuance (Glickman, et al, 1995). The formative evaluation through the action research cycle has already been addressed in the form of real-time intervention improvement and is sufficient for an action decision (Fullan & Stiegelbauer, 1991); a summative evaluation would necessarily include a consideration of the program outcomes beyond the MSA data. These include an enhancement of the data-informing-instruction feedback loop which developed the problem solving capacity of the action research team and the products developed, which are tools that continue to serve the organization. This less reductive rationale is not offered to dismiss the value of the procedural approach and empirical measurement taken thus far. To the contrary, the data analytically interpreted in accordance with the original goals of the 2006-2007 action research is sufficient to support the decision of continuance. Unifying the formative and summative analyses, the available evidence and cogent

analyses that measurable improvement has transpired make the case for a change management project that delivered measurable organizational value and is deserving of continued implementation.

In an examination of the assumptions about change, Fullan and Stiegelbauer (1991) argue that "effective change takes time", "implementation occurs developmentally" and that "implementing specific innovations can be expected to take a minimum of two to three years" (p. 106). Furthermore, in Fullan's view the change process of initiation, implementation, and institutionalization of an innovation or intervention is complex and time consuming (Fullan & Stiegelbauer, 1991). According to the National Staff Development Council (2001) for complex change to transition from inception to institutionalization requires three to five years. Since "persistence is a critical attribute of successful change" (Fullan & Stiegelbauer, 1991, p. 106) it is advisable to decide in favor of continuance.

With the need for continuance established by way of measurable organizational value, the issue of future iterations with changes to design and evaluation is addressed.

Need for Continuance with Modifications

The appeal for continuance of the program is based partly upon the need to improve the research design of the intervention program and to conduct analyses using more numerous data sources over longer periods of time. The intervention, as detailed in this EPP, is a sound approach to using data to inform instruction, requiring only an improvement to research design to become a program that can ultimately

arrive at statistically sound causal-comparative conclusions (Schenker & Rumrill, 2004). These improvements to design are discussed in Section III, as are modifications to implementation and evaluation.

Future Iterative Solution Strategies Forecasted

Future iterative solution strategies to the general problem of students occupying the *Basic* category of the MSA are forecasted using the logic that BES continues the developmental approach to organizational change through action research mediated project management. A systems-thinking approach requires a consideration of the federal standard of research-based and scientifically-based evidence so that future iterations of the interventional program are designed with the goal of meeting or exceeding said standards of research and evidence. All recommendations in Section III are made with the assumption the pilot program has been approved for continuance. It should further be noted that the participatory nature of the action research school improvement approach taken requires that recommendations be somewhat open-ended and informative, rather than highly prescriptive.

Section III- Recommendations

Sections I and II provide a valuable and sensible way to intellectually seal off the action research and report findings to the decision making body. The action research-systems-thinking nexus has provided a coherent framework for school improvement. With the ultimate fate of the interventional change management project for school improvement to be decided, the first recommendation would be continuance with modifications. For ease of distinction between the adopted and previous program iterations, the title of *Strategies for Success 2007-2008* should be made formal, and a logo designed. On the pressing matter of future iterations with improved design for school improvement, Glickman reminds us in *Renewing America's Schools*:

> It is irresponsible for a school to mobilize, initiate, and act without any conscious way of determining whether such expenditure of time and energy is having a desirable effect (1993, pp. 54–55).

Of equal importance to the recommendations, since federal legislation charges schools with changing their current instructional and behavioral practices to employ effective interventions (based on research) with proven outcomes (Schaughency & Ervin, 2006; Stollar, Poth, Curtis, & Cohen, 2006) a proper research design should be developed (Creswell, 2005) by the action research team. The recurring nature of the

cyclical action research model (Kemmis & McTaggart, 1988) should reinitiate in the 2007-2008 school year with reconnaissance. A reconnaissance session would allow for the creation of a plan to continue to use (1) action research for ongoing, evidence-based interventional program implementation and organizational improvement (Davies, 2001; Hollingsworth, 1997; Kratochwill & Shernolf, 2004); (2) a quasi-experimental research design to test the effectiveness of the innovation; (3) systems-thinking to fully articulate with AFG implementation teams and related sub-committees; (4) the Kotter change model to formatively evaluate the process and summatively determine the permanence of organizational change; and (5) on-going professional development to provide faculty with a systematic approach to action research and the intervention program.

In a final analysis of the 2007-2008 iterations, progress of the organizational change process and statistical or educational significance of the quasi-experimental results could be presented as findings to the planning council (BES-PC). The future course of iterations that are scientifically-based and rigorously evaluated could be plotted. A vision of a scientifically-based and rigorously evaluated intervention program is necessarily intrinsic to any viable innovation; therefore, the vision should be formally adopted as a challenge.

Action Research

Action research should be used for ongoing interventional program implementation and organizational improvement (Davies, 2001). The action research process should be formalized, keeping a record of the cyclical iterations (i.e., plan,

act, observe, reflect). McKernan (1988) states that action research as a method of inquiry has evolved over the last century and careful study of the literature shows "clearly and convincingly that action research is a root derivative of the scientific method reaching back to the Science in Education movement of the late nineteenth century" (p. 173). Since the vision of a scientifically-based and rigorously evaluated intervention program is a necessity, using action research is complementary to this vision. In addition, reasons for recommending that action research remain central to the change management project include the benefits of enhancing of the data-informing-instruction feedback loop, which, in turn, will continue to develop the problem solving capacity of the action research team and develop tools that will continue to serve the organization.

Lastly, action research synthesizes well with an advanced quasi-experimental research design. For example, the formative data can be used to inform instruction while the ex post facto MSA data can be used to determine if there is a statistically significant difference in the scores of students subject to interventional treatment when contrasted with comparable students not subject to the interventional treatment. Data analysis in action research implies a separate function (Gabel, 1995), where the focus shifts from planning and action, to more systematic observing and reflecting. This marks the stage where "statements or assertions about what the research shows are produced" (Burns, 1999, p. 153).

Research Design

A quasi-experimental research design to test the effectiveness of the innovation is recommended for the 2007-2008 school year. As "causal-comparative studies involve two or more groups and one independent variable, while correlational studies involve two or more variables and one group" (Gay & Airasian, 2000, p. 364), either could be employed as an adaptation of experimental design to the realities of the school setting.

Quasi-experimental designs were developed by Campbell and Stanley (1963) to counter the difficulties of pure experimental research (i.e., the separation of students and teachers randomly into experimental and control groups, and withholding potentially beneficial treatment from one group). "In designing a study, the researcher must always balance feasibility against definitiveness" (Glickman, et al., 1995, p. 271), so Buckingham might do well to opt for a quasi-experimental design.

Control Groups

Valid scientifically-based research requires the use of control groups. In solid studies, "Researchers compare several schools using a given program with several schools not using the program but sharing similar demographics and prior performance, preferably in the same school district" (Slavin, 2003, p. 13). This is, however, an ambitious approach that should be deliberated by the action research team and approved by administration while following human subjects protocol. A control group provides an estimate of what students in the experimental program

would have achieved if they had not been subject to the intervention. The control school(s) chosen must be as similar as possible to Buckingham Elementary School. Slight variations can be adjusted for in statistical analyses.

Matched Study Rationale

Randomized experiments are rare because of the difficulties they pose (i.e., separation of students and teachers randomly into experimental and control groups, and withholding potentially beneficial treatment from one group). Matched studies are much more common because program evaluation entails researchers comparing students in a given program with those in a control group that is similar in prior achievement, socioeconomic status, and demographics. A matched study is advised.

Hypothesis

No matter the specifics of the control group(s) insinuated into the design for comparative purposes, all experimental designs begin with a hypothesis. The hypothesis proposed is: Students subject to interventional math treatment, when contrasted with comparable students not subject to the interventional math treatment, will show greater gains on pre- and post-measures. As "measures must be isolated a priori" (Glickman, et al., 1995, p. 271), the measures would be the MSA scores at the scaled level. The desired gains could be quantified in advance by the action research team or administration. A statistical analysis, with a predetermined significance level, would then be conducted. This significance level would have to be determined; however, it should be noted that there is a difference between statistical and

educational significance, or practical significance. Practical significance is attained when "the difference between the means or the correlation is strong enough to be of practical importance" (Johnson & Christensen, 2004, p. 484). The potential for error is inherent in all interventions and analyses. This reality means that the error rate, or the alpha level, would also have to be determined so that a threshold of acceptable chance could be established.

P-Value Signifigance

Analyses of education experiments always indicate whether a statistically significant difference exists between the achievement of students in the treatment group and those in the control group. The p-value is the probability that the results were due to chance and not based on the intervention program. P-values range from 0 to 1 (Salkind, 2004). The lower the p-value, the more likely it is that a difference occurred as a result of the intervention program. The notation of $p < 0.05$ is the most widely recognized significance level. It means that the probability is less than 5% that a measured difference might have happened by chance. This notation represents what is called a *p-value* in the literature.

Alpha Error Rate

Alpha (α) level is the error rate that the organization is willing to accept. Alpha is often set at .05 or .01. The alpha level is also known as the Type I error rate (Salkind, 2004). An α of .05, for example, means that the organization is willing to

accept that there is a 5% chance that the results are due to chance rather than to the intervention program.

Effect Size

Effect size is a "measure of the magnitude of a particular outcome" (Salkind, 2004, p. 384). An effect size of zero is consistent with chance, while a large effect size is evident to any observer and convincingly rules out chance. Essentially, the smaller the study, the larger the effect size must be to rule out chance. Generally, effect size is calculated by taking the difference between the group exposed to the intervention and the control group (i.e., the mean of treatment group *minus* the mean of the control group) and dividing it by the standard deviation of one of the groups (Salkind, 2004). In a statistical evaluation with a treatment group and control group such as the one being recommended, effect size is the difference in means between the two groups divided by the standard deviation of the control group (Johnson & Christensen, 2004). Most social scientists use this interpretive spectrum developed by Cohen (1988, p. 56) to understand the magnitude of the effect: < 0.1 = trivial effect; 0.1 - 0.3 = small effect; 0.3 - 0.5 = moderate effect; > 0.5 = large difference effect. Generally in education experiments an effect size of +0.20 (20% of a standard deviation) is considered a minimum for educational significance; effect sizes > +0.50 would be considered strong and actionable (Evans, 1975; Slavin, 2003; Marzano, 2003).

Advancing the Research Design

In research involving the evaluation of organizational changes like Buckingham's interventional math program, "It is rarely possible to obtain the desired experimental controls" (Evans, 1975); however, we can advance the research design to quasi-experimental in 2007-2008 with the ultimate plan of a solid causal-comparative design (a synthesis of methodologies that satisfies the organizations' school improvement needs and federal standards of scientific research and evidence). Lastly, the distinct possibility exists that the use of local county math assessment data could be used as a comparative measure against the MSA results. Beyond county benchmark assessments in math, technology influencing student learning (Cradler, McNabb, Freeman & Burchett, 2002) produces scale-level math data. For example, SuccessMaker® lab data is aligned with the same voluntary state curriculum math standards as the intervention program, making integration of the data for statistical analyses quite easy. SuccessMaker® software combines standards-based instruction with multimedia presentations to deliver a comprehensive, interactive curriculum to Buckingham students on a regularly scheduled basis (as determined by the lab schedule by homeroom). Buckingham could use the math lab data generated that identifies student areas of difficulty and helps teachers effectively target instruction both formatively and summatively. Formatively, the SuccessMaker® reports could be used to corroborate the action research findings of the math intervention implementation; summatively the reports could be used as a comparative measure to determine practical significance of the intervention.

On the practical use of statistics, Utts states: “Statistics is a collection of procedures and principles for gaining and processing information in order to make decisions when faced with uncertainty” (1999a, p. 3). Buckingham Elementary School would benefit from the utility of statistical analyses for decision making, one of the best practices in system-level change (Curtis & Stollar, 2002).

Systems Thinking

A systems perspective for understanding the change initiative is integral to comprehending how it is interrelated with other aspects of the organization and its success (Curtis & Stollar, 2002; Dash, 1999; Davies, 2001; Senge, Kleiner, Roberts, Ross & Smith, 1994). The application of organizational change principles and systems theory to schools has been explored in the contemporary literature (Curtis & Stollar, 2002; Senge, Kleiner, Roberts, Ross & Smith, 1994). Subsequently, an understanding of essential elements for effective change efforts has improved (Fullan, 2001; Senge, 1990). This literature indicates that school change efforts are more likely to succeed when (1) visionary leadership effectively disseminates a vision and elicits a mission, (2) a common vision is shared (Fullan, 2003; Stellar, 1988), (3) the innovation is designed with the particular school’s culture in mind (Kame'enui & Simmons, 1998; Ringeisen, Henderson & Hoagwood, 2003), and (4) when faculty, staff, and community stakeholders are concerned with the problem the school change is intended to address (Hall & Hord, 2001).

Systems theory has been used as a framework for analyzing and solving problems in schools for decades (Curtis & Stollar, 2002). It was a systems-thinking

approach that led to a consideration of the federal standard of research-based and scientifically-based evidence so that future iterations of the interventional program are designed with the goal of meeting or exceeding said standards of research and evidence. In addition to that innovative recommendation, systems-thinking should be employed to fully articulate the action research team with AFG implementation teams and related sub-committees (Witziers, et al., 1999). This would be for the purpose of involving others in the process and reducing class sizes of the *Strategies for Success* groups (Achilles, Finn & Bain, 1997).

The continued inclusion of this researcher, and the addition of the math implementation team (or other sub-group committee members with schedules that allow participation in the *Strategies for Success* program) immediately reduces class size and allows involvement in the development of the interventional tool, which is diagnostic for grouping students by skill and provides novel approaches to teaching the math indicators. These novel approaches will always be subject to updating and change by the grade-level team(s), and the interventional reports can, ultimately, be sent to the respective teams' math coordinator (who does in fact request this kind of documentation for accountability). This means teachers can "work smarter" [*sic*] and use the same document student by student for ease of grouping, for instructional-services options (that they have a say in through the grade-level action research teams), and for accountability.

Permanence of Organizational Change

The Kotter Change Model should be employed to formatively evaluate the process and summatively determine the permanence of organizational change at the conclusion of the 2007-2008 school year. The Kotter model of transformation should proceed as follows: *Establish a sense of urgency* (using the 2007 MSA scores to identify the persisting problem of student representation in the *Basic* category); *create the guiding coalition* (the action research team might expand to include other faculty members or administration); *develop a vision and strategy* (the guiding coalition might refine the vision offered in this EPP); *communicate the change vision* (through symbol, deed, modeling and professional development); *empower people to act* (through distributed leadership); *generate short term wins* (at faculty and professional development meetings with notice of successes); *consolidate gains and produce more changes* (capitalizing on the organization living the cyclical problem solving process and the development of a problem solving ethos that drives the action research team and other faculty to continually improve their performance, synergistically learning to solve problem after problem); and *anchor new approaches in the culture* (with a change in the organizational group-mind from micro to macro, from a merely spaced to the more spacious systems-thinking habit of mind), ultimately resulting in permanence of desired changes (1996, p. 21). The Kotter Change Model steps can be used as benchmarks of organizational achievement, culminating in the anchoring of the new approaches in the culture (Kotter, 1996) when the changes are fixed procedurally and structurally. The two complimentary visions of (1) a scientifically-

based and rigorously evaluated intervention program, and (2) data informing instruction for improved student learning, as measured by school, county and ultimately state assessments, through action research should be popularized as *Strategies For Success*. This communication of the dual synthesized vision should be done through symbolism. Goodman and Truss (2004) in *The Medium and the Message: Communicating Effectively During a Major Change Initiative* remind us of the unifying power of the symbol and its practicality in the dissemination of a vision and popularizing of a message. The *Strategies For Success* logo, as developed and adopted by the action research team and the math implementation team respectively, would provide an easily recognizable "symbolic structure" and "interpretation scheme" (Barber, 2006, p. 23).

Professional Development

Many researchers assert that teaching and learning are strengthened when teachers act as leaders and collectively question teaching routines, examine new methods of teaching, find productive, egalitarian ways to prevent, acknowledge, and respond to conflict, and engage actively in continuous professional growth development (Achinstein, 2002; Grossman, Wineburg, & Woolworth, 2001; Gutierrez, 1996; Hopkins, 1985; King & Newmann, 2001; Little, 1999; Louis & Kruse, 1995; McNiff, 2002; Stokes, 2001; Westheimer, 1998; Witziers, Sleegers, & Imants, 1999). Professional development for teachers is designed in part to offer teacher education on matters of organizational import through andragogy (i.e., an adult-learner equivalent of pedagogy) with the purpose of mitigating the complexity

of bringing to fruition uniform approaches (Davis & Sumara, 1997). A schedule of professional development to provide faculty with a systematic approach to action research and the intervention program should be developed by the action research team (Grundy, 1995; McNiff, 2002). In fact, members of the action research team could share their experiences, successes and challenges using the iterative problem solving action research approach while implementing the 2006-2007 intervention. Action research is associated with improvement in professional practice (Hart & Bond, 1995): The researcher is immersed in the situation; the work unfolds in response to the situation and not to the researcher's requirements; the questions, problems and solution strategies are specific to the local context; descriptions and theories are inductive by way of iteration within the context and are tested within the situation; and there is close collaboration between researchers and stakeholder-participants, (Argyris, Putnam, & Smith, 1985; Baskerville & Wood-Harper, 1996; Burrell & Morgan, 1979; Lincoln & Guba, 1985; Robson, 1993; Whyte, 1991).

There are ample opportunities for professional development. For example, twice monthly meetings are held at which committees and sub-groups can present on AFG-related school improvement efforts or staff development issues of interest. To this end, after the action research team presents on the process used for initial implementation of the intervention program, as well as successes and limitations of the intervention program, members could conduct an interest survey of the faculty to determine how it might proceed with the remainder of professional development

presentations and activities. A menu of inservice topics developed by the action research team could include:

- Federal, state, local requirements for school improvement: Why worry about scientifically-based and rigorously evaluated programs?
- Organizational change management and systems-thinking: The problem solving process and ethos of an organization.
- The Kotter process of change: Formative and summative change evaluation.
- Distributed leadership: Every teacher is a leader in the classroom.
- Educational action research: Improving student performance in math.
- Use of the math intervention tool (in Word® template) as a technology for action inquiry (Brooks & Watkins, 1994).

Conclusion

Buckingham Elementary School is a dynamic, living organization involved in self-study and corrective action. Buckingham Elementary has become flexible in developing innovations and is poised to set levels at which it will achieve change management success, intervention efficacy, and a balance between "vision and the realities inside and outside the organization" (Curry, 1992, ¶ 8). The action research team must define what is meant by program success. Curry maintains that innovation is merely a necessary precursor to institutionalized change. A delineation must be charted between the intervention as a success (i.e., growth as participants, development and refinement of products, and vertical and horizontal articulation

within the organization) and the intervention as effective (i.e., statistically or educationally significant). With the adoption of these recommendations, an evaluation of the 2007-2008 interventional program can use scientifically-based standards and be rigorous by academic and legislative standards.

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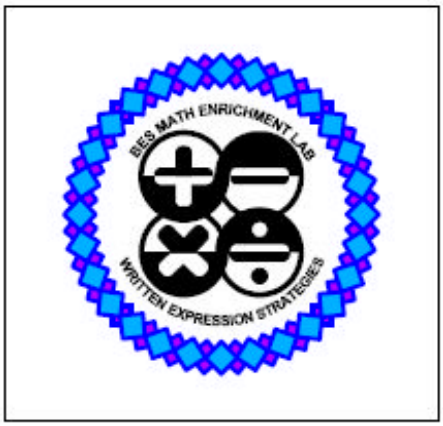
Appendices

Appendix A- BCR Initiative Logo

BES Math Enrichment Lab Written Expression Strategies Logo



Appendix B- BCR Template in Word Platform

The BCR prompt will be here.

Step A *The question will be here.*

Answer here_____

Step B
Explain how you found _____.
Use what you know about _____ in your explanation.
Use words and numbers in your explanation.

I found *state your answer* **by** *explain the steps you have taken to solve this problem in order and use math terms.*
The rule for *math skill or concept* **is** *cite the math rule.*
My answer is correct because *explain how using the math rule helped you solve the problem correctly.*
Use this space to show your work. Use numbers, words and/or pictures.

VSC citation here

CHECKLIST
- **My explanation is organized, uses math rules and uses math vocabulary**
- **My answer is correct and uses words, numbers and symbols or pictures**

Appendix C- BCR Score Distribution Reports

Frequency Distribution Report- Comparison of BCR Scores: Results

GRADE 2

WEEK 1	SCORE	WEEK 19
26	(0)	6
4	(1)	14
0	(2)	7

GRADE 3

WEEK 1	SCORE	WEEK 19
7	(0)	7
16	(1)	13
3	(2)	10

GRADE 4

WEEK 1	SCORE	WEEK 19
5	(0)	4
12	(1)	11
7	(2)	9

Appendix D- First Iteration Interventional Tool

Interventional Report Using Data Derived from Benchmark in Mathematics
TEACHER BES GRADE

Student: _____

INDICATORS (high-light those applicable)		DATE(S) COMPLETED	
1A1 1A2	*functions, tables, patterns*		
2A1	*plane geometry, angles*		
2B1	*solid geometric figures*		
4A1 4B1	*data collection, display, analysis*		
5B1	*probability*		
6A1	*whole numbers, place value*		
6A3	*money- $*		
6B1	*number relationships*		
6C1	*analysis, computation*		
6C2	*estimation*		

Appendix E- Second Iteration Interventional Tool

Interventional Report Using Data Derived from County Benchmark in Mathematics

TEACHER BES GRADE 4 Student: NAME

INDICATORS (high-light those applicable)		**PLAN FOR INTERVENTIONAL STRATEGIES FOR THIS SKILL** Instructional approach that differs from previous teaching for this student	DATE of intervention
1 A1 1 A2	*functions, tables, patterns*	EXPRESS INPUT-OUTPUT VOCABULARY REPRESENT FUNCTION TABLES VERTICALLY AND HORIZONTALLY DISCOVER AND DOCUMENT ENVIRONMENTAL PATTERNS TRANSLATE PATTERNS FROM SHAPES TO ALPHA-NUMERIC PATTERN GENERATION AND RECOGNITION USE MANIPULATIVES TO CREATE NUMERIC/NON-NUMERIC PATTERS GIVEN A PATTERN, HAVE STUDENT DEMONSTRATE THE FUNTION RULE DEMONSTRATE SKIP-COUNTING (SHOW, THEN DIAGRAM) ADD TO PATTERNS TO DEMONSTRATE COMPREHENSION OF THE RULE CREATE A 4-OBJECT GROWING PATTERN DRAW AND WRITE PATTERN SOLUTIONS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
2 A1	*plane geometry, angles*	CONSTRUCT AND RECOGNIZE SOLID PLATONIC FIGURES RECOGNIZE AND DOCUMENT ENVIRONMENTAL ANGLES FLASH CARDS TO MATCH TERMS TO GEOMETRIC IMAGES BODY-ANGLES (ACTING-OUT ACUTE OBTUSE, ETC. KINSTHETIC) TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
2 B1	*solid geometric figures*	CONSTRUCT SOLID FIGURES USING CARD STOCK PAPER IDENTIFY STUDENT CREATED SIDES (FACES), ETC. (AS NEEDED) FLASH CARDS TO MATCH TERMS TO IMAGES RELATE SHAPES TO REAL-WORLD OBJECTS AND STRUCTURES TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
4 A1 4 B1	*data collection, display, analysis*	EMPHASIZE USE OF KEY IN READING A LINE PLOT GRAPH INTERPRET AND DISPLAY STUDENT GENERATED (COLLECTED) DATA CREATE A 4TH GRADE SURVEY AND MAKE A TABLE/FREQUENCY CHART CREATE A LINE PLOT BASED ON THE FREQUENCY TABLE PRACTICE INTERPRETING TEACHER MADE LINE PLOTS REVIEW X & Y AXES, INTERSECTION, ORIGIN, AND COORDINATE POINTS IDENTIFY ELEMENTS OF A GRAPH: LABEL TITLE, LEGEND, INTERSECT. IDENTIFY APPROPRIATE USE OF A GRAPH TO DISPLAY DATA TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
5 B1	*probability*	FORECAST PROBABILITY USING STUDENT GENERATED DATA USE REAL-LIFE EXAMPLES TO EXPRESS PROBABILITY AS A FRACTION (USE COINS, DICE, SPINNER, ETC.) EXPRESS CONCEPTS OF A FRACTION AS PART OF A WHOLE PRACTICE SKILL RELATED SELECTED RESPONSE QUESTIONS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6 A1	*whole numbers, place value*	CREATE AND USE PLACE VALUE GAME, STUDENT AS FACILITATOR PLACE VALUE QUIZMO USE A PLACE VALUE CHART TO PUT DIGITS IN THE CORRECT COLUMN USE FORMULA TO DETERMINE PLACE VALUE + # x PLACE ($ CARDS) COMPARE NUMBERS USING NUMBER CARDS (KINESTHETIC) PRACTICE SKILL RELATED SELECTED RESPONSE QUESTIONS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6 A2	*fractions, decimals*	FRACTION STRIPS PARTS-OF-A-WHOLE-OVERLAYS FOR VISUAL REPRESENTATION MIXED AND WHOLE NUMBERS FRACTION ZIPLOCK BAG ACTIVITY DECIMAL BINGO (QUIZMO) TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6 A3	*money- $*	TOUCH-MONEY STRATEGIES MONEY QUIZMO (USING MONEY TO PRACTICE COMPARING/SOLVING) USE "MATH CENTER" $-CARDS TO COUNT AND COMPARE MONEY CREATE A POEM/BOOK FOCUSED UPON DENOMINATIONS	

		PLAY $ MANIPULATIVE TO SOLVE PURCHASE-EXCHANGE PROBLEMS FLASH CARDS TO MATCH TERMS TO DENOMINATIONS/VALUE SETS PRACTICE SKILL RELATED SELECTED RESPONSE QUESTIONS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6B1	*number relationships*	DISTINGUISH FACTORS FROM MULTIPLES THROUGH PROBLEM DIAGRAMMING USE MULTIPLICATION CHART TO HI-LITE MULTIPLES AND FACTORS MULTIPLICATION AND DIVISION QUIZMO (SKILL & DRILL FACTS GAMES) MANIPULATE STUDENT-MADE NUMBER CARDS TO ADD 3 ADDENDS MANIPULATE STUDENT-MADE NUMBER CARDS TO ADD THOUSANDS PRACTICE SKILL RELATED SELECTED RESPONSE QUESTIONS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6C1	*analysis, computation-* **÷, x, -, ⬇**	PRACTICE COMPOSING-DECOMPOSING NUMBERS UP TO 1,000 STUDENT SELF-CHECK USING RECIPROCAL RELATIONSHIP PRACTICE RELATED SELECTED RESPONSE QUESTIONS USE DIVISION STRATEGY: D M S B (DIVIDE, MULTIPLY, SUBTRACT, BRING DOWN) USE GRAPH PAPER TO ALIGN PLACE VALUE VERTICALLY TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
6C2	*estimation*	CREATE AND USE AN ESTIMATION GAME ESTIMATION QUIZMO USE SENTENCE STRIPS TO DECONSTRUCT THE WORD PROBLEM FIND RELEVANT INFO (#'S) AND USE PROPER OPERATIONS TO SOLVE THE GUESSING JAR ACTIVITY AND ROUNDING SKILLS TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
7B1	*proofing*	REVERSE ENGINEER THE MATH PROBLEM DIVISION AS REVERSE MULTIPLICATION AS PROOF TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	
7C1	*math ideas expressed in words, symbols, visuals or tech.*	BRIEF CONSTRUCTED RESPONSE: ANSWER HOW, ANSWER WHY, SHOW WORK USE PART B RUBRIC FOR STUDENT SELF CHECK: MY EXPLANATION IS ORGANIZED, USES MATH RULES AND USES MATH VOCABULARY MY ANSWER IS CORRECT AND USES WORDS, NUMBERS AND SYMBOLS OR PICTURES IF MY ANSWER WAS *YES* TO BOTH OF THESE, THEN I KNOW I EARNED A2! TAKE HOME SKILL PACKETS FOR EXTRA PRACTICE	

INTERVENTION IMMEDIATE
SEND TO MATH COORDINATOR; CC: PRINCIPAL

This tool is a variation and expansion of the R. Heher (WCPS Math Coordinator) intervention report.