Creating New Opportunities for STEM Learning: Insights from Case Studies of 5 Schools

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Introduction

On behalf of the Intel Corporation, SRI International conducted case studies of five schools that provide rich, rigorous science and math learning experiences for students. This report describes these schools, the challenges each faced, and how they were able to build effective learning environments.

The significance of these schools’ accomplishments can best be understood within the national interest in STEM instruction and learning. Calls for broadening the population of students motivated and prepared to pursue STEM studies, with the ultimate aim of strengthening the country’s competitiveness, have been frequent and widespread, including Prepare and Inspire: K-12 Education in STEM for America’s Future from the President’s Council of Advisors in Science and Technology,1 Building a STEM Agenda,2 and Rising Above the Gathering Storm.3

Each of the five schools in this study has been recognized with an Intel Schools of Distinction award, attesting to their outstanding teaching practices and student learning. In late 2012 and early 2013, SRI explored how the schools have successfully responded to the challenges of providing high-quality education in science and mathematics by examining the school’s prevalent conditions, strategies leading to their success, and the outcomes achieved within their unique geographic, policy, and community context.

The first part of this report provides an introduction to the schools and the cross-case themes that emerged from the cases. After this synthesis, each of the five case study schools is more fully described, including the challenges they faced and the factors leading to their success.
The case study schools were selected for their diversity of location and context. They were all consistent, however, in their inclusiveness, serving students representative of their area (versus schools that have selective admissions, for example), and for their histories of improvement (versus powerhouse schools that have long-standing records of success and/or unusually deep resources). The table below gives an overview of the five schools studied.

SRI & Intel researchers visited each of the five schools for 2-3 days. During these visits, we interviewed school leaders, district staff, at least three teachers, and other school staff members (such as the technology director or math coach). In addition, at each school SRI conducted a parent focus group, a student focus group, and at least three classroom observations. These activities provided insights into the context, challenges, and strategies implemented in the schools.

Across the successes documented in these very different schools were consistent underlying themes. First, all the schools broke from the norm in some way and created a new vision and culture of education. At George Hall Elementary, the break from business as usual included a new school leader, replacement of nearly all the teachers, a new curriculum, and drastically different school practices. In the restructuring, school staff even worked to clean up the school building. Change at this scale was difficult for the community at first, but community support was built over time. Although the changes at George Hall are dramatic, all five schools made bold changes of some kind. Byron High School flipped its classroom and homework periods, redefining the approach to student learning with a full openness to the digital revolution in education. Preston adopted a growth mind-set as a teaching staff, made every class advanced, and then developed ways of scaffolding and differentiating learning for the newly empowered students. An important factor within each school was that teachers and administration broke free of their old habits and thoughts, charted a new course, and harnessed their courage to make bold changes.

Second, the schools all provided professional learning communities (PLCs) and professional development opportunities shaped and directed by teachers. Teachers are often expected to implement curricular or pedagogical changes designed by experts or someone outside the school, and professional development or PLCs are
used to support teachers in making these changes. At these schools, the opposite was true. For example, at Byron teachers were provided the tools, time, and training to form innovative PLCs where members were encouraged and supported in attempting collaborative, measured, systematic implementation of radically new and ultimately quite effective instructional methods. Preston math teachers had a similar story. Their principal pushed for a culture where it was expected that all students could learn at the highest levels, but he then empowered teams to explore and craft their own innovative means of achieving that goal. Professional development and PLCs, then, were not a method of integrating someone else’s school improvement but a way to equip teachers with the skills and opportunity to envision and implement their own classroom improvements.

Third, all the schools provided creative and thoughtful out-of-school time learning opportunities for students. Preston offered plentiful opportunities to engage in hands-on science activities such as wildlife habitat restoration and created an elective system, with the final period of the day dedicated to help students discover and pursue their passions. Taking advantage of its New York location, MS223 provides students with the cultural opportunities routinely enjoyed by wealthier families, such as outings to museums and Broadway shows, in order to provide students a broader and more enticing worldview. Byron’s use of the flipped classroom, where students are introduced to content outside class and work on problems during class time, is a creative redefining of in-school and out-of-school time. In all five schools, teachers and administrators took a broad view of learning, beyond classrooms and standards, to encompass the motivations, interests, and passions of their students.

Fourth, the schools devised sensitive methods to meet each student’s unique learning needs. MS 223 hired a full-time math coach to support the use, interpretation, and teaching responses to formative assessments. In addition, it developed a mutually beneficial relationship with a teacher training program that now puts additional teaching professionals in high-need classrooms to maximize opportunities for small-group learning at a pace and with methods more customized to each students’ needs. George Hall also used a data-driven process, using a technology system that provides instant analysis of student skills, ensuring that what students learn is appropriately leveled and based on need. After pushing all students into an accelerated math program, Preston needed to develop a robust system for ensuring that all students learn. Its differentiation of instruction now comes through flexible student groupings where, each week, students across grades and classrooms address different learners’ needs lesson by lesson. In each case, the schools are finding ways to meet students where they are and support them in their personal learning trajectory.

Finally, all the schools sought out and leveraged nearby resources. MS 223 partnered with Teach For America to bring more adults into the math classes, Yale University to provide arts education, and local college fraternities, sororities, and sports teams to glamorize college for their students. Farmington View conducted an asset-mapping project and used it to identify local resources such as the Jackson Bottom Wetlands where students participate in wildlife preservation research. In addition, the mapping of resources extended to the school’s parent population, where any adult with valuable expertise was tapped to lead an afterschool club or activity. Byron High school has used technology to gather free web resources and tools to build and deliver learning content, first with math and now with many subjects. Each school has found creative ways to forge external partnerships to expand the learning resources available to students.

In all 5 cases, the Intel Schools of Distinction Award was a lever for additional, positive changes for these schools. This national recognition provided the schools with increased ability to forge new partnerships, extend their innovative practices, and serve as models for other schools and helping to disseminate best practices within their districts. The five common themes among these case studies demonstrate that the schools in this study were recognized for and built their success on a large view of their educational mission. They took bold and brazen approaches, they supported ground-up changes from teachers, worked to maximize both in-school and out-of-school learning opportunities, and brought in external resources to support their efforts. Each of the five schools provides a story of success within its unique setting and context, yet this bold, broad, and resourceful perspective runs through each case.
Summary of case:
Because of its poor performance, George Hall Elementary went through a radical restructuring in 2004. The new principal replaced almost the entire staff with the highest caliber teachers she could recruit, implemented a new curriculum, cleaned up the school’s physical facility, praised students publicly for their achievement, and thoughtfully integrated technology to create a new school culture with community support to back it. In 2010, the school was selected as a runner-up for the Intel SODA Award. Administrators and staff attended the Intel awards conference and learned a great deal from other schools about how to take George Hall to the next level, which primarily entailed connecting the school to the community and outside world. In 2012, they won a SODA award.

Lessons Learned From the Case Study

Recruit a dedicated, robust, mission-aligned staff
- By itself, injecting resources into a failing school cannot turn it around. In this district, four other schools received the same infusion of resources but did not see nearly the amount of growth as George Hall.
- For recruiting new staff, signing bonuses and performance-based pay helped attract many strong teachers in the applicant pool. These incentives enabled the new principal, a respected leader and proven team builder, to create the type of faculty needed for successful reform.
- Having five support teachers and five special educators was also critical early on for giving struggling students high levels of attention. These extra staff members also gave teachers extra support to help cope with their large workload and with a community initially very angry about the abrupt changes at the school.

Identify key curriculum and remain consistent
- The school used two key curricula from the start of the reform to help improve students’ skills.
- The administration began a practice of rewarding students for progress by announcing their names when they advanced a level in reading, creating student enthusiasm for the system.
- The curriculum was part of an integrated set of practices that include teacher professional development, technology, and school traditions that support its optimal use.
- In 2010, the school integrated minicomputers into its activities, introducing this technology into a learning practice with which students had grown comfortable and found success.
Win over the community

- From the start, the school principal and teachers made home visits to the families of children at the school, establishing personal connections with many of those who had been angry about the firings and other major changes at the school.
- The administration initially focused on cleaning up the school’s physical facility to make it attractive and inviting.
- The principal instituted quarterly family math and reading events. Students teach their parents how to use the reading and math curricula, which benefited many of the parents.
- The school recognized that helping parents more directly with GED classes, opportunities to meet employers, and other similar resources could indirectly help their students.
- Because of the school’s concerted efforts, parents are now more likely to support the school, their children’s academics, and even provide a more stable home.

Make the learning more engaging

- Students at the school have responded very well to public recognition for their achievements. The most salient of the recognitions are the morning announcements on reading gains, which seems to be a major motivator for student commitment and growth.
- The school uses manipulatives extensively throughout math and other parts of the curriculum, giving the children whole body, tactile experience with quantity, shape, space, and other fundamental academic concepts.
- Technology has also been used extensively to motivate children, both in individual activities and in whole-class interactive lessons where both the teacher and students operate interactive white boards.
- The school emphasizes meaningful and relevant learning related to students’ lives and about the wider world. The Field Trips for Vocabulary include preteaching lessons and vocabulary studies to prepare for the visits to community sites in which students are interested.
- The school works intensively to forge community connections—recruitment of civic leaders and professionals who come into the school to work with the students often.

Introduction

Driving to George Hall Elementary, we pass blocks of brick housing projects. Nearer the school, the government housing gives way to rickety wooden homes with peeling paint and unkempt yards. The school appears ordinary from the outside, not rundown but not lavish either. George Hall is in Mobile, Alabama, and draws nearly all its students from that long strip of projects and the homes just outside its doors.

Walking into the school, we are struck by the hallway walls. Every inch of every wall is decorated with something bright. On these particular days, the walls are covered with images of New Orleans Saints, the local NFL team that had just visited the school. The images are mostly drawn and colored by students, and they display football-related math reasoning (for example, charts on player salaries or game statistics).

The halls are quiet and orderly. We soon learn that structured and extremely controlled routines are drilled in consistently. Students with hall passes walk silently to and from bathrooms. Students changing classrooms walk silently. The occasional whispering is met with immediate redirection by the teacher walking backward in front of the class.

This case study describes the transformation of George Hall Elementary. In 2004, the Mobile County Public Schools District had identified five chronically underperforming schools for reform, and George Hall Elementary was one of them. The school had been extremely low performing for many years; less than 30 percent of students were proficient in math and less than 40 percent were proficient in reading. As a local reporter put it, “Imagine a school in a poor, crime-ridden neighborhood. It has discipline problems, a dismal reputation, and some of the worst test scores in Alabama.” According to a current teacher, the teaching staff before 2004 had very low expectations for students, instructional minutes were far from precious as they are now, and it was common for teachers to ask very little from students and let them draw for much of the day. Another teacher explained, “When we first came to George Hall, it was just a mess. There was no other way to describe it. The students weren’t being pushed, they
weren’t at grade level, they weren’t coming to school.”

Then Martha Peek, the deputy superintendent, began the transformation of George Hall and the other four very low performing schools in the district. Key elements of the transformation were bringing in new school leadership, allowing Mrs. Peek to hire and groom an entirely new staff, offering financial incentives to make teacher recruitment more competitive, hiring additional support staff, and adopting a new curriculum. With the infusion of resources and talented staff, the new principal emphasized a consistent curricular focus, a commitment to using data to drive instruction, extremely controlled routines, and a dedication to providing whatever is needed to the children and their families.

The dramatic changes implemented at George Hall have since led to national recognition. In 2010, the school was selected as a runner-up for the Intel Schools of Distinction award. Administrators and staff attended the conference to which all finalists and winners were invited. They used the opportunity to learn as much as possible from other schools about how to improve their school yet further. This brought them to recognize the need to better connect the school to the community and outside world, thereby making the students’ learning experiences more relevant to their life experiences. In 2012, they won a Schools of Distinction award.

**Early Challenges**

The transformation of George Hall involved nearly a complete overhaul of the school staff. The administration was replaced, and all the teachers were told that they needed to reapply for their jobs. Only three of the 27 teachers kept their jobs, and of those three only one lasted longer than a year. These abrupt changes sparked the anger of parents, compounding the problem of addressing students’ poor skills.

When asked what the key challenges have been for the school, every staff member mentioned the difficulties of earning family buy-in. The community was in an uproar as the teachers and administrators they had known, most of whom were black, were forced to leave. The new, nearly all white staff members seemed foreign, and their expectations were very different from those the community had grown accustomed to. Current teachers were emotional as they described that first year of the transformation 9 years ago. They had experienced constant accosting from parents, death threats, and several more dramatic displays of the community’s anger, such as the hanging of dead cats on the playground and the smearing of dead fish and shrimp guts on the school building, which left it reeking for days.

Less emotional but equally as trying was George Hall’s push to raise the basic skills of students, who had a lot of catching up to do. Although they have more recently transitioned to using more student-centered learning, the principal and teachers felt that they needed first to address their students’ immediate skill deficits. This resulted in a deliberate decision to deliver ample direct instruction—an efficient and constant cycle where the teacher models a skill, practices with students, assesses them, and then repeats—and create a robust skill-building program. George Hall would need to develop mechanisms to inspire student engagement, increase and use all instructional minutes, and constantly assess learning to identify and teach what students most need to learn.

Earning family buy-in and improving student learning were long, arduous undertakings. Keys to the eventual success were the teachers’ unwavering commitment to schoolwide efforts and the principal’s leadership, deliberate efforts to understand poverty through literature and discussion, and the school’s taking on the role of caretaker beyond learning for the children and their families.

**How They Did It**

**Recruit a dedicated, robust, mission-aligned staff**

Principal Tomlinson was brought to George Hall Elementary in 2004 with a mandate to hire the teachers she wanted and to mold the school to her liking. In fact, the decision to put Mrs. Tomlinson at the helm of George Hall was central to the school’s eventual success. She had a proven track record of teaching students from disadvantaged circumstances. Martha Peek, the current superintendent of Mobile County Public Schools, was the deputy superintendent when she recruited Principal Tomlinson. She had this to say about her background before George Hall:

*Mrs. Tomlinson was working in a school with a similar population, so the culture and the climate of the neighborhood were not totally foreign to her. I think there are always some surprises and particularly when you go into an area that has the level of poverty that George Hall is in. She was not naive. She was an experienced principal. Also, we had faculty and staff members that also knew her leadership style and what they were committing to. Then Mrs. Tomlinson also was very wise in the other choices that she made in bringing faculty and staff together.*
Attracting a large pool of applicants was made easier with the promise of a sizable signing bonus and merit pay for meeting goals that would be coconstructed by the principal and teachers. Hand-picking her staff, many of whom had taught for Principal Tomlinson at her prior school, helped ensure that all adults in the building would be committed to the school and classroom routines she designed, the curriculum she thought the students needed, and the high rigor she expected. Superintendent Peek added, “Certainly Mrs. Tomlinson had a core group of people who were willing to follow her—would’ve followed her over the edge of a cliff.”

In addition to the strong and committed team Principal Tomlinson was able to recruit, the school received funds to hire extra support staff. Thus, for the 5 years teachers received performance pay, two adults were often in each classroom. Students received significant attention, turnover was low, and Principal Tomlinson had the power and resources to consistently invest in what she saw as the academic and procedural priorities. With her talented staff on board, Principal Tomlinson was able to create a curricular vision that would remain constant, was always improving, and was benefiting from supplemental programs and technology to come.

**Identify key curriculum and remain consistent**

When the new school staff came in, there was a common understanding that the students’ skills were very low. A large majority of the students were behind in reading and math. With this in mind, the school invested heavily in educational hardware and software products aimed to improve math and reading skills through frequent assessment of learning to recognize achievement and better target areas of need. The district had made these products available to each low-performing school, but only George Hall chose to make them integral. Superintendent Peek remarked, “The district made that available to all schools. It’s been Mrs. Tomlinson and her staff’s decision to really go into it probably the most in depth of any school in the county.”

The curriculum change has been central to learning at George Hall. Yet the payoffs of that curriculum have not been solely due to this adoption. Principal Tomlinson has committed to providing teachers with training to use the curriculum effectively, purchased new technologies that synchronize to efficiently individualize learning, and created schoolwide celebrations of student successes. One teacher remarked that the curriculum “has helped our growth because it had has motivated students and it has helped us pinpoint their weaknesses.” In 2010 the school purchased small computers students use to complete math activities. For the student, this teacher felt it “really increases student engagement.” For the staff, the computers track student learning and match students with learning activities they personally need.

“Sure, we do some whole-group lessons, but when we get to independent learning, your math is focused on the gaps in your learning.”

- Teacher
  George Hall Elementary
Besides adding new technology to supplement the curricular focus, the school has also developed routines for recognizing and rewarding students’ success with it. When students demonstrated achievement in reading or math, their progress is celebrated publicly. For example, early each morning all classes freeze activity as Principal Tomlinson announces over the public address system which students made the greatest reading gains. The staff learned early on how much the students hunger for positive feedback and built structures to continually and predictably give it to them. “They love anything they’re recognized for,” one teacher explained, which has contributed greatly to student motivation to read. That is why, as another teacher remarked, “The most happening place to be in this building is the library,” where students can devour more books.

**Win over the community**

As stated, the most frequently mentioned challenge the school faced early in its transformation was earning the trust and support of families. This happened gradually through a process of first learning to understand poverty and the families, by providing for the children no matter what their needs, and by eventually making parents more direct recipients of support.

Bringing in what was virtually an entirely new staff of almost all middle class white teachers, Principal Tomlinson made one of her first missions to learn, as a staff, about poverty. The new staff began “book studies” from the outset, reading the same books and then discussing the material as a group. The book that most impressed many of the teachers and administrators was Ruby Payne’s *A Framework for Understanding Poverty*, which has affected the school at its very foundations. It has shaped how teachers empathize with students and their hardships and how they speak to students, and it has affirmed the importance of positive framing and recognition.

Along with the initiative to understand poverty came routines to help students avoid letting troubles from home detract from their learning. One such routine, implemented from the start of Principal Tomlinson’s tenure, was the Morning Meeting that all teachers facilitated in their classrooms first thing in the morning. As one teacher explained, the purpose was to acknowledge and show understanding of the difficulties students faced at home and then reestablish the importance of leaving the negative feelings at the door. She explained that the message to students was, “You didn’t eat breakfast, your daddy’s in jail, but now we’re moving on and we’re going to see what we can do to make you a better person.” Parents echoed that this message is common at the school and added, “If something happened that has nothing to do with school, [kids] really have gotten where they don’t bring that in.”

Issues from home, however, have not gone unaddressed. Another resounding message from parents of students currently at the school is that, no matter the needs, the school will try to help. One said, “If the children are lacking anything, Ms. Tomlinson herself will come out of her pocket and provide those children with what they need ... whatever she needed for that child so that child wouldn’t struggle in school.” This is how George Hall began to earn its reputation as more than just a learning institution and as a more general provider in a community with great need.

Two years into the transformation, once the extreme tensions had begun to dissipate, more routinized traditions began and the school pushed to make its influence extend into homes. Family Math Nights and Family Reading Nights started to occur once per quarter and provided a chance for students to teach their parents what they were learning and how they were learning it. For some families, George Hall just wanted to familiarize parents with its intense math and reading skill-building activities for better reinforcement at home; for others, whose young children had already surpassed the parents’ abilities, this became an opportunity to reinforce parents’ basic skills. That same thinking—that helping parents indirectly helps their students—was much of the impetus for turning the school career night, Fast Forward, into an opportunity for parents as well as their children to learn more about employment opportunities and the preparation needed. To meet the first preparation needs of many parents, the school recently began offering GED classes on site when George Hall teachers offered to become certified as their children to learn more about employment opportunities and the preparation needed. To meet the first preparation needs of many parents, the school recently began offering GED classes on site when George Hall teachers offered to become certified and teach those classes as well.

**Make the learning more engaging**

Teachers at George Hall have raised student engagement in three primary ways: by connecting with professionals outside the school, by using technology, and by employing manipulatives whenever possible.

Regarding connecting with the outside world, one teacher put it best when she exclaimed, “We’ve got resources—people resources—and they’re free!” The school has aggressively recruited professionals, especially in engineering and banking, to come to the school to teach children applied math. For example, this teacher had just brought
a roofer to the school to teach the students surface area by analyzing model roofs. It was when George Hall’s staff attended Intel’s awards ceremony in 2010, as finalists, that they fully recognized the extent to which their instruction could be connected to the outside world. They were able to meet with, and learn from, schools around the country that were finding creative ways to incorporate local professionals with STEM expertise into their teaching and designing curriculum where students apply knowledge to solving real problems.

This teacher also discussed the connection forged with the University of South Alabama, which now sends over engineering undergraduates. When asked how they do it, she explained that they make a lot of phone calls and that they ask only for people’s time. When asked about how they ensure learning takes place, she explained that teachers are very careful about thinking through the course of study to choose who, where, and when to employ the real-world connections that abound. Students’ visits to professionals and institutions that present learning opportunities are called Field Trips for Vocabulary, and they are always preceded by preteaching lessons and exposure to valuable vocabulary relevant to the trip.

Technology serves several roles at George Hall: visual captivation, individualization of learning, and constant formative assessment, all of which tie in to engagement. A teacher explained that technology is the basis for individualization and added, “Sure, we do some whole-group lessons, but when we get to independent learning, your math is focused on the gaps in your learning.” In fact, the constant assessment that students know to expect has been central to their vigorous efforts. They know that when they read longer and with more focus, their reading points will add up, they will be acknowledged in the morning announcement, and their learning feels tangible. Technology plays a major role in student enthusiasm because it ensures that student learning is measured, yields instant feedback, and then is rewarded through recognition. It also allows teachers to track reading gains and consistently assess math learning, so students know that the problems put in front of them are not busy work, but rather targeted learning with the benefit of instant feedback. Investing in technology has become a priority for Principal Tomlinson and has proved an effective, efficient way of getting students to buy in to assessment and engage more deeply in lessons.

In classrooms, the engagement tool most obvious to an observer is the interactive white board. Teachers are constantly displaying visual representations that students can then manipulate. In one kindergarten classroom, the teacher was able to get nearly all the students to raise their hands to answer questions and did not need to remind any child to look up when she worked at her interactive white board. She called students up, one by one, and they all knew how to manipulate the blocks on the screen to add and

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- Teacher
George Hall Elementary
subtract building blocks. The manipulating of visual objects, though, is not done only on these interactive boards. For most math concepts, students have something they can hold and use to visualize the learning. The use of manipulatives is, in fact, what parents referred to as the main source of engagement and understanding for their children.

**Results and Takeaways**

George Hall’s 9-year transformation story was not the product of one silver bullet strategy; teachers and administrators deeply believe that message. Their effort and resilience with students far behind in their learning and with a community that initially fiercely rejected their presence cannot be overstated. Without that effort and resilience, none of their strategic endeavors would have been so effective. That said, it is valuable to recognize some of the most critical decisions and design elements that helped make George Hall’s transformation successful.

Before the transformation, less than 30 percent of students at George Hall were proficient in math and less than 40 percent were proficient in reading based on the ARMT, the Alabama Reading and Math Test. Over the past several years, nearly 100 percent of third-, fourth-, and fifth-graders have achieved proficiency in both subjects, test after test. Crucial to this growth in math and reading skills was the consistent curricular vision set forth by Principal Tomlinson back in 2004. The consistency of curriculum and tools has given students predictability and stability, while the additions of new training and technology have increased engagement and efficiency. Engagement strategies made possible by interactive white boards, closets filled with math manipulatives in every room, and learning made meaningful through connection to the outside world also played an important role.

Looking to the future, though, some of the school’s most important advancements have come through its development of a more sustainable innovative culture. Much of this has been a product of gradually diffusing responsibility from administration to teachers and now from teachers to students. In the first years of George Hall’s transformation, leadership structures were more vertical. Superintendent Peek explained that the district was “very much involved in the school particularly in the initial stages … always working alongside the administration in the school.” However, once the school’s structures, rigor, and culture were more established, Principal Tomlinson began to empower her teachers. After all, they will be the ones to maintain the school’s growth after her departure, and it has increasingly become the case that instructional progress starts with the teachers. Discussing the school now, Superintendent Peek said, “It’s not long that you’re in George Hall before you realize really Mrs. Tomlinson has moved to a facilitator’s position in that school because she has developed so many strong teacher-leaders.”

One product of pushing for increased teacher leadership has been the evolution of teaching methods in the upper grades. This transition has mirrored the administration’s diffusion of responsibility as teachers are now putting more learning responsibility on students. One teacher explained, “Those first years it was just we were very specific about our teaching. We taught good, solid lessons that involved really direct instruction, and we stuck to that because [the students] needed structure.” Now, on the other hand, she explained, “We’ve gone from a very structured set of lessons to much more of a teacher as facilitator type of learning.” With students’ basic skills strong and constantly reinforced by the school’s robust skill-building regimen, teachers are doing more project-based learning, especially in grades 4 and 5.
Summary of Case:
Rather than basing math instruction on textbooks, Byron High School has students in advanced math courses study teacher-produced videos accessible on the Internet as homework and uses class time for teacher and peer interaction to reinforce and clarify students’ understanding of the content. This teaching innovation is just one of several schoolwide innovations developed through a structured and measured approach.

Lessons Learned From the Case Study

Use technology to support student learning
- Byron has used technology to redefine how class and homework time are spent and to give students access to the rich content available on the Internet.
- Teachers have designed teaching and learning so that uses of new technology are reinforced through student reward and motivation structures.

Support bottom-up changes
- The school, its academic departments, and the entire district act on ideas that teachers and staff develop, clearing away technical and administrative roadblocks.
- School and district staff provide assistance through technical support as well as support for conceiving, designing, and implementing creative ideas.
- The successes they have seen in other classrooms encourage more staff at Byron and other local schools to adopt and adapt these innovative practices.

Create a culture of innovation
- New ideas at Byron, whether based on teacher ideas or a district change, are tested on a small scale or for trial periods. Not everything is expected to succeed, but this trial process is used to screen for effective practices that can be adopted and honed.

- All innovations are measured for effectiveness. This measurement continues as new practices are implemented, tracking the impact of continued refinements.
- PLCs (professional learning communities) and the Malcolm Baldrige Performance Excellence model are used to provide structure and training for developing innovation.

Maintain a shared and consistent focus
- The innovations at Byron High School arose from a tight-knit group of professionals working with a shared focus on student learning and maintaining a disciplined practice of innovation. The school and district used frequent communication to build shared visions of teaching and learning and held firm in designing innovations and initiatives aligned in support of that goal.
Motivation and Challenges

Byron High School enjoys an educational environment that many schools would envy. It does not face challenges of community poverty or administrative chaos. In fact, the school has had the advantages of supportive families, stable leadership, and a close relationship with the superintendent’s office. Byron and its staff do share the core challenge of teaching and learning of every school—how to prepare students to be self-directed learners, providing the right supports at the right times in their learning, so that students enter and succeed in higher education.

The story of this school’s success is one of visionary teachers and staff, supported by school and district leadership, making innovative changes in teaching and learning. Rather than being linked to one specific moment, the transformation at Byron High School began with the educators transforming their instruction in response to a number of motivations and catalyzing events over a 5-year period.

- In 2006, the first year of state testing, only 30 percent of students were proficient in mathematics on the state exam. This created motivation to change.
- In 2006, physical renovations included a new school building, interactive whiteboards in classrooms, and wireless access to the Web throughout the school. All teachers, by this point, had been provided laptops.
- In 2007, each school got a data coach and began to use data to shape instruction. Professional learning community (PLC) groups of teachers were also established.
- In 2008, the high school staff started using an online learning management system to host courses. Since then, they have also adopted an online and integrated document, email, calendar, and chat system.
- In 2010, the math department found its out-of-date textbooks covered only 70 percent of the state standards. It needed (but could not afford) a new and more complete approach to teaching the standards to students.

With a motivation to raise student proficiency in math, technical and staff resources in place, shared goals and regular discussions about teaching practices, the math department at the high school took the lead in developing innovative and effective approaches to math teaching and learning.

How They Did It

Use technology to support student learning

The practice Byron has received most of its recognition for is successful use of “flipped” instruction to support and improve student learning. Flipped instruction is a form of blended learning in which technology is used to present a lesson to students outside class time and class time is used for teacher and peer interaction to reinforce and clarify student understanding of the content (thus flipping the learning activities traditionally done during and outside class). Led by math instructors Troy Faulkner and Rob Warneke, flipped instruction is being used at Byron in advanced math classes all year and transitioned in over several months in lower level classes. It has also been adopted in
other departments at the high school to a lesser extent. The flipped instruction grew out of the practice Byron math teachers already had of recording their lectures as internet videos for the days they would miss class and use a substitute teacher. Beginning in 2010, the math staff built on this practice and created class videos for all (or many) class lessons to restructure, or flip, their classes.

This innovation of flipped instruction relies on technology to change student access to course content. Instead of getting one chance to hear an idea explained in class, students can watch the teacher-produced videos as many times as they like. Because they watch the videos in advance of class discussion, they can stop at key points, rewind, and review the material until they feel fully prepared. Then, in class, their extended periods of group-work time, with the teacher walking around and checking in, give them more opportunity to understand the most difficult applications of the learning. Students are clearly taking advantage of this accessibility, with online records showing that more than 90 percent of students access the class learning management sites after school, during the evenings, and on weekends.

Because the math department is not using textbooks to organize courses, one of the richest sources of information for students to construct knowledge with is the Internet. Many Byron classrooms are equipped with a variety of devices (laptops, tablets, e-readers, and other handheld devices) that students may use to access or review the video class lessons or to explore other information needed to complete a learning activity. Some (although not all) teachers also encourage students to use their own smartphones or other personal devices during class.

An important feature is that these uses of technology have been accompanied by reward structures to help reinforce their effectiveness. Along with flipped class time and the “bring your own device” (for example, smartphones) policy, the staff incorporates accountability and motivational strategies to keep students on track and engaged in their classes. For example, if homework activities are accessed or submitted online, student work is time stamped to ensure students complete it on time. Teachers also use “jigsaw” activity designs where students rely on each other to complete a project. With so much time for group work enabled by the flipped structure, coming to class unprepared becomes an issue of letting down friends and peers, not just the teacher. In some classes, students who maintain an average of over 90 percent and turn in all homework on time are allowed to work from home (or somewhere else off campus) 2 days per week for that class period; this way, students are rewarded for success, and teachers can spend more time with students who need more help. For some math

“The difference is made in the classroom by teachers. That was a key message that I conveyed, [and] why I was here. Believing in teachers. Believing in the capacity.”

- Wendy Shannon, Superintendent, Byron High School
classes, students who do not maintain an average of 80 percent or higher are required to spend their lunch period in a math study hall.

One teacher described that in earlier years donors “would come in and say here’s some computers. I’d always say, well that’s a nice computer, but I just don’t know how to get it involved. ... It was just there.” When the math department dropped textbooks and began to use the resources freely available on the Internet, “Then technology started to have a different meaning.” By using these resources and making content available to students, it’s no longer just a nice computer, “It’s a necessity.”

“The learners have legitimately changed in the last 5 to 6 years,” a teacher explained.

With the accessibility of their personal learning devices, and Wi-Fi, and information accessible to them 24-7, the student learners changed. The kids were leading us, and we were just trying to try fill that need ... the information was out there available to us. We just had to really tap in to it and start to make it work.

Support bottom-up changes

An important feature of Byron’s success, acknowledged by teachers and administrators alike, is that the innovations culminating in the flipped method of instruction were brought forward by teachers. One staff member wrote, “Our leaders remove barriers that stifle innovation. Most of the most innovative ideas we have had have not been a top-down initiative.” Instead, they have been suggestions by teachers, then supported by leaders. The principal said that when teachers proposed the flipped classroom approach, they took the idea “to administration, and we said we’d remove all the roadblocks we could for them and make it as easy as possible.”

In addition to technical resources like reliable wireless Internet access, laptops, and learning management systems, a key source of support for Byron teachers has been the district technology director, Jen Hegna. With a constant eye on the most promising new education technologies, mostly via social media and blogs, Ms. Hegna has been a catalyst for thinking about technology in new ways. She has actively facilitated change by constantly reaching out to individual teachers with ideas and suggestions and a willingness to help troubleshoot implementation. By training teachers in the best practices of teaching with technology and helping educate the school board about using technology to support learning, Ms. Hegna has supported innovations well at all levels.

Further, rather than creating platform and security barriers that teachers must work around, like blocking video-sharing sites as many schools and districts do, Ms. Hegna looks for doors left unopened and roadblocks to eliminate. Her full embrace of technology’s transformative potential for learning has encouraged teachers to reimagine the role technology could play in innovative teaching and learning. The mixing of teachers’ ideas with technology solutions was the potent combination for creating effective changes in teaching and learning at Byron.

School and district leadership played an important role in cultivating and enabling teacher innovation as well. Rather than driving initiatives from the top, the district has allowed ideas to take root and spread among the teachers themselves. Wendy Shannon, the superintendent leading the district at that time (she is now retired) described, for example, the decision to allow students to bring their own technology devices into school. She said, “There are still teachers that have not embraced the personal learning devices in the classroom, but our approach was to support those teachers who choose to embrace this change. Then more and more teachers are interested,” as they see successes that others are having, asking, “Can you show me how you’re using it?” Then we have seen more and more [teachers] interested in moving forward in that direction.” Rather than define and dictate the changes the district wanted teachers to make, the district regularly allowed teachers’ ideas to be piloted. For those pilot ideas that were successes, the district supported and facilitated their dissemination across departments and across schools.

Teachers, district staff, and school board members all described the superintendent’s willingness to consider new ideas from staff. Superintendent Shannon described her belief that “The difference is made in the classroom by teachers. That was a key message that I conveyed, [and] why I was here. Believing in teachers. Believing in the capacity.” She continued, “Everyone knows that my expectation was that I would come to work, and I would say, ‘I can be better tomorrow than I can be today,’ and ... that’s the attitude that our teachers would have as well.” Teachers and staff were not only supported in innovation, but also worked within a culture that expected innovation and continuous improvement.
Create a culture of innovation

The innovation process at Byron was not random or casual; ideas had to be demonstrated to have student learning at their center, started on a small scale, and measured for effectiveness. “The accountability piece was always built in,” the retired superintendent stated. Not every idea had to succeed, but every idea had to be proven successful before being allowed to continue or grow. For example, in 2012 classrooms had laptops, multiple types of tablets, and color e-books available for students to use during class in addition to their own devices (smartphones, etc.). The district will choose which device it plans to purchase and support after this year’s trial period.

This aim for measured innovation—in both senses of measured: carefully considered and backed up by numbers—is not just a consideration of administrators. One teacher, who was one of the initial educators at the school to implement a classroom flip, has thoroughly documented student learning and its association with differing teaching strategies. Graphs he produced show student scores on assessments after lecture-based learning and flipped learning, revealing noticeable benefits attributable to the flipped method. Another member of his team tracked the effects of varying degrees of flipping his classroom, eventually deciding that his ninth-graders benefit most from a gradual transition. He now starts the year with a more traditional learning format and then uses a combination of lecture and flipped learning at home, before finally transitioning into a fully flipped system. This action-based research confirmed the efficacy of the new model and served as a strong testimonial to encourage other teachers to adopt aspects of it.

This culture of innovation at Byron is supported by an explicit structure. Around 2007, when teachers and administrators began to deeply reflect on how to take learning to new heights, the decision was made to focus on professional learning communities. Teachers in many schools today think of PLCs as just another newfangled buzzword way to force them into more meetings. In fact, teachers at Byron had PLCs before 2007, but they were ineffective. Change came when the school decided to invest in training to turn the former cross-curricular PLCs into small, focused departmental teams with the agency and tools to explore and invest their energy in ideas they find meaningful.

Instructor Warneke explained,

We thought we were doing PLCs, but we were doing it wrong. We didn’t really have a good focus on it, but when we came back from the DuFour Teaching Summit, we realized we need to have a purpose for every PLC, you know, and not just be cross curricular, which is what we had before. We needed to have a department PLC.
Beyond that, it became ever clearer that the pedagogical and philosophical underpinnings of the innovations at Byron started with DuFour and its PLC model. Emphasizing learning over teaching, creating a shared vision, constant collaboration, common assessment, and trying various approaches and then measuring and comparing the effects of each are all emphases of DuFour PLC training.

The flipped learning model developed within the math PLC, which was the product of slow, deliberate improvements, week by week, as a teacher created initiative. The teachers in the PLC set out to spend 1 year researching and building their own curriculum based on material that was free, online, and effective.

He continued, "Here's the beauty of it. With PLCs we meet every week and we modify and improve that curriculum with the data we collect, common assessments, all those things, looking at how they perform. Then it doesn't mean that that's right. It's just version one. It's like okay, well now let's improve that."

Rooted in the school's adoption of DuFour PLCs and the district's adoption of the Malcolm Baldrige Performance Excellence model, the innovations made at Byron High School follow a progression of growth. Teachers putting a few lectures online for absent students led to a flipped classroom design, which then led to more student-centered approaches including the freedom to use their own technology devices for learning in class as well as out of class. Singular or disconnected ideas were not tried and tossed away. Instead, a focus on student learning was maintained and strategies to achieve that focus were enhanced through continued and deliberate analysis, trial, and measurement.

Maintain a shared and consistent focus

Byron's flipped instruction is an exciting and interesting story of school success. Yet when asked about it, the staff and leadership do not begin the story at the first day of flipped instruction. Instead, they tell the story by describing their work 5 to 6 years prior, as committees and teams worked to build a shared vision of effective instruction and data-based understanding of student success. The central role of school data coaches, teacher PLCs, and even the district's history with the Baldrige approach to organizational improvement created the environment for the flipped instruction approach.

Beyond flipped instruction and the math team that has functioned as a PLC exemplar, the consistent and collaborative focus has extended to other subject PLCs as well. For example, the English team also began to question how students learn best and how technology could be applied. Through a similar process of trial and error, these teachers have built their own institutional knowledge and nuanced view of where flipped learning is most effective in English, along with discoveries of their own. One English teacher, for instance, recently discovered the value of having her students write essay drafts in blog form and read complicated pieces in social media-friendly sites. She noted that more informal spaces can loosen up the writing process—making it more social, deep, and engaging—and encourage shy students to share their thoughtful but often inhibited insights with their peers.

Rather than pursuing unrelated or disconnected initiatives, school PLCs have given a structure for teachers to form agile, thoughtful, collaborative teams. They have been one way that the district has worked to "align our arrows" (as the retired district superintendent put it) and maintain a focus on clearly defined and shared goals for student learning. In other words, the new uses of technology and classroom teaching strategies at Byron High School did not simply arise as good ideas that happened to work but were logical extensions of a culture of shared vision, disciplined practice, and alignment established through regular meetings of school and district professionals.

Results and Takeaways

The story of Byron's success may seem irrelevant or even impossible to replicate for schools without Byron's resources, such as a new building, strong wireless infrastructure, laptops, interactive white boards, and students with high-speed Internet at home and smartphones in their pockets. These resources are important but only one part of a larger improvement process. Byron uses technology as a tool to offer learning opportunities to students in new forms, but technology by itself is not the strategy for change. Instead, the changes stem from Byron's culture of innovation and collaboration and the shared understanding that modern students learn differently, that learning can happen anywhere, and that learning is more important than teaching.

Some insights offered from the experience of Byron are the inspiration to go ahead and try something new. Taking risks involves risking failure, but improvement does not come from continuing to do the same thing. A math teacher described a key moment in the midst of the fertile time of
change at Byron: “There was a time where we said, why are we just accepting what’s happening [in student achievement scores]? That was a pivotal question. That allowed us to really rethink what we were doing.”

Teachers and other school staff members can be sources for ideas for improvement, both large and small. At Byron, teachers and staff proposed flipped instruction as well as more incremental changes to refine the practice. Byron engaged experts and consultants to help pursue and refine bottom-up ideas for change—they were not the source of some new programs that the district adopted. Such programs were often the product of teacher innovations that were constructed and tested within small, focused teams, supported by administrators who trust their teachers and remove the barriers in their way. Change at Byron is a discipline. It is not left to chance; ideas are collaboratively produced, technologically supported, piloted, measured for impact, and, if shown to be promising, improved.

These teachers and leaders have harnessed their collective commitment to helping students succeed in high school, college, and beyond. By looking carefully at the lives and inclinations of students, they have adapted instruction to the preferences and needs of these digital natives and have taken a fully learner-centered perspective. This open examination of typically unquestioned aspects of school—such as books, lectures, and homework—has helped Byron generate an innovative, effective approach to teaching and learning. In 2011, Intel recognized Byron for its exceptional use of online resources that allow students to work at their own pace, and make it easier for teachers to help students who need extra support. Intel researchers identified that classrooms were providing collaborative environments where students were “free to arrange desks in the best way to collaborate,” with many using laptops, smartphones and tablets “to look up information, videos, and solution guides” on the material they were studying.

Looking to the future, the focus on improvement means that innovations will continue at Byron. For example, the school is considering integrating online student quizzes, hand-held student responder systems, and evolutions of its video-based math curriculum. The flipped approach is also spreading into other departments and into the younger grades in the district, so students will soon enter the ninth grade already experienced with this type of learning.
Summary of Case:
The school developed a STEM focus in 2007, a time when it also transformed its collective mind-set about new possibilities for teaching and learning. The school administration and staff committed themselves to supporting peer groups and implementing instructional differentiation to create opportunities for every student to learn at the highest levels. With this new mind-set, Preston Middle School moved from traditional teacher-centered instruction toward student-centered learning experiences, from whole-group approaches to systems more responsive to individual learners’ needs, and to a structure emphasizing a rich range of STEM learning experiences.

Lessons Learned From the Case Study

Change in leadership strategy
- School leadership provided a clear focus on inquiry-based STEM learning, emphasizing the 21st century skills of critical thinking and problem solving.
- Most students participate in informal STEM activities, such as robotics competitions, Science Olympiad, science fair, and MathCounts. The school offers a “ninth” period after the regular school day during which most students have the opportunity to pursue a unique interest.
- The science staff has focused on building student interest and relevance. They have drawn on local partnerships to offer a wide variety of courses and activities, including a wildlife habitat improvement project and project-based inquiry science experiences.
- The school decided to eliminate nearly all tracking, instead opting for a system in which all students are in an advanced track.
- Concerned about making the accelerated learning accessible to all students, the math team adopted a series of strategies to differentiate instruction to respond to individual learner aptitudes.

Transition to student-centered learning
- Preston students are provided learning opportunities that address their needs and interests, yielding increased levels of student engagement. These opportunities include an engineering project in which all students pursue their own research on and solutions to a real-life challenge.

Preston Middle School

Information About the School

Location: Fort Collins is 1 hour north of Denver, at the foot of Rocky Mountain National Park.

Grade range: 6–8

Number of students: 1,012 in 2013

Year and type of Intel Schools of Distinction award: Winner in 2011
needs, and abilities.

- Teachers are encouraged to innovate in their teaching and are provided staff development and collaboration opportunities to support innovation.

Emphasis on thinking strategies and metacognition

- Preston has partnered with PEBC (Public Education Business Coalition) to help teachers introduce routines in their classrooms that promote strong critical thinking.

- Emphases of the PEBC approach include the “thinking strategies” all teachers have listed on their walls, which include ways of using prior knowledge to understand new information and ways of making meaning and drawing inferences.

- It is common practice for students to evaluate their own learning at the close of each lesson to better understand their own thinking. One-on-one conferencing to help students make deeper connections to their work is also becoming a more common practice.

Introduction

At the base of the Rocky Mountain foothills along the Northern Front Range and beside the Cache La Poudre River, approximately 65 miles North of Denver, sits the city of Fort Collins. With a population approaching 150,000, it is the fourth largest city in Colorado.

Approaching Preston Middle School from the east, we see the Rocky Mountain National Park and Roosevelt National Forest rising in the distance. Preston Middle School opened in fall 1994, and teacher input had been considered in the architectural design, resulting in a modern, energy-efficient facility with natural lighting from windows on all sides and large common area with displays showcasing numerous awards. The awards are not for sports achievement; rather, they represent the success of the many academic teams, such as the school’s robotics and Science Olympiad teams. One such award brought Preston to the attention of this research team as a case study school to understand the many factors associated with successful STEM education. In 2011 Preston was named an Intel Schools of Distinction winner for demonstrating excellence in science education and ability to promote students’ problem solving, critical thinking, and collaboration skills—21st century skills.

In its two decades of operation, the school has grown from serving 420 seventh- and eighth-grade students to a current enrollment of over 1,000 students in grades 6, 7, and 8. Similarly, the school has expanded its academic offerings from core curriculum to a diverse set of courses and STEM initiatives.

The success and recognition Preston now enjoys have not always been the case. As a relatively new school in a comfortable middle-income neighborhood, it faced enrollment challenges in 2007 when a charter school opened nearby. To compete with the new charter school and maintain Preston’s enrollment, the principal embarked on a strategy to “inspire and challenge our 21st century learners,” resulting in a four-pronged approach to STEM education: STEM-focused classes and enrichments, schoolwide research projects on STEM themes, STEM extracurricular activities, and the STEM Summer Institute.

Key Early Challenges

Preston Middle School began its commitment to STEM education in 2007 to address the concerns about and challenges in achievement in math, technology, and the sciences. The Poudre School District allows families to choose the school that best meets their child’s educational needs. To be competitive as one of 10 public middle schools and two charter schools in the district feeding into seven public high schools, Preston adopted a STEM-focused strategy to build interest and engagement in learning.

Before the STEM approach was adopted, methods of instruction at the school were traditional, heavily lecture-based lessons with few enrichment opportunities for students. The emphasis on content delivery afforded little attention to individual student understanding and little opportunity for adjustment to individual learners. Student behavior issues resulted in six or seven disciplinary referrals a day.

With this very traditional approach to teaching and learning, staff members reported that a fixed mind-set was prevalent at the time. Performance tracking of students was also common, driven by an implicit belief that not all students are capable of learning at a high level. As a result, the school culture resembled one where teachers attempt to minimize failure by accommodating the lowest performing students, not one that seeks to engage students and optimize learning. Cameron Shinn, the department leader in language arts
described the change by stating, “The mind-set is [now] about kids, it’s not about content. The mind-set is about whether they have learned it, not about whether we have taught it.”

How They Did It

Change in leadership strategy

Around the time when Principal Scott Nielsen joined the staff at Preston Middle School, the Poudre School District had initiated a district-wide transition from junior high schools to middle schools and intended that these schools emerge as more than another neighborhood school. Together with Assistant Principal John Howe, Principal Nielsen took the opportunity to create a STEM focus and build STEM programming for Preston. STEM-focused instructional strategies were then identified to help students learn 21st century skills that promote critical thinking and problem solving.

This focus has since shaped every aspect of the school, starting with recognition of the importance of inquiry and experience-based learning for students’ engagement and development of critical thinking skills. With this in mind, the school set out to build a variety of STEM-focused classes, enrichment and extracurricular activities, schoolwide research projects with STEM themes, and summer programs for both students and teachers. When students describe science learning at Preston, the first words that come to them are “real problems,” “teamwork,” and “hands-on.”

According to one teacher, the school leaders have chosen to set the vision for the school while supporting and celebrating teachers in developing the actual innovative strategies that have been the force behind the school’s continuous improvement. As a long-time special educator, Principal Nielson spent considerable time devising ways to teach students with learning challenges, but he never served as a teacher with 30 or so students in front of him. Acknowledging this, Principal Nielson explained that he never enters a room with his teachers assuming he has the best ideas. This humility and deference for his own teaching staff have empowered them to pursue their ideas and iterate on them confidently. The leadership of the school then moves to remove roadblocks and support teachers with their innovations. One empowered teacher said, “That shift in us moving forward and really reflecting on what we are doing and sharing the great things that are happening and trying to figure out how we apply those principles in our own room has really moved us forward.”

Principal Nielsen said that early on he noticed the school was not an environment that encouraged risk-taking by teachers. When asked how he sees the difference between the culture that was and is currently, he said, “I want to encourage risks and celebrate the heck out of successes and failures.”

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Transition to student-centered learning

Preston Middle School’s transition from a junior high and adoption of the vision to become a STEM school also marked the point for teachers who did not see themselves fitting in to move with their students to the high school. Those who remained at Preston were the teachers who took up the new vision and the student-centered teaching and learning that accompanied it.

According to Mary Klass, department leader in science, her students are driven by their needs and their interests, whereas students a generation ago would do what they were told to do in a more teacher-directed setting. She also sees in her students’ marvelous potential for learning through self-motivated and self-directed opportunities, when they are provided. To illustrate this point, she described how the Science Olympiad team meets at 7:00 a.m. hungry for problems to solve or designs to improve because they have been put in the driver seat of their own learning process. She elaborated, “They [the students] are not being taught; they are learning through questions and problems or ideas.” She added, “It seems like everything we teach, some kid wants to change it a little bit to make it their own.” The school’s push to become more student centered recognizes the yearning in students and has embraced it.

The practice of actively engaging the students in the scientific inquiry processes and guiding them through an investigation is an important part of Preston’s instructional strategy. Currently, all students participate in a research and presentation curriculum, The Grand Challenge, designed to provide real-world relevance to students’ science and math courses. Each student selects an engineering challenge based on a real-world problem. Through an interdisciplinary approach, students build background knowledge through their courses during the first semester and then create solutions to these real-world challenges in a second semester. Small groups present their solution and the data they collected about its effectiveness
at the end of the term.

The growth in classes and enrichment activities resulting from student interests and STEM themes represents this commitment to student-centered instruction. Beginning in 2007, the school leaders began to document the number of Preston students who accessed STEM classes and activities. That year, they counted 25 students participating in STEM activities that were not required science classes. In 2012-2013, when Preston counted the number of students enrolled in STEM classes or enrichment activities, the total was over 2,600 (Table 1).

Student interests are driving learning at Preston, and the “ninth-hour” classes, which are mostly electives, give students options for what they learn. As a means of empowering both teachers and students, this ninth-hour idea emerged as a chance for teachers to develop the class of their dreams. If they are passionate about the subject area, it is likely that teachers’ instruction will be meaningful to students.

One student explained,

*There’s a lot of ninth-period enrichments; they give you chances to explore whatever you want. For example, there’s a biotechnology class, there’s a Math Counts class, there’s robotics class, there’s in-depth computer classes where you learn to program, there’s cooking.*

In settings like ninth-hour enrichment, students find learning opportunities they can pour their passions into. For example, with the encouragement of his teachers, one student designed a flood emergency abatement plan after a major flood in the region. With teacher support, he designed a plan for diverting water flow from potential flood zones and ended up presenting it to the governor. Students also have been encouraged to pursue their passions in the telemotor program through an electronic mentorship organization introduced to the school several years ago. Through this program, students are paired with professionals who are able to invest energy in codesigning learning opportunities with their student mentees that are fully individualized and adaptable based on a student’s interest. For a student who loves to write, teachers found a telementor to support him in writing a novel. Other students have done projects like building websites with their telementors. Student-centered learning is theoretically appealing to many educators, but practically teachers may find it intimidating to give students the reigns to their own learning and time consuming to individualize supports.

### Table 1. STEM Course & Enrichment Growth

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Preston has embraced this approach, devising ways to unite teachers and students in pursuing in ninth period, allowing for deeper individualized support with telementoring and through more open, inquiry-based teaching.

Discussions about growth mind-set and all students being able to learn at high levels

The instructional approaches used at Preston Middle School align with notable innovative practices. Susanne Martino, a math instructor at the school, described a growth mind-set as, “the mindset of knowing students, regardless of prior achievement, can think at a higher level.” She went on to say, “They [the administration] support us being innovative, they also support us with staff development, training, and opportunities to collaborate with other schools and with each other.” In the math department, instructional and curricular reforms were grounded in the philosophy that all students are capable of excelling and that remedial math could be eliminated with enough instructional face time. The members of the department structured the class schedule to include daily math instruction (rather than the typical schedule of class time on alternate days). After reviewing student test scores at the end of that first year, they found no significant difference in students’ performance from previous years. Math department leader Ryan Martine described feeling shock and frustration after a year of extra time spent on math instruction. But within this culture that supports risk taking, the math department set out once again to restructure the instructional approach. This time, the entire math department participated in a book study and found promise with Making Differentiation A Habit: How to Ensure Success in Academically Diverse Classrooms by Diane Heacox, Ed.D.

Together, the math faculty came to see differentiated instruction as a strategy that would enable them to approach the curriculum and instruction in a way that acknowledges individual learners’ different levels of aptitude, achievement, interest, motivation, needs, and ability. The faculty members began to alter their practices based on student need. One practice that has been broadly adopted is the use of heterogeneous groups that situate low-performing students with higher performing students. In fact, the teachers have deeply analyzed this (as a master’s thesis for one) so as to structure groups and activities to maximize the support struggling students receive from peers while still holding every student accountable for learning and producing work.

Another widely adopted strategy for differentiation is flexible grouping, whereby once per week students follow up on the previous week’s learning based on their needs. The groupings are determined by common assessments for each grade level, which are typically short, low-stakes opportunities for students to show how well they understand a unit. The week after these assessments, students are sorted into three levels of mastery for one class period: full, mostly, and partially or not at all. Students are thus assigned to groups where they learn based on those determined needs. Typically, one group learns the content over, one uses the understanding they have for deeper practice, and the group that achieved full mastery receives some form of creative enrichment practice with the material. With flexible grouping, students move to different groups frequently as their understanding fluctuates, avoiding the determinism and low expectations that come with more permanent tracking. As a result, the math department is currently on track for all students to be taking algebra by grade 8.

Innovation in the science curriculum was driven by student interests and enrichment opportunities. According to Assistant Principal John Howe, the most viable way to meet the needs of all students in science is to offer a wide variety of courses and activities, delivered though accessible instruction. Of all middle schools in Poudre School District, Preston has the most science offerings in grades 6, 7, and 8, as well as an honors course at each grade level and extracurricular clubs and activities. For example, partnerships with Front Range Community College and Colorado State University have allowed the students to participate in an invasive species project and a wildlife habitat improvement project. Learning opportunities for authentic inquiry include work with web-based inquiry activities to analyze existing data: creating graphs, tables, and diagrams and learning values of representing data in different ways. Finally, students learn to write scientific explanations supported by evidence. Project-based inquiry science drives the instructional strategies of core science classes at Preston, while instructional content is aligned with Colorado State Science Standards.

Adoption of PEBC thinking strategies, including metacognition

Comprehensive and multifaceted professional development directly related to the vision for the school is a key factor in the success of the education-
al innovations at Preston. The variety of professional development programs are a blend of site-based collaborative learning activities, including departmental collaboration and learning communities, and coaching, mentoring, study groups, and in-service workshops and consultants.

One source of professional development at Preston is the Public Education Business Coalition (PEBC). A resource PEBC supports is The 5 Dimensions of Teaching and Learning Instructional Framework from the University of Washington Center for Educational Leadership. The five dimensions of this professional development tool are:

- Purpose
- Student Engagement
- Curriculum and Pedagogy
- Assessment for Student Learning
- Classroom Environment and Culture

Faculty members at Preston reported that this tool has helped them think through their planning and teaching and understand what kind of thinking students are doing. One teacher explained that PEBC stresses “helping students work more collaboratively together, emphasizing student inquiry, and problem solving, inquiry and discovery.” Another teacher described her evolution as an instructor at Preston and stressed that PEBC has significantly influenced her daily practices. For instance, she begins every day with silent reading while she confers one on one with students to support and push them to make connections and pull from prior knowledge to understand new schema. She also described how every class period now ends in self-reflection, so that students evaluate their own learning and develop a deeper cognizance of their own intellects.

Results and Takeaways

Competition among schools via school choice for families can be controversial. Opponents sometimes argue that it discourages collaboration among schools and concentrates more motivated and more privileged students at higher achieving schools. Supporters argue that it spurs innovation and the crafting of school specialties, which give students more options for choosing a school that matches their needs and interests. Engaging in that debate is not within the scope of this case study, but the competition is relevant to the recent history of Preston, so it merits mentioning.

When a charter school was formed in the vicinity of Preston, it began to draw some of Preston’s students. This was the sparkplug for innovation at Preston as it (1) caused the school to deeply reflect on what its education was lacking and (2) pushed the school to choose and cultivate a focus area to master. Now, almost a decade later, the school has developed a deeply ingrained culture of innovation, systems that push and support every student to learn, and a STEM program that has earned it an Intel Schools of Distinction Award. That award has now

“They [the students] are not being taught; they are learning through questions and problems or ideas.”

- Mary Klass, Dept. Leader in Science, Preston Middle School
positioned Preston as model school in the district, and district leaders have since worked to find ways that Preston’s STEM focus and instructional practices can benefit its other schools. Preston accomplished this transformation by empowering its teachers and its students. Principal Nielson and Assistant Principal Howe set a clear vision of emphasizing student-centered learning, critical thinking, deep STEM investigations, and a growth mind-set that all students can learn at a high level. Critically, they gave teachers the tools, collaboration time, and encouragement to design their own innovative methods to accomplish this. Principal Nielsen’s attitude of “encourage[ing] risks and celebrat[ing] the heck out of successes and failures” has given his teachers the creative space and mandate to create effective learning routines. For the most part, the thoughtfully designed varied-ability group learning, the flexible grouping for math once per week, the telementoring, the meaningful science projects, and the flipped teaching by some teachers have all been the product of teacher collaboration and innovation.

These innovations, in turn, have empowered Preston students. Before, students felt a need to act out. When Principal Nielsen began at Preston, referrals averaged six or seven per day. This turned out to be partly, if not mostly, a product of the culture of learning. Students were implicitly categorized as accelerated or slow through tracking, and struggling students were not being given the support to learn at high levels. However, after the adoption of a growth mind-set by the staff and the decision to start giving every student an accelerated learning track, students rose to the higher expectations of them. Referrals are now a rarity and, with the supports of the differentiation techniques, all students are learning more.

One last takeaway from Preston’s transformation should be rethinking how schools address the individual needs and interests of learners. In the modern classroom, there are 30 students per class and a number of classes per teacher. The very idea of helping individual students unearth their passions seems daunting and unrealistic. What Preston has done, however, is design structures that facilitate this. One important one is the school’s last period of the day, dedicated to completely interest-driven electives for most students. Interviewed students were quick to mention “ninth hour” as their opportunity to choose what they are most interested in among the myriad offerings in order to pursue learning they can get excited about. Additionally, teachers are excited because they have agency to choose what they teach during that period. Beyond ninth period, Preston has been able to tap in to students’ unique and personal interests through the telementoring program. With other adults as mentors, students have been able to receive one-on-one support in such undertakings as writing a novel, redesigning water flow mechanisms to minimize flood damage, and creating and maintaining websites. None of these weighty pursuits are easy to accomplish, but Preston highlights what is possible when leaders create a clear vision and empower their teachers and students effectively.
Summary of Case:
MS 223 opened in 2003 with a new principal and seven new teachers in a faculty of nine. Working with students from the poorest congressional district in the country, drawn mostly from the housing projects adjacent to the school, their mission from the start extended beyond academics. The school’s greatest strength has been its ability to leverage partnerships to create opportunities for its students. These partnerships include, among others, the summer arts program through Yale, a music program funded by Bette Midler, teaching residents provided by a local teacher education program, and refurbished computers for entering sixth-graders. Technology is integral throughout the school day, differentiated small-group learning provides extra support for the many students with learning challenges, and a student interest-based school design keeps students wanting to be there.

Lessons Learned From the Case Study

Make school desirable and cool
- The process of making school desirable and cool begins before students even matriculate. By visiting local elementary schools and delivering their pitch, MS 223 administrators inform fifth-graders early on what MS 223 has to offer. Additionally, the students’ interests are solicited and used to shape learning opportunities the following year.
- The name of the school itself is the product of what students reported as their greatest interests in school. Building in finance opportunities, mostly through a school currency system, and ubiquitous opportunities to learn technology have earned the school strong buy-in from students.
- Rethinking college visits in order to show students the social aspects of college has broadened the appeal of postsecondary learning to more students, motivating them to work toward that goal.

Leverage partnerships and keeping kids longer
- MS 223’s leader is a firm believer that the reason children living in poverty sometimes make bad decisions is that they lack vision of what the world has to offer. As a result, the school treats every opportunity to broaden that scope as a “touch” that might change a student’s life.
- The Summer Bridge program gives students opportunities to partake in cultural outings, such as going to Broadway shows. A partnership with Yale provides arts education. Some instruction is help students avoid the summer slump, a well-documented loss in learning for low-income children who lack academic activity during the summer months.
- The learning day was extended through talks with the teachers union. Additionally, the principal
encourages teachers to start clubs. If they can recruit 10 students, he finds the funding to support them.

- The school moved a former teacher into a role as grant writer, the assistant principal constantly scans databases for funding opportunities available within the large district, and the school started a nonprofit to have access to further funds for afterschool enrichment. Intel’s recognition of MS 223 as an exceptional STEM school has helped legitimize the school’s success to many funders.

Data-driven, differentiated math

- In 2008, the school hired a math coach who helps teachers use formative assessment data to continually adapt their teaching for each student.

- The school takes on teacher residents who work as apprentices to master teachers. This allows for more adults in high-need classrooms. For example, one sixth-grade math class that is fully inclusive of students with learning disabilities has two residents, a lead teacher, and a special educator.

- A high adult-to-student ratio enables teachers to teach small groups of about seven students using lessons crafted to the specific needs of those students.

- The math coach and principal push a conceptual focus in learning. Teachers find that students thrive with the options of finding their own methods for problem solving.

Community development and building the whole child

- MS 223 is helping address low literacy in the South Bronx through its “Community Reads” program in which it delivers free books to drop sites.

- Parents are encouraged to build community through the school’s organization of a soccer league. They are also supported in finding work through workshops on technology, creating resumes, and how to perform job searches.

- The principal consistently reinforces the school vision with teachers by communicating the importance of developing leadership in students, along with social and emotional skills. One parent explained, “It’s like running a church and Gonzalez is the head and he has his vision.”

Introduction

MS 223, also known as the Laboratory School of Finance and Technology, is situated several floors up in a large building in the South Bronx. It is most accessible by train, sandwiched between two train stations, each a 10-minute walk from the school. From the south, we walk by housing projects, massive buildings identical in color and architecture. From the station to the north, the walk is busy, loud, and colorful. Foot traffic is heavy, and the streets are lined with name brand shoe stores, colorful awnings, and small markets with “Food Stamps” written in big letters in the windows. On entering the school, what stands out most are the hallways: they are full of students and loud like the streets. This noise is indicative of several of the school’s central goals: to empower instead of control the students, to serve as a place where students genuinely want to be, and to support students in becoming socially and emotionally healthy people.

The middle school MS 223 had opened in September 2003 in a different building, sharing space with IS 162, another middle school with a disproportionate number of students with behavior challenges. The story of the departure of MS 223 is an important part of its lore. Several months into that first school year, a student from IS 162 punched an MS 223 sixth-grader in the hallway and bloodied his nose. At that moment, Principal Ramon Gonzalez decided that the school needed to be moved to protect the children. On Christmas Eve 2003, in the pouring rain, the dedicated founding staff began the move, carrying computers and books in plastic bags to keep them dry. Within weeks the teachers, administrators, secretaries, and custodians had transplanted everything in the building to the current location, about 8 blocks away.

Challenges and Vision

The decade since has not been short on challenges. To begin with, the new building had just been vacated by a failing school and thus carried a bad reputation. Test scores at MS 223 were extremely low at that time; among sixth-, seventh-, and eighth-graders, proficiency rates were 29 percent in math and only 18 percent in reading. Seven of the original nine teachers were in their first year of teaching, and turnover was and would continue to be consistently high, with the strongest educators often moving into leadership positions at other schools. The school’s relationship with the district has been one of constant self-advocacy rather than collaboration. Nonetheless, under the strong and visionary leadership of Principal Gonzalez, the school has developed a very powerful learning experience,
motivating and inspiring students. MS 223 is in the poorest congressional district in the nation.

As described in the New York Times Magazine,

[M]ore than 90 percent of its students live in one of five housing projects, most prominently the Patterson Houses, a sprawling complex of 15 towers across the street from the school. About 70 percent of its students are Hispanic, predominantly Puerto Rican and Dominican. The remainder are black, either African-American or recent immigrants from West African countries like Senegal. Roughly 11 percent of the school’s students are ELLs, or English-language learners. (Another 60 to 70 percent of its students are former ELLs.) About 17 percent have learning disabilities.11

The kind of student that MS 223 is aiming to build to develop is not just one who can read, write, and do arithmetic. Principal Gonzalez proudly said, “My goal is not to build scholars. I want to build activists. I want to build kids who will make changes, who can adapt to situations, who are well balanced and know their strengths.” This philosophy pervades the school and is apparent in all its efforts to up the community. This community-mindedness is an important part of the school’s ideological mission, benefiting students through both the modeling of how to positively influence one’s community and by the strengthening of school and neighborhood culture.

Focusing on community is a central goal of the school, but several critical other factors have been important in making the school what it is today. Crafting school activities around student interests, leveraging partnerships, keeping students on campus longer, and using a data-driven system for intense, conceptual, highly differentiated math have been key as well. These overarching efforts have enabled the school to achieve many successes despite the difficult context of its surroundings.

- By 2009, MS 223 improved its math proficiency rate from 29 percent to 85 percent and reading proficiency rate from 18 percent to 61 percent.
- In math, students are able to think and learn conceptually instead of just procedurally, and their instruction is differentiated so that learning occurs with an appropriate pace and degree of support.
- The school has built robust music and arts programs.
- School leaders have created a summer program that prevents the summer slump that low-income children often experience and exposes them to cultural experiences.

This case provides a view of a school that has been able to succeed and help students thrive by applying innovative strategies focused on the school environment and taking advantage of every possible resource available.

How They Did It

Making school desirable and cool

Make every kid feel exclusive, and then they’ll treat you like you have an exclusive product.

—Principal Ramon Gonzalez

Students at MS 223 believe they are attending a special school. This belief is the outcome of a deliberate campaign that begins when students are in grade 5. Every year, school staff travel to neighboring elementary schools to deliver a sales pitch for MS 223—explaining what MS 223 has to offer, alerting students about the school’s rigor, getting them excited about attending, and soliciting their feedback about what interests them. In fact, it was through talking to students that Principal Gonzalez discovered that students from the Bronx, if not all students, love the idea of learning about technology and money. The strong appeal of these themes was the impetus for naming the school The Laboratory School of Finance and Technology.

Finance is woven into the school’s culture through the token economy of school bucks. For doing things like demonstrating school values or serving as an aid to a teacher, students earn school bucks. This approach by itself is not novel; many schools reward good behavior with tickets. MS 223, however, has added new layers by creating a central bank where deposits earn interest and

“Make every kid feel exclusive, and then they’ll treat you like you have an exclusive product.”

- Ramon Gonzalez, Principal at MS 223
of that. Interviewed at the school’s Finance Day in 2012, Principal Gonzalez explained, “In our community, financial literacy isn’t stressed and families can be victimized, but our goal is to give our students that experience.”

MS 223 also pushes students to think like entrepreneurs. One opportunity for this is the annual Finance Day, which is the culmination of a seventh-grade student project in which groups of students conduct market research and then develop a product concept and pitch. The project is organized in conjunction with NFTE (Network For Teaching Entrepreneurship), which sends actual entrepreneurs and business leaders to MS 223 to co-design learning opportunities with teachers. Students then apply their knowledge to their product ideas before pitching them at the school’s Business Expo. In addition, Junior Achievement, another nonprofit that teaches students about finance, sends entrepreneurs and other volunteers to MS 223 to share their experiences with students on Finance Day.

The use of technology throughout instruction at MS 223 also makes students excited about school. Computers are ubiquitous. Every student who enters grade 6 without a computer of their own is provided with a refurbished computer through a nonprofit that has partnered with the school. Teachers of all classes are encouraged to incorporate computer literacy and use into their curriculum. Every grade level has a technology teacher. Most fundamental to students’ success in learning technology, however, is the way the school makes technology engaging and clearly relevant to real-world uses.

Commenting on technology’s appeal, one parent said, “Every student in this school loves their technology class.” Her child had just completed a very popular animated story unit code-designed by one of the MS 223 technology teachers and an animation studio. Each student in the course produces an animated story with images—usually photographs—overlaid with text, like a graphic novel. This project combines story writing skills, graphic design, and use of professional animation software to create a product for an authentic audience.

One of the school’s technology teachers elaborated on the real-world relevance and importance of technology in the arc of learning. In sixth grade, students are exposed to all the most commonly used software applications—basic word processing, presentation, and design software, reinforced by projects taken on in other classes that incorporate those programs. In seventh grade, students learn how to use software for finance purposes. They learn market research software, how to create graphic images that communicate information (e.g., a product’s value), and giving graphic presentations. In eighth grade, the complexity of students’ work deepens as they begin to learn coding and animation.

MS 223’s approach to introducing students to college is unconventional, aimed less at academics and more at making college seem desirable and cool. When the school’s college visits began years ago, they were typical: Students made day trips to universities, observed classes, took a tour, and headed back to MS 223 after a few hours. Mr. Gonzalez was not satisfied, feeling that the experience had much more potential to be life-changing and affect the way that students think of college. In short, he wanted to make college more appealing to all his students. At that point, the school began to make connections with groups of college students. School leaders reached out to fraternities and sororities of color and to sports teams and then planned overnight trips with the specific purpose of exposing their students to the more social aspects of college. While many students at MS 223 are naturally drawn to the intellectual rigors of postsecondary learning, Principal Gonzalez often asked, “How do we win the buy-in of those other students?”

Leveraging partnerships and keeping kids longer

What I found out in [doing] gang research was that kids had these problems early in life—15, 12, 13 years old—because of lack of vision. If we can get them vision earlier, it’ll help avoid situations later when they’re making decisions. The more you put them in situations where they get to see what’s possible in the future, that’s when you start making an impact. I go back to this whole experience gap ... the idea of this experience gap is we wanna give our kids as many experiences to help them with their vision.

—Principal Gonzalez

Principal Gonzalez concentrates much of his attention on giving students exposure to experiences that expand their sense of possibility. This has led to the development of many extracurricular programs at MS 223, including arts and music programs, summer cultural field trips, the multiday college visits, and career days. Creating these opportunities has been a slow, deliberate process of identifying student interests, destigmatizing summer
school, applying for grants, reaching out to organizations with resources, and collaborating with the teachers union.

On the basis of published findings and his own research in Chicago with young people living in poverty, Principal González decided early on that to change students’ lives, he and his staff needed more time with the children every day. With this in mind, and with a young, driven teaching staff who bought into his vision, he began discussions with the teachers at the school, along with the school's teachers union rep, to change teacher contracts to allow for an extra 50 minutes of school 3 days every week. Although this change extended the school day until about 3:00 p.m., it was still not long enough. The school needed afterschool programming, so it took advantage of the district’s afterschool offerings and began a push for teachers to create clubs. The informal rule has become if a teacher has an interest and can recruit 10 students to take part, the principal will find the funding to support the club. Regarding this policy, one founding teacher explained how supportive the administration had been, saying, “There is a lot of room for putting ideas to work.” Asking so much of teachers has most likely contributed to the teacher burnout and turnover, but it is also, according to the assistant principal, what keeps about half the students at the school until 5:00 p.m.

The extracurricular opportunities offered to students, such as attending the opera or interviewing an engineer, are possible through partnerships the school builds via outreach. In the 2005–06 school year, MN 223 initiated a Summer Bridge program, during which students receive arts education, music training, and some academic support to mitigate the summer slide—the well-documented phenomenon among low-income students of dropping in reading ability and math skills during the summer most likely because of the lack of related activity. Besides preventing such setbacks, Summer Bridge was designed to expand students’ range of experience, giving them something to feed their hopes and dream about. During this program, students go to the museum, the opera, and other cultural events. Yale University supports this program by providing various types of arts education, and Bette Midler has donated musical instruments and support for a new auditorium.

MS 223 makes these productive connections through four main vehicles: (1) the staff members, especially the assistant principal, continuously scan the highly active New York City school district for any type of funding possibilities, (2) the principal is unabashed about approaching business and community organizations to partner with the school, (3) a former teacher has been employed as a grant writer for the school, and (4) the school created its own nonprofit organization to be eligible for funds for afterschool programming. National recognition of the school, including Intel’s Schools of Distinction award and an extensive profile in the New York Times Magazine, has helped open doors to potential funders and partners.

Of the principal’s moxy and resourcefulness, the New York Times Magazine wrote, González has shown the kind of entrepreneurial thinking that, were he a C.E.O., would attract attention: he joined the board of the Randall’s Island Sports Foundation in part to gain access to its playing fields, hired a part-time grant writer to raise money for the school, brought in a number of nonprofits to support the school’s extracurricular activities and even rented out space in his building to underwrite 223’s two-week summer-school program.

This reaching out to build partnerships is an important lesson for students and parents alike about advocating for themselves and being resourceful. One parent said, “Principal González is not afraid to go anywhere and ask for help, and that’s what he teaches us as parents.” Principal González has made many crucial moves. He has tapped professionals to share their experiences with students, organized a resident teacher program to improve the teacher-to-student ratio, and created a nonprofit partner to tap different funding options—all of which have added diverse types of support for the school’s success.

**Data-driven, differentiated math**

In addition to developing its culture and outside partnerships, the school has directed much academic effort to improving math learning in the classroom. In 2008 MS 223 hired a math coach who helped transform the school’s use of data. With the coach’s support, the school developed a strong emphasis on formative assessments and started using pre- and post-tests to measure learning outcomes. The formative assessments are used across grade levels as the basis for teachers to analyze students’ performance and discuss with coaches and peers how to improve instructional practices for better the school...
moves away from multiple-choice answers to having students write out responses to explain their thinking. This subtle shift, although more taxing to grade, has not only served as a more rigorous test of student learning, but has also proven less punitive. Students are more likely to get partial credit for the parts of problems they did accurately. A special educator at the school explained that this change seems minor on the surface but makes all the difference to struggling students. Many of her students with learning disabilities, who are particularly prone to making minor errors that result in an incorrect final solution, benefit emotionally from seeing which parts of the problem they answered correctly.

One teacher explained, 

Before [the arrival of the math coach and the teaching residents], there would be one mini-lesson given, and then all the work was done in small groups with one teacher and six kids. Now we’re moving toward taking one objective and differentiating it on three levels, and each one of us takes a different level. When [the special educator] is in the class, we can split up the most needy to form a fourth group.

Strategic use of teaching residents has enabled MS 223 to create this differentiated small-group approach. As part of an alternative certification process, some graduate schools of education allow their student to serve as part-time teacher apprentices or residents. Connections made through Teach for America corps members helped the school create an alliance with one particular teacher education program that now sends residents to MS 223. The primary purpose of having residents is to train them in the teaching profession by allowing them to teach with masters. They are given increasing responsibility throughout the year and learn by doing. A beneficial by-product is that they greatly improve the teacher-to-student ratio. This low ratio allows for finer scale differentiation in that with more small groups teachers are able to introduce content at an appropriate pace and use customized strategies according students’ needs.

In addition to providing significant supports for students in math classrooms, MS 223 is moving from teaching mathematics procedurally to conceptually. One math teacher explained, “Now we never teach a procedure or emphasize that kids need to know a procedure, but it’s more them doing it conceptually and figuring out a procedure by themselves so that it’s linked with a meaning.” As one teacher said, “I can see the light bulbs a lot more quickly. What I like about it is that it gives the kids options. You can draw a picture, use an algorithm, whichever you prefer.” In that sense, this conceptual emphasis has also proven to be a support for students who need options in the ways they generate ideas or communicate their understanding. The math coach and math teachers work to inject more critical thinking into their teaching, and the school has recently adopted a new curriculum to support the conceptual focus. Principal Gonzalez summed up the school vision: “This year is really about getting our kids to … think critically.”

Community development and building the whole child

Our goal is not to quarantine these top kids from the neighborhood and give them this fake neighborhood and say if we inoculate them from the neighborhood, they’ll do well. No, the neighborhood is an asset. We have to learn how to use the neighborhood to make them learn.

—Principal Gonzalez

A defining characteristic of MS 223 is its embrace of the local community. It is important to the school staff to improve the community by teaching students to learn about their neighborhood and to work to improve it. Principal Gonzalez put it concisely when he said, “If you’re not addressing the community along with the school, you’re not addressing the problem.”

Among many other serious issues in the South Bronx, the literacy rate for youth and adults is extremely low. School personnel noted that one aspect of the problem is that libraries in the area are underresourced and overused. Furthermore, there is not one bookstore. This lack of access to reading material prompted the creation of the Community Reads program, in which the school drops off books at six community sites for people to pick up free on a weekly basis. The principal explained, “The idea is to get people used to reading.”

MS 223 has also proactively worked to build community by organizing events for parents. It began a parent soccer league to encourage positive relations among families. It also runs workshops to teach parents how to use technology, create resumes, and hunt for jobs. The school is currently building a relationship with the Mercy Center to start offering nutrition classes to parents.

The school’s effort to improve the neighborhood and assist parents communicates the importance of community building to students as well. When asked what is most special about MS 223, the first thing students
mentioned was the relationships their teachers have forged with them. Students and teachers described the bonds among them that have helped students develop socially and emotionally.

Principal Gonzalez explained,

*Overall we have a wide range of kids. The ability is to teach them how to get along with such a wide range [of peers], and I think we’ve done a good job of that. I think that has a lot to do with structures in the school. That has to do with adults trying to develop a relationship beyond the kids they know.*

It is clear that Principal Gonzalez and much of his staff care deeply about supporting children in ways that extend beyond their academic learning—cultivating the full range of their capabilities. This pervasive philosophy is mostly a result of developing a cadre of teachers committed to a distinct and powerful school culture. Sometimes, however, pressure has had to be applied to keep everyone aligned with the overarching vision for the school. Principal Gonzalez offered an anecdote to illustrate this. After an observation of one of his top-scoring teachers, he said to him in their debriefing, “I don’t see the girls talking.” The teacher did not seem to think this mattered.

The principal continued,

*Philosophically we were at different ends. Cuz his belief was teachers here should do whatever they want as long as they’re getting results. My belief is we’re not here to look at test scores—we’re here to build citizens. We’re here to build leaders. I want girls talking because I want them being leaders.*

For most staff at MS 223, test scores are not the bottom line. Their students’ future is what matters most.

**Results and Takeaways**

The staff at MS 223 have committed themselves to a huge undertaking: beyond its rigorous academic goals, The Laboratory School of Finance and Technology aims to give students a vision of the world that is bright, rich with arts, music, and culture, and filled with opportunity for those who strive. The school’s academic achievements include dramatic gains in reading and math proficiency and the development of a technology learning arc that is integrated throughout all subjects and predicated upon the importance of students seeing the value, practicality, and applicability of technology use.

One key takeaway from MS 223’s development strategy is paying close attention to student interests and shaping the school around these interests. Making the school a place where its students are happy to be—through finance activities, technology resources, engaging afterschool clubs, cultural programs, and college visits—has created in MS 223’s students a willingness to work harder at all the tasks put before them.

Being part of a large district has both advantages and disadvantages. While the school lacks opportunities to influence district policy, it benefits from the funding and resource opportunities available through the New York City Department of Education. MS 223 has developed an effective recipe for bringing in new funds to enrich student experiences. The school (1) keeps a close eye on funding databases, (2) transitioned a staff member into a role with grant writing responsibilities, (3) created a nonprofit to receive afterschool funding, and (4) assertively pursues partnerships with anyone willing to support their school and students. The school’s partnerships have supported many of its most successful initiatives, including summer and afterschool programs and an improved teacher-to-student ratio, which has been critical for achieving the level of differentiation that the school uses to ensure a truly student-centered model of instruction.

This intensive model has costs, most notably teacher burnout. Since winning Intel’s Schools of Distinction Award in 2010 for excellence in math education, for example, the school’s entire math staff has turned over. To

"Now we never teach a procedure or emphasize that kids need to know a procedure, but it’s more them doing it conceptually and figuring out a procedure by themselves so that it’s linked with a meaning."

**Math Teacher**

**MS 223**
keep its innovations alive and well, MS 223 has focused on developing its resident-program teachers, aiming to transition current apprentices in the program into fulltime roles. Still, the school faces the ongoing challenge of making teaching at MS 223 more sustainable while maintaining the quality of relationships among students and staff and the high degree of teacher involvement in afterschool programs.

Looking to the future, school leaders continue to think outside of the box to develop resources and opportunities for their children. Disheartened by hearing from their graduates about the poor quality of their high school experiences, MS 223 will soon be expanding into the high school grades to maintain its support in its students’ lives. Principal Gonzalez intends to do even more. Concerned that boys with the most troubled home lives need more support than MS 223 can currently provide, he intends to build a boarding school to house and nurture them. In the business of changing lives, there is always more that can be done.
Summary of Case:
Farmington View has a long history of a stable teaching staff, well-documented learning outcomes, and a strong community. In 2001, Hillsboro School District hired a new principal who identified science as an area for growth. By conducting an asset map of the human and natural resources available in the community, the school created an instructional strategy for STEM that consistently incorporates environmental studies and afterschool enrichment for learning.

Lessons Learned From the Case Study

Asset Mapping: People Resources
- The school emphasizes that parents have a wealth of practical knowledge and experience to share with children.
- The former principal set out to meet all the parents and identify the skills and abilities they could contribute to the school, especially with afterschool programs. Parents are given meaningful opportunities to shape learning for students, as opposed to menial tasks.
- Acknowledging that primary teachers cannot be experts in every subject they teach, the school reaches out to experts in the community to integrate their technical expertise—in architecture, for example—into learning experiences.

Asset Mapping: Natural Resources
- The school has a relationship with the Jackson Bottom Wetland Preserve and designs projects for students to perform primary research and fieldwork on topics like animal population tracking.
- As Farmington View began to identify opportunities for having students learn in the outdoors, it invested in 2 years of professional development on learning how to integrate outdoor experiences with concrete, rigorous science objectives.
- Because the school is next to a large pond with many birds, the staff created an observation garden with bird feeders, gardening opportunities, and wildlife viewing.
- The STEM focus on observing the world acutely pervades all subjects. For example, one teacher pushes students to identify the angles of lines on their palms and the lines on seashells to reinforce their understanding of angles.

Sheltered Instruction as Differentiation
- In 2011 the school added an intentional focus on its achievement gap between the 20 percent Hispanic students and majority white students.
- The school is trained in SIOP (Sheltered Instruction Observation Protocol), to help teachers to redesign lessons in such a way that makes learning more accessible to students with language challenges.
- Teachers consistently use strategies like checks for understanding with white boards and opportunities for students to call on prior
knowledge at the beginning of lessons.

Bold Pursuits and Overcoming District Pressure

- Farmington View was its own district for many decades. When it was consolidated into Hillsboro School District (HSD), the community was vehemently opposed to losing local authority.

- Since the consolidation, the school has worked to retain its vision and developed meaningful STEM experiences for students.

- Catalyzed by attending the Intel Schools of Distinction award ceremony, the district is now using Farmington View as an incubator for STEM innovation and is determining the best ways to transplant its best practices.

Introduction

Farmington View Elementary School is 20 miles west of Portland, Oregon, just south of the city of Hillsboro. Although the school is only several miles below the heart of Hillsboro, where most of the businesses are, it feels farther away and more isolated, according to both parents and staff. This perception is not surprising: to get to the school, we drive by miles of lush greenery and wide farm lots. The school itself is just in front of a large pond with many birds flying about, making the school seem as if it is tucked into nature. Circling the perimeter of the school, we cannot help but stop in the “wildlife observation garden” the school constructed, which is next to the lake and has a large scenic mural. Of note, the observation garden had once been the school’s dumping ground with over fifty years of accumulated junk, overgrown with weeds and blackberry bushes. The goal in creating the garden was to take an eyesore and turn it into an area of beauty, an outdoor site for environmental learning.

On the far side of the school is a well-manicured soccer field, the product of a few parents’ hard work with their tractors. Solar panels are situated next to the field with a screen for monitoring how much energy the school is harnessing. Without having taken a single step inside the building, we can infer several of the school’s most integral principles: using the bountiful resources of nature for learning about the world, encouraging students to be keen and thoughtful observers, and drawing on the efforts and abilities of parents.

The story of Farmington View Elementary is not one of complete transformation. It is the story of a school going from good to great by adding to its already harmonious communal school environment, staffed by very experienced teachers. When first asked what makes Farmington View special, the current principal, Roger Will, was quick to mention the 213 collective years of teaching experience of his staff of eight teachers (a staggering average of 27 years each). Three-quarters of these teachers also have master’s degrees. Another advantage is that children at the school have historically been well behaved. Talented teachers contribute to this, but parents and administrators alike attribute much of the lack of behavior challenges to the tight-knit school community. Principal Will explained, “It’s not just a school that happens to be in our neighborhood. It sort of is the neighborhood … it is the community center.” Thus, parents are constantly in the building, helping out, and feeling empowered to help reinforce positive communal norms with the children.

Farmington View enjoys several critical advantages. One advantage is that it has been able to inadvertently recruit motivated students from other schools. For the most part, the Hillsboro School District does not allow for family choice of schools, a measure to prevent the concentration of highly motivated students at few schools. However, there is an exception to that general rule. If parents are seeking a certain type of programming for their child that is offered only at one school, they are allowed to transfer. With its accelerated math program and eventually its engineering program, highly motivated families from the area were enticed by and permitted to transfer to Farmington View. All students who met the district’s guidelines were permitted to transfer, not just the most motivated or best and brightest. One PTA member estimated that almost a third of the students had transferred to the school. In addition, the Farmington View parent organization annually raises enough funds to pay for the school’s accelerated math teacher, and this additional educator is an important part of the school’s success in math. Another important advantage for the school is provided by Intel. Intel’s nearby location has facilitated a strong partnership, in which Intel has provided to the school technology support, numerous tutor and volunteer hours, and support for programs such as a school technology fair. These advantages do not detract from what the school has accomplished. It is just important to remember that these quite special foundations, which are rare and difficult to replicate, helped in the school’s development.
The Vision and the Challenges

In 2001, Bill Tracy became the principal of Farmington View Elementary and a driving force in developing the school as it is today. When he arrived, the school already had experienced teachers, an accelerated math program in its sixth year since inception, well-behaved children, and an involved parent community. His decade at the helm would not, however, be filled with complacency or satisfaction with the status quo. Early on, Principal Tracy devoted much of his energy to building a science and STEM focus, transforming that one aspect of the school into its greatest strength.

During that first year of his leadership, Principal Tracy saw sparse resources and teachers who did not know where to obtain, or were not supported in obtaining, the appropriate resources to do in-depth scientific investigations. With meager resources and a general lack of training in how to teach science in a meaningful way, science simply was not taught very much at the school. When it was, Principal Tracy claimed, it came straight out of a textbook or a science kit with depleted supplies, and in his mind that is “probably the worst way possible to teach science.” He believed and stressed that to learn science, “you have to really immerse yourself in real science.”

In building a STEM focus at the school, Principal Tracy set out to identify all the possible resources the school could take advantage of. The result, 10 years later, is a STEM program that has students doing authentic wildlife research and fieldwork. These efforts produced a science curriculum that consistently integrates studies of the local environment with learning objectives. It resulted in an afterschool program that harnesses the expertise and passions of parents and community members to give students applied experiences to supplement their school day learning. Last, it yielded a unifying vision of learning that pervades all subjects, pushing students to be careful observers and treat everything around them as an opportunity for curiosity and learning.

Principal Tracy’s successor would arrive in 2011 to a school that had just won Intel’s Schools of Distinction Award for exceptional elementary science. Again, like his predecessor, Principal Will set out to determine what challenges his teaching staff could take on to better serve their students. He determined that despite the strength of instruction and the enrichment opportunities at Farmington View, the needs of not all students were being met. With a 20% Hispanic population, many of whom are the children of migrant workers, the school has a high number of ELs (English learners), and 10% of the students require special education services. To make learning accessible to all students, Principal Will began professional development on sheltered instruction practices, which are teaching techniques to make rigorous learning supported for ELs. This is the next frontier for the school, and while its impacts have already been

“It’s not just a school that happens to be in our neighborhood. It sort of is the neighborhood ... it is the community center.”

- Roger Will, Principal, Farmington View Elementary
while its impacts have already been felt, there is more to improve upon. At Farmington View, there is always more to improve upon.

How They Did It

Asset Mapping: People Resources

Former principal Bill Tracy will not admit to ever having used the words “asset mapping” to describe his work. Nonetheless, teachers and parents continue to attribute those words—and, more important, their impact—to the efforts of Mr. Tracy. Asset mapping, according to current teachers, is the process of identifying helpful resources, be they people, organizations, or the environment, that are available within the community.

The history of asset mapping at Farmington View begins with the perspective that parents have a wealth of practical knowledge, job skills, and experience to share with the children. However, according to Mr. Tracy, the reason parents often shy away from helping significantly in schools is that they are given menial tasks, not ones that are exciting, intellectual, and offer real opportunity for leadership and big-picture design. Like students, parents need to be empowered to put forth their best effort. Of course, for some schools, finding parents with technical skills to share with children is difficult, especially expertise in STEM fields. At plenty of schools, though, those parents exist and are underutilized. Mr. Tracy explained,

You have to look a little bit deeper and ask what do all parents have to offer and how can we utilize their talents and their skills? It’s that sort of thinking that takes volunteer recruitment one step beyond just having parents coming in to grade worksheets or something like that.

With this in mind, Mr. Tracy resolved to meet as many parents as he could and ask them what they have to contribute to the school. One parent offered an anecdote to illustrate this. He said that he “came from another Hillsboro school, where one never even talks to the principal, and there’s no way to plug in.” Then he contrasted that with Farmington View: “When I first met Bill Tracy, he was super excited about the school … he tells me about what is going on in the school, asks me what I do.” The next thing he knew, this parent was running an engineering club after school. This story was repeated over and over again. In fact, the parent focus group at the school dubbed Mr. Tracy “The Connector.” It was as if he saw the entire community as a set of puzzle pieces, every one of which he would attempt to connect to the school in some meaningful way.

The product of this approach was the development of more than 25 popular clubs—including several LEGO robotics teams, Rocketry Club, Robot Club, and Kids Saving Earth Club—that meet after school. Research has shown, according to Mr. Tracy, that the more kids are involved in afterschool activities, the better they do in school. If students were behind, the school encouraged parents to put them in reading and math support programs after school. Students did not view this as a punishment, as most students participated in afterschool programs and because educators worked hard to make sure afterschool sessions felt different from those in the school day. Notably, nearly as many students participated in after school activities as attended during the regular school day.

The other social resource that Farmington View has taken advantage of is local community members who are experts in their fields. When asked about the school’s instructional strengths, Principal Will first mentioned the school’s ability to tap experts to bring their knowledge into the school.

He explained,

What [our teachers and past principal] have been really good at is finding experts to come in and support their work. … When you’re an elementary teacher, you might have a particular love or passion, but you have to be Johnny on the Spot for everything.

As a result, they have pursued experts in fields from fields such as art, wildlife preservation, engineering, and architecture to come in, year after year, and blend their expertise with the teachers’ curriculum. For instance, each year, architects come to Farmington View for 4–5 weeks. Not only do students have access to “the people with the highest level of expertise,” as Principal Will described them, but so do teachers. Principal Will explained, “The teachers, they’re learning as the students are learning.” As a result, these longtime teachers are consistently receiving subtle professional development opportunities through working with these experts.

Asset Mapping: Natural Resources

Every school has its own unique set of opportunities for learning off site. For Farmington View, its most obvious natural resource to map as an asset was the Jackson Bottom Wetlands Preserve located only a couple of miles north of the school. According to its website, “The Preserve is a premier resource center for information and services related to wetlands and aquatic education in the Pacific Northwest.”15 As would be the case
with much of Mr. Tracy’s resourceful networking, all it took was asking to establish a relationship. He said, “It’s amazing how often you’re received and people are willing to support you when you come to them and say this is what we’re trying to do and we need some help doing it.”

Plans were quickly in the works because the school staff was excited to use the wetland to teach science. Students began to perform primary research and fieldwork there. One of their larger research undertakings was animal population tracking. Concerned that the population numbers of certain species were declining, the students set up experiments to measure and estimate population numbers for the animals in different parts of the wetland preserve. This entailed learning how to identify animals based on their tracks, creating tracking stations, and interpreting data to infer where certain animals were most prevalent. To determine which animals and how many were living in different areas of the preserve, students built tunnel contraptions. Animals that entered were navigated onto a strip that captured their footprints. Students analyzed the footprints to determine the types of animals living in the area and drew inferences on the general magnitude of that animal’s population in certain areas based on the number of footprints.

Students also had the opportunity to experience affecting environmental outcomes by taking a problem in the wetland and working on a proactive intervention. One identified problem was the drastic decline of the red-legged frog population in the area. According to Mr. Tracy, “There are only certain plants that the red legged frog will lay its eggs on,” and their numbers were diminished. To address this problem, students began work in one of the marshes on the wetland, now named Bobcat Marsh after the Farmington View Bobcats (the school mascot). After 2 to 3 years of planting shrubs and trees in the marsh, the students were able to document that the red-legged frog had returned to the marsh they had made habitable.

Through their work at the Jackson Bottom Wetland Preserve, students have not only learned about how to conduct environmental science research, they have also experienced a number of benefits. They developed a sense that they can affect the real world by understanding problems and working to address them. They have made real-world connections to their learning in the classroom and developed a deeper interest in science, and they consistently leave these projects with a stronger appreciation for wildlife preservation.

Other learning opportunities were created for students through the schools’ partnership with Jackson Bottom Wetlands Preserve, including the establishment of an environmental day camp at Camp Madsen, used exclusively by Farmington View fourth and fifth grade students to explore the flora and fauna of the area. A
wetlands education specialist, Sarah Pinnoch, helped establish and lead the Junior Naturalist Club as part of an after school program for fifth and sixth grade students. In addition to conducting bird surveys and habitat restoration, students developed a field guide for identifying plants and animals. The Jackson Bottom staff also taught wetlands science classes at the school for all grade levels and participated in the school’s annual research symposium, which highlighted students’ accomplishments in science, technology, engineering and math.

Although these types of experiences undoubtedly promote highly valuable and meaningful learning, a challenge is that it can be difficult to align that learning with the material teachers are held accountable to teach. Mr. Tracy explained, “There’s so much pressure with testing, it’s a struggle to do that. Some schools have abandoned science altogether … so it’s hard. … It takes a real effort and time to do these things.” He continued, “We tried to match, as much as we could, our science curriculum to what we were doing [in nature]. It didn’t necessarily match exactly, but it was close.” For some units, teachers had to get quite creative. For example, to meet the state’s second-grade emphasis on learning about birds, the school hung feeders in the observation garden and capitalized on bird watching opportunities presented when a neighboring farmer planted black caps berries (similar to blackberries and attractive to birds) near the garden and pond. Second graders became junior birders, using binoculars to understand the morphology, feeding habits, and other behaviors of birds.

Mr. Tracy recognized the difficulty in designing these units that wed nature experiences with concrete science objectives. Determined to make real science learning an integral part of every classroom, he ended up providing teachers with 2 years of professional development with a major emphasis on just that: designing lessons that take advantage of the environment. With increased training and comfort teaching this way, teachers were able to give students increasingly more opportunities to test hypotheses, practice inquiry-based science, and think like real scientists.

**Sheltered Instruction as Differentiation**

With its STEM program solidly in place, Farmington View sought to grow in other areas. After spending the better part of his first year observing classrooms, Principal Will was convinced that not all students were learning the material. He explained, “Some students have difficulty accessing the content, sometimes it’s the vocabulary, so the building of your lesson plan should make sure that you’re utilizing the background knowledge of students” among other best practices in differentiation. He continued, “Our staff, because we do have a discrepancy between our Hispanic students and our white students, really said, ‘Well what do we need to do differently?’ and I said that we really need to go through SIOP training.” As a result of these conversations, the school began “a 6-week intense training on SIOP that really provides a lot of the best practices on how to, in a nutshell, provide access to all of the content for all students.”

One component of the school’s new focus on making learning accessible for all students is frequent informal checks for understanding. Many teachers, for example, have students use dry erase boards as a tool for formative assessments by asking them to jot down their understanding or questions. This quickly helps the teacher see how broadly the class is understanding a lesson and identify who needs extra help before the lesson is over. Of this and other SIOP strategies, one teacher expressed, “I think the biggest part of teaching is that you have to be open and try new things all the time and not just get stuck doing things one way all the time.” The Farmington View teaching staff has a wealth of experience in its veteran teachers, but they still show a consistent willingness to expand and improve their practice by trying new things. A perceptive parent noticed this as well, commenting, “You have these risk-tolerant educators, but they’ve also been doing this for 20 or 30 years, which is kind of an odd match.” He later went on to say, “There is this mentality that, ‘If something hasn’t been tried before, why don’t we try it?’”

**Bold Pursuits and Overcoming District Pressures**

For many years now, Farmington View has boldly pursued uncharted territory to create valuable learning experiences for students. The larger district, however, has had priorities geared to the general population of K-12 students, and has consequently expected all schools to use consistent instructional practices geared to remediate low reading, writing, and math test scores. These policies have been at odds with the student needs at Farmington View, which has high test scores and is the only school in the district to receive an exceptional rating from the state six years in a row. Fortunately, the staff was resolute in its drive to create an
experience-based STEM program that gives students consistent practice exploring their world using the scientific method. Mr. Tracy worked hard to cooperate with the district while holding true to that vision. Eventually, as Hillsboro School District learned more about Farmington View’s success with STEM learning, it began to consider the school as a model for best practices.

For most of Mr. Tracy’s tenure, the relationship between the school and the district was somewhat rocky. One key cause was the fact that for many years Farmington View had served as its own district. All decisions had been made at the school level, and families of the school felt that their voices were heard. In the late 1990s, Oregon had a push for consolidating small districts into larger ones. When Farmington View was originally brought into the larger HSD, Mr. Tracy commented that many community members “were kicking and screaming.” He continued, “There was a real distrust with the larger district.” And, to him, that was partially justified because the district tended to hinder the efforts of the school whenever it deviated from the course HSD charted to pursue what it felt was best for students.

Mr. Tracy acknowledged the cost-saving benefits of purchasing curriculum, professional development, textbooks, and other resources at scale, but he found certain requirements restrictive to the school’s development.

He explained,

_It got down to the point where they were telling us, “These are the materials you’re going to use, this is how much time you’re going to spend on it, and this is how you’re going to teach it”… that can be pretty stifling to veteran staff._

District consolidation in Oregon along with many other states has been controversial, and some argue, like Mr. Tracy, that it stifles innovation at the school level in return for “Economy-of-scale purchase power,” as the current assistant superintendent put it.

John T. Wenders, Ph.D., an education researcher at the Cascade Policy Institute in Oregon, wrote,

_The idea behind consolidation is that districts will reap economies of scale, reduce costs, boost efficiency and leave everything else the same. The reality is that… consolidation sucks power upward and away from parents and students into top-down, centralized and inflexible political arrangements._

Mr. Tracy’s vision for Farmington View hinged on the school’s ability to transform the way it taught science, connect students to the world around them, and incorporate scientific inquiry into all areas of the school. Unfortunately, HSD was not prioritizing science learning to the same degree. Mr. Tracy asserted, “My mission at Farmington View was to do what I knew we could do and do well and overcome the obstacles that might be put in front of us by the district.” Unwilling to slow the development of his school to oblige the district, Mr. Tracy

“I think the biggest part of teaching is that you have to be open and try new things all the time and not just get stuck doing things one way all the time.”

- Teacher, Farmington View Elementary
found himself frequently negotiating with the district to identify points of flexibility.

The district itself, however, has proven adaptive to what its schools are learning and has come to see Farmington View in a new light. Mr. Tracy attributed this shift to the moment Farmington View won the Intel Schools of Distinction Award, which validated its progress, particularly in science. The ceremony had a profound effect on the HSD members in attendance, reshaping their views on STEM learning as they watched schools from around the country describe how they push critical thinking skills through STEM study. According to Mr. Tracy, “After that, it was a turning point,” and the district has since tasked Principal Will with helping the district adopt the lessons of his school; now Farmington View is viewed as an incubator for STEM innovation. HSD has plans to turn some Farmington View classrooms into “labs”, Principal Will added, that educators from other schools can visit to learn about their STEM instruction.

Results and Takeaways

During Bill Tracy’s tenure at Farmington View, standardized testing never shaped the school’s instructional agenda. Still, year after year, the students showed high proficiency: In 2011, proficiency rates for third- to sixth-graders were over 95 percent in reading, 88 percent in math, and 93 percent in science, each considerably higher than state averages and averages achieved by schools with comparable demographics. In addition to the skills measured by the tests, students at Farmington View are developing problem-solving skills, often through applied activities in the real world.

Standardized tests are important to mention because, according to Mr. Tracy, they are often the reason why schools underinvest in learning outside classrooms and giving students opportunities to do “real science.” Organizing and executing such activities are time consuming and difficult to integrate into lessons that have measurable objectives. However, it is possible. The recipe of Farmington View is nuanced and complex, but the ingredients that deserve special attention are (1) identifying and assertively pursuing natural and people resources, (2) making the learning process “real” and situated within meaningful contexts, which inevitably cultivates greater interest in learning in general, and (3) investing in professional development that helps teachers integrate real-world learning into core subjects.

Not all schools have the resources of Farmington View. For example, many schools do not have as many parents with STEM interests to share with students in afterschool clubs; nor do many schools have a wetland preserve several miles away with a desire to educate children on local wildlife and environmental issues. The message Mr. Tracy stressed, however, was that most schools do have resources that they have never considered tapping. For instance, he was shocked at how willing local experts were to spend a significant amount of time at the school, working with both students and teachers, if school staff just “[go] to them and say this is what we’re trying to do and we need some help doing it.”

Beyond asset mapping, much of the teachers’ effort and success has been the result of professional development, especially with regard to integrating experiential learning, reading, and math into science undertakings. When asked how the school is able to maintain such high test scores while spending whole days performing wildlife research and fieldwork, Mr. Tracy explained that almost every involved science project can incorporate opportunities for math through measurement and interpreting of data, along with supplemental nonfiction reading. Additionally, by incorporating meaningful quests into the curriculum, students are more highly engaged and motivated to undertake deeper intellectual work in every related part of the project.

The Farmington View teaching staff is unique in its combination of experience and willingness to learn new classroom practices. For decades, the school has never struggled with instructional or behavioral problems, and yet the staff continues to identify areas of growth and then invest in teacher capacity to support those areas. Having developed a STEM experience that extends meaningfully from the classroom to the observation garden to the wetland preserve to highly enriching afterschool clubs, the school will next move to improve its capacity to meet the individual needs of every learner.
Science, Technology, Engineering, and Math (STEM)

Intel believes that young people are the key to solving global challenges. A solid math and science foundation coupled with skills such as critical thinking, collaboration, and problem solving are crucial for their success. To help educators foster the next generation of innovators, Intel provides STEM curriculum, competitions, and online resources to encourage students’ interest and participation.

To learn more, visit:

4. Student focus groups were held in middle and high schools only; student focus groups were not held at the elementary schools in the study.
5. Education reporter Dan Carsen of Public Radio WBHM, a listener-supported broadcast service of the University of Alabama at Birmingham; http://www.wbhm.org/News/2012/HalfTurn-around
10. The University of Washington, College of Education Center for Education Leadership, 5 Dimensions of Teaching and Learning. http://www.k-12leadership.org/services/5-dimensions
13. Cite something if this seems unsubstantiated