Applying the Effective Change Zone Paradigm to Develop Recommendations for Improved Student Achievement in Mathematics: A Case Study by Prospective School Leaders

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Abstract

This article identifies procedures that may be effectively employed by constructivist leaders to use data and manage instructional and curricular changes in the *effective change zone* (Polka, 2007) for the improvement of student achievement. Data for this case study, developed by aspiring constructivist school leaders enrolled in a graduate course in educational leadership, were drawn from four years (2006-2009) of New York State Mathematics testing in one actual New York State suburban school district (fictitiously identified in this article as *West Central Suburban School District* (WCSSD) in order to maintain anonymity and confidentiality). The graduate students involved in this case study disaggregated and analyzed the data in order to identify key areas of success and specific areas in need of improvement in terms of student achievement in mathematics. In order to illuminate reader understanding of the processes used in the graduate course, the *effective change zone* paradigm is presented along with the students' actual data analysis and recommendations

The graduate students' analysis indicated a potential problem with algebra, an area of identified weakness in student performance at the elementary level, and an area of mathematics that is significantly assessed beginning at the eighth grade level. Because algebra is such a "gatekeeper" content area, the case study hypothesizes that curriculum and instructional improvements at the elementary grade levels could improve student achievement not only in the "higher stakes testing" of secondary mathematics but also in other related content areas such as the sciences. The case study concludes that in order to make meaningful curriculum and instructional changes, leaders must develop targeted constructivist approaches to student learning as well as address the organizational, professional, and personal needs of teachers in the *effective change zone*.

The article concludes with a discussion of the case study's effectiveness as a strategy to be used in graduate courses or professional development programs about data analysis and school improvement by school leaders using the *effective change zone* paradigm.

Introduction

During the Summer 2010 term, advanced graduate students at Niagara University enrolled in an "on-line" administration leadership course (Edu 599 "Technology, Data Analysis & School Improvement") were required by their professor to review large-scale public data bases and to select an area of interest from them for further investigation, analysis, and eventual recommendations for school improvement. This research team decided to investigate the New York State Comprehensive School District Data Base with a focus on student achievement in mathematics to ascertain if there were patterns in school district testing that could be improved at the district-level via appropriate curriculum and instruction interventions. After sifting through the data, the team determined that there were a number of public school districts that they could use for a case study related to focused mathematics curriculum and instruction improvements based on the data findings. However, there existed one specific district, West Central Suburban School District (WCSSD) that would definitely serve as a good case study model because of its demographics: fairly high achieving, average SES, suburban school district with growing and diverse populations. Subsequently, the data from WCSSD were further analyzed and recommendations for curriculum and instruction improvements were provided based on employing the constructivist principles associated with managing in the *effective change zone*. (Polka, 2010)

New York State Mathematics Achievement Testing Data

The New York State Department of Education in 2005 revised the Mathematics learning standard (Standard 3). In this revision, the standard was defined as,

> Students will:
> - understand the concepts of and become proficient with the skills of mathematics;
> - communicate and reason mathematically;
> - become problem solvers by using appropriate tools and strategies; through the integrated study of number sense and operations, algebra, geometry, measurement, and statistics and probability. (NYSED, 2005)[1]

[1] In 2011, NYSED revised its learning standards to adopt its version of the Common Core Learning Standards. While the current New York State Standards in Mathematics are different from those

The research team was able to retrieve publicly available data related to student mastery (100%) in each strand and performance indicator from the NYS Math assessment subsets, grades 3-8 for four consecutive years (2006-2009) for this school district. Data collected from these assessments indicated areas of strength and areas in need of improvement for WCSSD students. Strengths indicate the top five scores within the data when the data was placed in descending numerical order and the weaknesses the bottom five. For example, this means that even if the “bottom five” were all above 80% of the students with 100% mastery, they would still have been identified as “weaknesses in need of improvement.” The top five and bottom five were identified regardless of the cut-off percentage. The belief of the researchers was that there is always room for improvement in student achievement, despite higher scores. They assumed that the assessments from each level substantiate where teachers within the district are positively impacting student achievement and where additional work can be done to improve student achievement. They also assumed that over time, these results compound to affect student scores in secondary school years. The following were the respective mathematic achievement weaknesses and strengths of the West Central Suburban School District:

Grade 3 Math Weaknesses

The table below indicates the average percentage of students that reached 100% mastery over the four years (2006-2009) on specific math performance indicators from the Grade 3 NYS Math Assessment. The five performance indicators listed below are the resulting areas in need of greatest improvement. Three of these weaknesses (60%) are located in the Number Sense and Operations (N) strand. The remaining two weaknesses in performance indicators (40%) are from Geometry and Algebra strands.

published in this article, the effectiveness of the authentic case-study strategy (using the Effective Change Zone concept) remains the same.

Table 1
Performance Indicator Weaknesses from Grade 3 NYS Math Assessment

Performance Indicator Weaknesses	% of Students at 100% Mastery
3.N.25 Estimate numbers up to 500	64.38
3.A.2 Describe and extend numeric (+, -) and geometric patterns	75.25
3.G.1 Define and use correct terminology when referring to shapes (circle, triangle, square, rectangle, rhombus, trapezoid, and hexagon)	75.65
3.N.18 Use a variety of strategies to add and subtract 3-digit numbers (with and without regrouping)	76.49
3.N.4 Understand the place value structure of the base ten number system: 10 ones = 1 ten; 10 tens = 1 hundred; 10 hundreds = 1 thousand	78.48

Grade 3 Math Strengths

The strongest five performance indicators are shown in Table 2, averaging above 90% at meeting 100% of mastery. 60% of the strengths lie within less challenging indicators of Number Sense and Operations (N) strand. The other 40% are from the Geometry (G) strand. Interestingly to note, 98.5% of students are reaching 100% mastery of performance indicator 3.G.4 regarding faces of a 3D figure.

Table 2
Performance Indicator Strengths from Grade 3 NYS Math Assessment

Performance Indicator Strengths	% of Students at 100% Mastery
3.G.4 Identify the faces on a three-dimensional shape as two-dimensional shapes	98.50
3.N.8 Use the zero property of multiplication	94.93
3.N.2 Read and write whole numbers to 1,000	93.98
3.N.13 Recognize fractional numbers as equal parts of a whole	91.37
3.G.5 Identify and construct lines of symmetry	90.33

Grade 4 Math Weaknesses

The data from the NYS Math Assessment in fourth grade indicated that students did have some lasting difficulties with 3rd grade performance indicators. Additionally, both the strands of Measurement (M) and Number Sense and Operations (N) were areas of weakness. The area of greatest difficulty for 4th grade students in this local district was on performance indicator 4.M.1, indicating that these students are unable to select the correct tool or unit of appropriate measurement.

Table 3
Performance Indicator Weaknesses from Grade 4 NYS Math Assessment

Performance Indicator Weaknesses		% of Students at 100% Mastery
4.M.1	Select tools and units (customary and metric) appropriate for the length measured	61.63
3.N.14	Explore equivalent fractions	62.22
4.S.5	Develop and make predictions that are based on data	64.29
4.M.3	Know and understand equivalent standard units of length: e.g., 12 inches = 1 foot; 3 feet = 1 yard	68.07
4.N.27	Check reasonableness of an answer by using estimation	68.85

Grade 4 Math Strengths

The strongest five performance indicators at the 4th grade level over the past 4 years (2006-2009) averaged around 90% of students at the mastery level. The area of greatest ability indicated by student performance is a third grade performance indicator. In actuality, 40% of this table are 3rd grade performance indicators. Additionally, students are showing strengths in areas of Geometry (G). Similar to 3rd grade, 4th grade students expressed strength in the ability to read and write whole numbers.

Table 4
Performance Indicator Strengths from Grade 4 NYS Math Assessment

Performance Indicator Strengths		% of Students at 100% Mastery
3.N.19	Develop fluency with single-digit multiplication facts	91.39
4.N.2	Read and write whole numbers to 10,000	91.16
4.M.10	Calculate elapsed time in days and weeks, using a calendar	89.89
4.G.4	Find the area of a rectangle by counting the number of squares needed to cover the rectangle	89.15
3.G.2	Identify congruent and similar figures	89.06

Grade 5 Math Weaknesses

The Grade 5 NYS math assessment five weakest performance indicators (averaging below 59%) are shown on the next page. 100% of the weaknesses are from the Number Sense and Operations (N) strand. 60% of the weaknesses are Grade 4 performance indicators. 60% of the weaknesses involve fractions. The other 40% involve finding common factors and least common multiples, both of which relate to finding equivalent fractions. Overall there is a weakness in understanding fractions.

Table 5
Performance Indicator Weaknesses from Grade 5 NYS Math Assessment

Performance Indicator Weaknesses		**% of Students at 100% Mastery**
4.N08	Recognize and generate equivalent fractions (halves, fourths, thirds, fifths, sixths, and tenths) using manipulatives, visual models and illustrations	50.18
5.N15	Find common factors and the greatest common factor of two numbers	52.01
4.N24	Express decimals as an equivalent form of fractions to tenths and hundredths	53.69
5.N13	Calculate multiples of a whole number and the least common multiple of two numbers	56.88
4.N09	Use concrete material and visual models to compare and order unit fractions or fractions with the same denominator (with and without the use of a number line)	58.72

Grade 5 Math Strengths

The percentages in the following table indicate the average percentage of students from the school district that reached 100% mastery over the past 4 years (2006-2009) on specific math performance indicators from the grade 5 NYS math assessment. The strongest five performance indicators (averaging above 92%) are shown. Strengths span two math strands, Numbers and Operations, and Measurement. It is worth noting that students show strength in linear measurement to the nearest ½, ¼, and 1/8 inch. It is also noteworthy that adding and subtracting fractions with like denominators are strengths.

Table 6
Performance Indicator Strengths from Grade 5 NYS Math Assessment

Performance Indicator Strengths		% of Students at 100% Mastery
5.N01	Read and write whole numbers to millions	94.59
4.N11	Read and write decimals to hundredths, using money as a context	94.09
5.N07	Express ratios in different forms	93.41
5.M01	Use a ruler to measure to the nearest inch ½, ¼. And 1/8 inch	93.32
5.N21	Use a variety of strategies to add and subtract fractions with like denominators	93.07

Grade 6 Math Weaknesses

The grade 6 NYS math assessment five weakest performance indicators (averaging below 58%) are shown. Weaknesses are scattered over three math strands: Algebra (A), Number Sense and Operations (N), and Geometry (G).40% of the weaknesses indicate problems with percents. Performance indicator 6.A01 indicates trouble using algebra to problem-solve.

Table 7
Performance Indicator Weaknesses from Grade 6 NYS Math Assessment

Performance Indicator Weaknesses		% of Students at 100% Mastery
6.A01	Translate two-step verbal expressions into algebraic expressions	48.10
6.N26	Estimate a percent of quantity (0%-100%)	49.27
6.G07	Determine the area and circumference of a circle, using the appropriate formula	53.47
6.N12	Solve percent problems involving percent, rate, and base	56.81
6.N19	Identify multiplicative inverse (reciprocal) of a number	57.12

Grade 6 Math Strengths

The grade 6 NYS math assessment strongest five performance indicators (averaging above 81%) are shown. Strengths span two math strands, Numbers and Operations (N), and Geometry (G). The strength in expressing equivalent ratios as proportions is noteworthy since in grade five equivalent fractions is a weakness and equivalent ratios as proportions are basically the same as equivalent fractions.

Table 8
Performance Indicator Strengths from Grade 6 NYS Math Assessments

Performance Indicator Strengths		% of Students at 100% Mastery
6.N07	Express equivalent ratios as proportions	91.79
6.N23	Represent repeated multiplication in exponential form	89.17
6.N15	Order rational numbers (including positive and negative)	84.35
6.G06	Understand the relationship between the diameter and the radius of a circle	84.11
6.N24	Represent exponential form as repeated multiplication	82.94

Grade 7 Math Weaknesses

The grade 7 NYS Math Assessment five performance indicators listed on the next page are the resulting areas in need of greatest improvement. In reviewing the 5 questions of most difficulty for the 7th grade, no pattern emerges. Instead, each of the 5 most troublesome questions is unique. The questions involve: scientific notation, Venn diagrams, converting mass, probability, and multiples. The only commonality is that, for each question, almost half of the grade answered incorrectly! As a consequence there needs to be varied and focused strategies both to improve instruction as well as student learning.

Table 9
Performance Indicator Weaknesses from Grade 7 NYS Math Assessments

Performance Indicator Weaknesses		% of Students at 100% Mastery
7.N.5	Write numbers in scientific notation	49.61
6.S.3	Construct Venn diagrams to sort data	49.89
7.M.4	Convert mass within a given system	52.71
6.S.10	Determine the probability of dependent events	53.13
7.N.9	Determine multiples and least common multiple of two or more numbers	55.10

Grade 7 Math Strengths

In analyzing the results from the grade 7 math assessment, some generalizations can be made about the five questions yielding the greatest number of correct responses. The first point of interest is that two questions (1 & 3 on chart) deal with geometry, one of which concerns calculating area. As there are many practical applications for understanding "area," this may be a good topic to design a challenge/extension question or unit in the future.

The second noticeable trend is that two questions relate to basic identification (3 & 5). While it is reassuring that students can get these types of questions correct, these are not questions that ask students to "apply" math concepts to complete "higher level" problems. Some might say that this raises a level of concern whether the state's ultimate goal is teaching the genuine application of skill as opposed to simply test taking strategies. The final point to consider is that two questions (2 & 4) deal with the beginning steps of experimentation. When students are asked in both math and science classes to conduct experiments and to apply the scientific method, it is crucial they get started correctly. The fact that many students were able to predict outcomes (or hypothesize) and choose appropriate tools/techniques is commendable. Experiencing success in the early stages of an experiment helps in motivating students. The strongest five performance indicators are shown in the table on the next page.

Table 10
Performance Indicator Strengths from Grade 7 NYS Math Assessments

Performance Indicator Strengths	% of Students at 100% Mastery
7.S.10 Predict the outcome of an experiment	88.72
7.G.3 Identify the two-dimensional shapes that make up the faces and bases of three-dimensional shapes (prisms, cylinders, cones, and pyramids)	86.80
7.M.9 Determine the tool and technique to measure with an appropriate level of precision: mass	86.58
7.N.1 Distinguish between the various subsets of real numbers (counting/natural numbers, whole numbers, integers, rational numbers, and irrational numbers)	86.48

Grade 8 Math Weaknesses

The Grade 8 NYS Math Assessment five performance indicators listed on the next page are the resulting areas in need of greatest improvement. 80% of theses weaknesses are located in the Algebra (A) strand. The remaining weakness based on the performance indicator is from the Geometry (G) strand.

Table 11
Performance Indicator Weaknesses from Grade 8 NYS Math Assessment

Performance Indicator Weaknesses		% of Students at 100% Mastery
8.A12	Apply algebra to determine the measure of angles formed by or contained in parallel lines cut by a transversal and by intersecting lines	48.20
8.G02	Identify pairs of supplementary and complementary angles	51.03
8.A07	Add and subtract polynomials (integer coefficients)	53.24
8.A08	Multiply a binomial by a monomial or a binomial (integer coefficients)	55.03
7.A07	Draw the graphic representation of a pattern from an equation or from a table of data	55.53

Grade 8 Math Strengths

The strongest five performance indicators are shown in the table below, averaging above 79.44% at meeting 100% of mastery. 80% of the strengths lie within the Geometry (G) strand. The other 20% is from the Measurement (M) strand; specifically, students are successfully calculating distance using a map scale.

Table 12
Performance Indicator Strengths from Grade 8 NYS Math Assessments

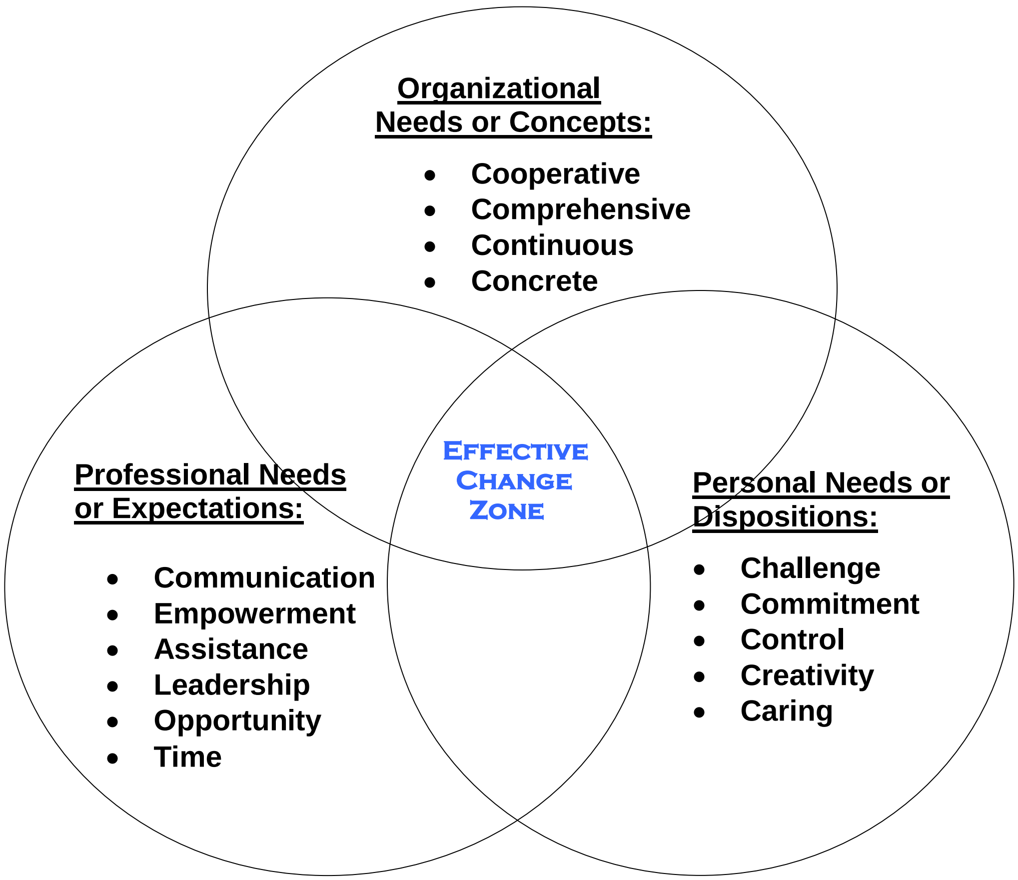
Performance Indicator Strengths		% of Students at 100% Mastery
7.G05	Identify the right angle, hypotenuse, and legs of a right triangle	86.23
7.M01	Calculate distance using a map scale	81.26
8.G01	Identify pairs of vertical angles as congruent	81.02
8.G12	Identify the properties preserved and not preserved under a reflection, rotation, translation, and dilation	80.78
8.G06	Calculate the missing angle measurements when given two intersecting lines and an angle	79.44

Therefore, because this research team “drilled down” into the mathematics achievement data of the West Central Suburban School District, they were able to uncover major gaps in achievement at all of the elementary and early secondary levels analyzed, even though the general data was fairly successful for the school district. The mathematics achievement discrepancies identified at WCSSD by the research team are salient factors that contribute to the need for improvement at the high school level in algebra achievement and other curriculum areas because students didn’t develop the necessary competencies in those tested subsets earlier in their education. Using this information as a catalyst to stimulate faculty discussions about teaching and about curriculum innovations in mathematics is a key factor in changing this paradigm. Leaders who possess this information would need to use it appropriately with the faculty in order to promote meaningful and sustainable changes that will positively impact student achievement at all levels of the curriculum. The research team recommended that appropriate method to do so is for those educational leaders of WCSSD to manage in the *effective change zone*.

The Effective Change Zone

Constructivist school leaders manage people, things, and ideas of their organization in the “effective change zone.” This is the zone where constructivist leaders effectively bring together their interpersonal skills and their management talents to facilitate the momentum of innovators (Polka, 2010, p. 9). The following Figure 1 illustrates the dynamic interaction between the personal, professional and organizational need categories and the area of confluence of all three (i.e., “The Effective Change Zone”) where the implementation of change is most successful (Polka, 2007, p. 17). See Polka (2010) for a complete description of the concepts and justification for the effective change zone.

Figure 1.
The Effective Change Zone



The significance of managing in the "effective change zone" to address the personal, professional and organizational needs of change implementers has been cogently articulated by change researchers:

> Everyone must take responsibility for understanding the concerns that they and other people have about change, and they must also be willing to ask for what they need and be there for others in their time of need … Effective change is not something you do to people. It is something you do with them. (Blanchard & Waghorn, 1997, p. 200-201)

Fullan also identifies the importance for the educational leaders, themselves, when they address those "high-touch" needs of others, "… they find well-being by making progress on problems important to their peers and of benefit beyond themselves" (Fullan, 205, p.104). Accordingly, constructivist leaders and their colleagues learn from each other in the finest Vygotskyian tradition by scaffolding each other in the “effective change zone” as they plan and implement educational changes (Polka, 2010, p.9).

The following matrices, Figure 2, Figure 3, and Figure 4, were developed by the research team based on the review of this case data to illustrate how each of the various high-touch need components from the effective change zone may be addressed in the WCSSD and subsequently how instructional improvements and curriculum development changes that increase student mathematics achievement may be implemented and sustained:

Figure 2.
Managing WCSSD Mathematics in the Effective Change Zone
Matrix A (Organizational Concepts and/or Needs)

Effective Change Zone Components	**Key WCSSD Applications to Improve Student Mathematic Achievement**
Cooperative	Develop a “professional learning community” of teachers and administrators collaborating about the implications of these mathematics data findings and reach consensus about the instruction and curriculum changes necessary to address the identified problems related to algebra inclusion at earlier levels.
Comprehensive	The data reveal that there exists an ever increasing negative achievement impact in terms of subsequent math courses and potentially other curriculum areas (i.e. science courses) because of the 3rd -8th grade mathematics instruction. The correction of the problem in math achievement should also lead to greater student achievement not only in math but in other curriculum areas.
Continuous	This data analysis revealed that the mathematics achievement problem is not unique nor isolated to one class of students nor one instructor but has been fairly constant for the past four years according to the data in all student groups and grade levels tested. It needs to be addressed and corrected immediately.
Concrete	The data charts generated by the research team serve as specific illustrations of the achievement gaps that exist and need to be addressed by educational leaders using instruction examples that may be easily replicated at each grade level.

It should be noted that the above four organizational concepts and/or needs have been comprehensively researched in education for the past sixty years (Polka, 2009, p.189).

Figure 3.
Managing WCSSD Mathematics in the Effective Change Zone
Matrix B - Professional Needs or Dispositions

Effective Change Zone Components	Key WCSSD Applications to Improve Student Mathematic Achievement
Communication	The achievement data contained herein needs to be shared and discussed with the faculty at all levels to illustrate the value of desegregating data and “drilling down” into the data. The analysis of that data needs to be the key catalyst for curriculum and instruction changes in mathematics.
Empowerment	Mathematic teachers need to collaborate with each other about the data and reach consensus about the most appropriate ways to address the gaps uncovered without “blaming” or “shaming”.
Assistance	Teachers need to be provided help by administrators to continue to use data as presented herein to make curriculum and instruction changes that positively impact achievement.
Leadership	The administration of WCSSD need to review this article and plan how to provide the constructivist leadership necessary to make change happen to improve mathematic achievement,
Opportunity	The administration needs to illustrate the personal and professional value presented to each faculty member because of this data analysis.
Time	The administration needs to find ways to provide additional planning time to teachers involved in redesigning their mathematics curriculum and instructional strategies.

The above six professional needs or expectations of people implementing change have been researched as essential to both the successful short-term innovations as well as to the long-term sustainability of organizational changes (Fullan, 2005; Hall & Hord, 2006; Kotter & Cohen, 2002; Polka, 2009).

Figure 4.
Managing WCSSD Mathematics in the Effective Change Zone
Matrix C - Personal Needs or Dispositions

Effective Change Zone Components	Key WCSSD Applications to Improve Student Mathematic Achievement
Challenge	The faculty and administration of the school district need to accept the "brutal reality of their situation" (Collins, 2001), and positively approach making changes to improve facilitate this district moving from good to "great" vis-à-vis student mathematical achievement.
Commitment	The administration and faculty need to focus their attention on improving mathematics achievement and make the change a major purpose for their professional learning community discussions and decisions.
Control	The administrators need to empower their faculty and support staff to make decisions about curriculum and instructional changes that they believe will address the issue at their respective grade levels and district-wide.
Creativity	The administrators need to encourage the faculty to try various instructional approaches, resources and materials, technology software and different grouping techniques to provide more algebraic concepts and activities at all grade levels.

The above five personal needs have been well researched during the past three decades as key "high-touch" factors for leaders to address when implementing changes that impact individuals in their respective organizations (Csikszentmihaly, 1990; DePree, 1989; Glasser, 1990; Kobasa, Maddi & Kahn, 1982; Polka, 1997). Also the personal needs of challenge, commitment, control, creativity and caring were enumerated as key "hardiness factors" of the managers who contributed to the success of companies classified as those companies who "…made the leap from good to great" (Collins, 2001, p.82). Thus, addressing these personal needs contribute to implementation successes associated with key organizational changes as documented in the change literature and research (Polka, 2010, p.17). Subsequently, it is recommended that the administration of WCSSD manage the changes associated with student mathematic achievement using the above "effective change zone" paradigm.

Recommendations for Mathematics Instruction Improvement and Curriculum Development at WCSSD

The research team's recommendations were based on their application of the effective change zone concept(s) to the data analysis. Their conclusions are presented throughout this section, as follows:

In all areas in need of improvement, in-depth pre-testing including extended response questions with multiple questions per performance indicator to determine levels of awareness is recommended. After, it is recommended to then allow for flexible grouping strategies with follow-up instruction as suggested by Tomlinson and Kalbfleisch (1998):

> Teachers may assign students to groups on a random basis or on the basis of similar readiness, mixed readiness, similar interests, mixed interests, similar learning profile, or mixed learning profile. Sometimes teachers constitute the groups on the basis of an assessed perception of need; sometimes students themselves select the groups (p. 53).

Additionally, teachers should carry out small-group, differentiated-instruction that targets varied competency levels within each performance indicator and reinforces basic fact fluency at the early grades. Lessons should immerse students in mathematical vocabulary and be constructivist in nature, designed with real world application and include written explanation of learning by students. Vertical alignment of curriculum must be a focus in order to increase math scores in areas in need of improvement. Mathematical concepts must be made apparent, fluent and concrete through learning facts and formulas.

Instruction in the classroom at all levels should be strengthened in order to use methods that help students learn difficult concepts. As Marilyn Burns (2010) notes in her suggestions for increased success and understanding in math, communication is absolutely essential. Students should be taught to communicate their understanding of math in both oral and written manner. By allowing students talk-time, teachers are giving opportunities for group discussion that allows students to understand different approaches to a math problem. Students that are explicitly taught to communicate their understanding of math through written form also find greater success in testing and retention of material. Additionally, Burns (2010) stresses the importance of allowing confusion and mistakes in mathematical work. In order to learn concepts, students must first sort through their misunderstandings.

The question arises, however, of what teachers are to do when they cannot devise these strategies on their own? The answer involves collegiality. Through mentoring, Professional Learning Communities, and individual initiative, teachers need to collaborate and communicate. Danielson (2009) validates this approach:

> Of all the approaches available to educators to promote teacher learning, the most powerful (and embedded in virtually all others) is that of professional conversation. Reflective conversations about practice require teachers to understand and analyze events in the classroom. In these conversations, teachers must consider the instructional decisions they have made and examine student learning in light of those decisions. (p.5)

When teaching, culminate opportunities with project-based evidence of learning that employs active involvement and includes student choice. Appropriate projects may include but not be limited to: spoken presentations with visuals, multi-media presentations, and teaching others. The following table offers a selection of instruction, practice, and assessment options that offer best constructivist practice suggestions for effective instruction and learning:

Table 13
A selection of instruction, practice, and assessment options

Instruction	Practice	Project-based Assessment
Differentiated instruction	Interactive Websites	Rubrics
Small group instruction	Computer programs	Student choice
Discussion among students	Textbook	Presentation
Teacher models student expectations	Whiteboard	Teach others
Interactive lessons	Homework	Use multi-media
Engaging lessons	Written explanations	Other
Real-world application	Immediate feedback	
Before or after school tutoring	Practice NYS assessment	

Research Team Conclusions

The data collected by the research team about this district (WCSSD) from the existing state large-scale school district achievement data base indicates that by the time students reach the eighth grade NYS math assessment, they are showing a clear deficit in algebra, a disconcerting notion considering high school math courses build upon algebra and algebraic thinking. Prior to grade 8, algebra is only a weakness in grade 3 (Describe and extend numeric (+, -) and geometric patterns) and grade 6 (Translate two-step verbal expressions into algebraic expressions). It is essential to note that no algebra performance indicator is considered a strength throughout the presented data.

Upon further investigation it is noted that the approximate percentage of questions that address algebra on NYS math assessments is considerably less in years prior to grade 8. According to David Abrams, Assistant Commissioner Office of Standards, Assessment and Reporting (2010) in NYS, at third grade 13% of the assessment is based on algebra, in fourth grade 14%, fifth grade 11%, sixth grade 19%, seventh grade 17%, and in eighth grade 44%.

Assuming the educators' adage "what gets tested gets taught" is true, the research team recommends that this district may be wise to evaluate the importance of emphasizing algebra throughout the formative years - even though it's not tested abundantly - to support vertical success of each cohort in algebra. Algebra's importance for today's students, above and beyond math and school assessments, is underscored by the National Council of Teachers of Mathematics (NCTM) (2010):

> Algebra provides a systematic way to investigate relationships, helping to describe, organize, and understand the world… Knowing algebra opens doors and expands opportunities, instilling a broad range of mathematical ideas that are useful in many professions and careers. All students should have access to algebra and support for learning it (p.1).

This information can be used by administrators in order to take the data presented here, along with the impressive advocacy by NCTM, in support of algebra instruction to their teachers for reflection and dialogue on how to best support their students' success in algebra. Additionally, as curricular changes are made, constructivist leaders must recognize that the organizational, personal, and professional needs of teachers implementing those changes, as identified as components of effective change zone (Polka, 2010), must be addressed not only to facilitate the implementation of changes but also to sustain them.

Summary

It should be noted that this type of assignment was extremely useful for a group of graduate students studying to become educational leaders in this contemporary era of student achievement accountability. In contrast to using a contrived example or fictitious set of data, conducting authentic case studies within existing districts was far superior. Candidates were tasked with appealing to faculties for participation, to cooperatively disaggregate data, and to write a coherent analysis affording each an opportunity to report findings. In essence, constructivist theory was able to take root, grow, and influence the leadership experience of the graduate students who developed the case study. Furthermore, collaborating alongside the professor added a wealth of experience and knowledge to the team of aspiring school leaders. It should be noted, consistent with constructivist theory, that the professor did not commandeer the process. Rather, he participated as a contributing colleague.

In 2013 with Common Core Standards and the implementation of related new assessments in New York State[2], our data-driven school culture benefits from this model to analyze current student achievement. Regardless of opinions and views toward this current climate[3], this data-driven approach is beneficial for school leaders and those in training. Since data has been, is now, and will probably be used as benchmarks for student achievement for years to come, the Effective Change Zone paradigm continues to be appropriate to make and sustain positive gains in student achievement. In order to prepare the future leaders entering the schools of today and tomorrow, graduate courses in school leadership and professional development programs must include instruction in the human side of change from such a constructivist perspective.

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[2] See http://engageny.org for further information on current assessments in New York State.
[3] See http://partnershipforsmarterschools.org for opinions and views towards the current climate.

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