

The Mathematics Culture of Teachers in Low Performing Schools:
A Case Study of Educational Leadership

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Abstract

How do you advocate for effective programs in mathematics that create an environment where students can learn and teachers are empowered? How do you create an empowering environment when only 25.3% of your students are “At or Above Grade Level” on a state mandated mathematics test? According to Marzano (2005), educational leadership must have in depth and research-based theory and practice to lead in 21st Century Schools. Educational leadership must have a strong leadership team, delegate responsibility to those teams, solicit the right work, identify the order and magnitude implied by the selected work and match the management style to the order and magnitude of change. School educational leaders should seek strategies that will facilitate change and remove barriers for 21st Century learning. School educational leaders should create a culture of mathematics that embraces change and promotes dynamic continuous improvement. Educational leaders should strive for environments that promote expectations that all students can succeed in mathematics. Policies and programs to meet the mathematical needs of students and instructional needs of staff must support these environments. What challenges do educational leaders face at low-performing schools and how can they find ways to empower their faculty staff? This paper describes the beginning of the journey of one low-performing school, the struggles encountered and the steps taken by its leadership, to create a mathematics culture of teacher empowerment.

Focus and Background

The history of charter schools began in 1997 with the acceptance of the first applications to the North Carolina Department of Public Instruction (NCDPI). Since then, charter schools have been serving North Carolina students in grades K-12. North Carolina General Statute, 115C-238.29A, established “a system of charter schools to provide opportunities for teachers, parents, pupils, and community members to establish and maintain schools that operate independently of existing schools.” NC General Statute established 6 encompassing goals that charter schools were to be used as a method to accomplish, four of these goals have a direct impact on student learning, and they are:

- Improve student learning;
- Increase learning opportunities for all students, with special emphasis on expanded learning experiences for students who are identified as at-risk of academic failure or academically-gifted;
- Encourage the use of different and innovative teaching methods; and
- Create new professional opportunities for teachers, including the opportunities to be responsible for the learning program at the school site.

All in all, a charter is an agreement between the state and the school. To make sure that charter schools live up to their end of the contract, they are subject to complying with the NCDPI’s ABCs Accountability Model, just as other public schools are required.

Timely Charter School (TCS) (pseudonym) was one of the first charter schools in North Carolina, opening in 1997. TCS has tried to establish itself as a “leader in public school choice education,” while struggling with several issues during the last eight years. From 2001-2004, TCS’s annual enrollment ranged from 221 – 282. During these years TCS was designated grades kindergarten through sixth. During the 2004-2005 school year TCS, was designated K-7 and increased its enrollment by approximately 30 students. Since then, TCS has expanded to grades K-8 and has had a mean annual enrollment of approximately 347 students. Since the 2001-2002 school year, TCS’s African American student population has ranged from 95.8% up to 100%, in grades 3rd – 8th grade. TCS’s economically disadvantaged students have been approximately three-quarters of their 3rd – 8th grade student population and their students with disabilities population have been at most 14.6% of this population. Lastly, another issue that TCS has been dealing with is its number of “Highly Qualified Teachers.” The number of highly qualified teachers has ranged from 47% in the 2004 – 2005 school year, up to 100% in the 2006 – 2007 school year. Many of these factors could have played roles in the school’s designation as determined by the NCDPI’s ABCs of Public Education.

The ABCs of Public Education began in the 1996-97 school year as North Carolina’s primary school improvement program and with three primary goals: 1.) to strengthen local school accountability, 2.) to emphasize mastery of basic subjects, and 3.) to provide as much local decision-making as possible. The ABCs model was one of the first in the nation to focus attention on the academic growth of students from year-to-year. The school designation categories remain stable in scope and in definition. School designations are listed in Figure 1.

Designation	Performance	Growth		
		Learning Achieved in One Year		
		High	Expected	Expected

		Growth	Growth	Growth Not Achieved
Honor School of Excellence	At least 90% of students at grade level and school made adequate yearly progress (AYP)			
School of Excellence	At least 90% of students at grade level			
School of Distinction	At least 80% of students at grade level			
School of Progress	At least 60% of students at grade level			
No Recognition	60% to 100% of students at grade level			
Priority School	50% to 60% of students at grade level, OR Less than 50% of students at grade level			
Low Performing	Less than 50% of students at grade level			

Figure 1. School designations.

Each year, schools in North Carolina may receive several designations based on their performance on the state’s ABCs tests. These designations are awarded on the basis of the percentage of students performing at grade level and on whether students have learned as much as they are expected to learn in one year (NCDPI, 2007).

Figure 2 contains TCS’s designations, as determined by the ABCs of Public Education, since the 2001 – 2002 school year.

Designation	Performance	Growth		
		Learning Achieved in One Year		
		High Growth	Expected Growth	Expected Growth Not Achieved
No Recognition	60% to 100% of students at grade level			2003 – 2004
Priority School	50% to 60% of students at grade level, OR Less than 50% of students at grade level	2002 - 2003		2001 – 2002
Low Performing	Less than 50% of students at grade level			2004 – 2005 2005 – 2006 2006 – 2007 2007 – 2008

Figure 2. Timely Charter School’s designations since the 2001 – 2002 school year. Adequate Yearly Progress (AYP) requires schools to focus on the proficiency of groups of students within each school with a goal of closing achievement gaps and bringing proficiency rates to 100 percent for every student group by 2013-2014 (www.abcs.ncpublicschools.org/abcs). AYP sets the criteria for school performance by groups of students, and schools either make

AYP or not, there is no partial credit. In order to make AYP, schools need to meet all the performance targets set for them. Targets are set for performance on ABCs test, as well as student attendance. Schools work towards the goals set for them in each area as a whole and for student groups when they contain 40 or more students in defined target populations. The target populations are white, black, Hispanic, Native American, Asian, multiracial, economically disadvantaged, limited English proficient, and students with disabilities (North Carolina Department of Public Instruction, 2007).

Except for an Annual Charter Schools Conference sponsored and coordinated by the Office of Charter Schools, within the NCDPI, the state has not established a vehicle by which the traditional public schools can examine charter schools innovations and consider them for adoption. Some stakeholders in the traditional public schools may not feel there is much to be learned from charter schools, which contributes to a disconnection between charter schools and traditional public schools. In a Fordham Institute Report, North Carolina’s charter law received an overall grade of B. However, in the same report, North Carolina received a D for its support of charter schools (Palmer and Gau, 2003).

Methodology

The purpose of the professional development workshops titled “Empowering Our Students by Empowering Ourselves” was to determine the needed resources that the teachers at TCS needed to improve their students test scores. In addition, to giving the teachers a sense of empowerment, the workshops looked to find ways to use available resources within schools and the NCDPI to enable TCS’s teachers to teach grade-level mathematics content to all students. Research states that teachers need to align standards, assessments, and learning environments to produces outcomes for today’s students (Partnership for 21st Century Skills, 2009).

The most recent released NCDPI data for the ABC’s End-of-Grade (EOG) Tests for TCS revealed an urgency for assistance in mathematics at all grade levels.

	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Overall
# of students taking the test	29	32	34	24	38	33	190
% of students at or above Grade level	37.9%	18.8%	41.2%	33.3%	15.8%	9.1%	25.3%

As determined by the NCDPI EOG scores, overall, a little more than one-quarter of the students are performing at or above Grade level, in the 2007 – 2008 school year. These scores suggest that there was a need to implement teaching and testing strategies for both teachers and students.

There were three 1 ½ – 2 hour sessions covering the following topics:

- Focusing instruction to address EOG test requirements for mathematics
- Test taking strategies for mathematics
- The North Carolina Standard Course of Study (NCSCS) for mathematics

- Implementing NCSCS resources for mathematics
- Implementing the NCSCS with current textbooks and resources for mathematics
- Time Management and NCDPI resources for mathematics
- Higher Order Thinking questioning strategies

In support of the three workshop sessions, there were school observations and feedback given on lessons, monitored the use of resources, staff meetings were held and discussions on planning, model lessons and activities. Lastly, there was time when individual teacher concerns and to assist with students needs were addressed.

During the first meeting, eight teachers agreed to take part of the professional development workshop. They represented grades K through 8th. It was during this meeting, that they discussed the type of professional development they needed. In the first meeting it was stressed that the teachers were in charge and that this series of workshops were designed to empower them and give them a voice in the mathematical curricular decisions made by TCS. Lastly, a survey was given to the participants. This survey collected information on their backgrounds, as well as their knowledge of state resources, and insights into their teaching styles and strategies. The questions and a summary of their responses are below:

Questionnaire

Grade I teach: K-3, 4, 4, 5, 5, 6, 7&8, and 1 unanswered
 Years I have taught: 2, 5, 6, 10, 14, 21, 32, and 1 unanswered.

1. If I need mathematics resources from the North Carolina Department of Public Instruction (NCDPI), I feel confident that I know where to get them.

Strongly Agree	25%
Agree	62.5%
Disagree	12.5%
Strongly Disagree	0%

How would you get the resources?

- I know that I could go to learnnc.com and get lessons for grade levels. I am aware that there are also Test Prep items to be used according to NCSCOS.
 - Information shared by other teachers, Internet, team partners, school resources.
 - [Unanswered]
 - Npublicschools.org, call my NCAE rep, call DPI
 - Google
 - Go directly to the website
 - Internet, recommendations from other teachers.
2. Which of the following is a Mathematics resource provided by NCDPI?

Correct Answer	0%
Incorrect Answers	100%

3. Which of the following is NOT a mathematics resource provided by NCDPI?

Correct Answer	75%
Incorrect Answers	25%

4. I feel as if I use good teaching strategies in my classroom that promote understanding.

Strongly Agree	12.5%
Agree	75%
Disagree	0%
Strongly Disagree	12.5%

5. I feel as if I clearly understand the Goals and Objectives as they relate to my grade level in the North Carolina Standard Course of Study.

Strongly Agree	25%
Agree	75%
Disagree	0%
Strongly Disagree	0%

6. I feel as if I clearly understand what my students will be tested on when taking the NCDPI End-of-Grade test.

Strongly Agree	0%
Agree	87.5%
Disagree	12.5%
Strongly Disagree	0%

7. What is the highest level mathematics course that you took, when did you take it, what was its title, and what grade did you receive in it?

Highest level (e.g. High School, Undergraduate, Graduate, etc.):

6 Undergraduate and 2 Graduate.

When did you take the course (e.g., 2003)?

1984, 1990, 1990's, 1996, 2004, 2005, 2005, 2006

What was the title of the course (e.g., Calculus)?

Intro. to Grad Studies, 2 Elem Ed, Stats, Calc-trig, trig, 2 don't remember

8. As a student, myself, I had mostly positive experiences in my mathematics courses.

Strongly Agree	37.5%
Agree	37.5%

Disagree	12.5%
Strongly Disagree	12.5%

9. I feel as if I have enough resources available to aid me in the making my students successful in mathematics.

Strongly Agree	12.5%
Agree	50%
Disagree	25%
Strongly Disagree	12.5%

If either, Disagree or Strongly Disagree, what resources do you feel that you need?

- More manipulative- concept tools, overhead calculator, some “wish list” high-tech stuff.
- Still feel like we need updated resources. We have to go find everything.
- Internet, Smart Board, more manipulatives.
- The calculators are coming – I’d plan to use them this week.

10. I would describe my students as

- Excited about math – they question and ask “why.” I must admit I have to ask a team mate sometimes. My goal is to answer the questions they ask in a way they understand them.
- Below grade level and have trouble staying focused.
- Students that really want to learn but need it to be exciting or fun.
- Generally enjoyable.
- 30% visual learners, 40% hands-on learners, 15% EC, 15% don’t care.
- Having lack of drive and focus.
- About 75% low performance, unable to recall information, do not know how to multiply, subtract, or able to differentiate between number operations and or when to use them correctly.
- Energetic, but most of them are interested in learning.

11. The one thing that impresses me the most about my students is

- Their ability to catch onto to some (most) concepts easily.
- How easily they engage in conversation.
- Their ability to think outside of the box.
- General willingness to work.
- Being able to accept constructive criticism and apply it to their own well being.
- They have lots of energy.
- I think they can do when they want to.
- For the most part they try to be successful.

12. If it were possible, the one thing that I would change about my students is

- Their ability to retain information taught.
- To make them more serious when it comes to homework and projects.
- Their ability to grasp and master basic math computations and skills.

- Few changes.
- Lack of study skills.
- Their attitudes about learning Math.
- Being responsible, accept accountability.
- Their need to antagonize each other.

13. I will describe my teaching style as

- That of lecturer – sometimes a facilitator. I'd like to be more of a facilitator.
- Student focused with hands-on activities.
- Ever-changing.
- Focused, real-life examples.
- Adaptive.
- [unanswered]
- Effective, student-centered, and try to cross reference real world with classroom.
- Facilitator.

14. The one thing that I would change about my teaching is

- I'd like for my style to be more interactive. It started out that way with "Investigations Math."
- Have the students to teach or lead the class more.
- I would improve on my ability to differentiate instruction for all my students in Reading and Math.
- Be more places at one time.
- More technology.
- Make learning more fun.
- Try to seek other resource outside of our setting.
- To be able to provide more hands-on activities and multi-level grouping with students.

15. If I were not a teacher, realistically, I would be

- Working on a college level or in corporate teaching teachers.
- Corporate banker.
- A Psychologist.
- Business information.
- A community activist or a preacher.
- Pastor.
- Still be involved in student work in our community
- A housewife.

Another purpose of the first workshop was to enable the voice of teachers, and to begin to empower them to better instruct their students. With less than 2 months left in the school year, collected data concluded that the students were weak in several content areas. The teachers were informed of which goals were most heavily tested in each grade area and they became dedicated to teaching these objectives over the course of the last 26 days left of classroom instruction. With their new focus, the teachers of TCS wanted to incorporate as much of the NCDPI resources to assist them in their endeavor. They were given released sample items, classroom strategies, and objective indicators. With all these tools now in their hands, each grade level had a focus and a direction.

In reviewing the data presented throughout the workshops and observations, it was decided to compare what the participants said was going on in their classrooms, before, during, and after the workshops to what was actually happening. The focus of this research will be on what new processes and procedures were put in place that potentially contributed to an increase in overall student achievement.

Results

The survey indicated that the teachers at TCS knew how and where to get NCDPI resources. During observations of the classroom instruction, only two individuals used NCDPI resources. Resources used by most teachers came directly from the text. Research (Cohen & Ball, 1999) suggests that teacher use of text materials shapes the way that students learn. Davis (2003) suggests that teachers' beliefs of what and how to teach are largely influenced by their backgrounds and belief structures. Therefore, if the teachers believe that the text books are aligned with the text and materials they will use them. During the observations two incidents suggested that this was happening in the classrooms. Both instances involved the teachers using the textbooks as the main structure causing them not to teach NCSCS grade level competencies. The first involved teaching adding and subtracting fractions with unlike denominators when the grade level objective stated, "Develop fluency with addition and subtraction of non-negative rational numbers with like denominators..." (NCDPI, 2003). Clearly, the teaching the addition and subtraction of fractions with unlike denominators, while in the textbook, was not aligned with the state objective. The second incident involved another teacher seeking help about teaching students about operations with rational numbers. The teacher's textbook had the students computing with negative integers and this was, again, not an objective to be taught during that grade level, unless it was to be an enrichment activity. When both teachers examined the NCSCS more closely, they realized that they had spent valuable instructional time teaching something that was not aligned with their curriculum.

The second workshop focused on allowing the teachers to express what they needed to help them become more successful in their classrooms. This set in motion the teacher's ability to feel empowered. Admittedly, at first, it was difficult to get the teachers to ask for materials. But when they saw ways to engage student learning, better focus on the objectives to be taught, and possibly increase their scores, they became excited over the opportunities. The opportunities that the teachers became excited about were getting a better understanding of how to implement the NCDPI resources in their classroom, getting access to sample test items, and finding ways to encourage their students. The teachers wanted to see a lesson modeled using the NCDPI resources. The lesson sparked interest on everything the NCDPI offered for classroom instruction. The teachers asked for the links and hardcopies of the printable NCDPI resources. When the model lesson was presented there was discussion about how to use the resources to better align the teachers' instruction with the NCSCS. Student engagement in the lessons became a topic for discussion. One teacher suggested offering the students rewards for attempting the mathematics. The teacher had been successful in the past with offering small candies to get her students to participate. The other teachers felt that a similar approach might be something worth trying with their students. It was decided by the group that the candies were to be used as an incentive for staying focused, getting problems correct, and attempting the mathematics. Lastly, the teachers wanted to use sample test items on a more consistent basis. They had access to a formative assessment computer program, but it was something that had to

be scheduled in a computer lab, and they wanted to be able to have sample items for the students to also work on in the classroom. The teachers received sample released items from NCDPI and other test booklets but then they, themselves, began to look seek out more items for use in their classroom. One teacher ran across a series of test banks for grades 3rd – 8th and after they were reviewed for their alignment with the NCSCS, the teacher shared this information with her colleagues.

By the time that the EOG tests were about to take place there was change in the culture of the school. The teachers felt as if they themselves had improved and that their students were going to do better on the NC EOG tests. The teachers and administrators felt as if the culture of the school had become a more positive teaching and learning environment. By stepping back and not trying to dictate academic policy, the administration allowed for the teachers to seek out the answers that they needed without feeling inferior because they sought help. When the teachers began to feel empowered, they asked more questions, requested more resources with plausible justifications, sought further resources, and held higher expectations for their students.

The preliminary data from the first test showed an improvement in test scores, see below.

	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Overall
# of students taking the test	35	34	37	42	15	27	190
% of students at or above Grade level	60.0%	35.3%	16.2%	26.2%	66.7%	37.0%	36.8%

The largest gains were in 3rd grade, 7th grade and 8th grade. On the first taking of the state test, approximately 46% more students passed the test than the previous year. Because of new state policy, students were allowed to take a retest of the NC EOG test and schools could have these retests count in their overall passing scores. These retested scores greatly impacted student achievement.

With the retest data under preliminary review, it is still possible to say that the students at TCS achieved Expected Growth in 2008-09 as measured by the NC EOG tests. More than 60% of the students in grades 3rd – 8th experienced at least one year of academic growth as determined by the state achievement tests. This growth is a substantial improvement in student performance when compared to the performance of students during the past several years. Also, it appears that student proficiency increased by approximately 80% as compared to the results of 2007-08 EOG tests. That means that the number of students that scored “At or Above Grade Level” on the tests almost doubled as compared to the past year. As stipulated by the North Carolina accountability standards, a student must score “At or Above Grade Level” to be academically proficient at grade level. Thus, we substantially reduced the number of students scoring “Below Grade Level” on the tests.

Since receiving the information regarding student performance on the EOG tests, TCS learned, based on the achievement of their students on the EOGs, it made AYP as measured by No Child Left Behind (NCLB). TCS has been in School Improvement status for five years, meaning that it had not made AYP for 5 years. If TCS achieves AYP next school year, it will move out of

School Improvement status and will no longer have to comply with the organizational sanctions that it has encountered during the past years.

Since the improvements made by the faculty, in mathematics, at the end of the last year, they have created a Math Leadership Team (MLT). The MLT consists of at least one individual from each grade level. The MLT is charged with deciding what resources each grade needs, they have chosen new textbooks and materials that better align with the NCSCS. Lastly, the MLT has planned to create math pacing guides for each grade level, and has begun discussions about creating benchmark tests.

Implications

It takes the ability of the school executives to provide their teachers with worthwhile professional development in order for teachers to align state curriculums, state assessments, and classroom teaching (Malone & Davis, 2009). When teachers are involved in professional development focused on state curriculums, they begin to make better decisions about what and how to teach. There is a shift in instruction so that it better aligns with what is expected from a state curriculum, as deemed by a state mandated test. If teachers have this understanding about what and how to teach, they are better able to engage their students and have clearer indications of their understandings.

The empowerment of teachers means giving them opportunities to make decisions, learn, and grow, while providing guidance, as opposed to restrictions. If we hold teachers accountable for what is learned in their classrooms, then we must empower them with the necessary tools to be successful.

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