Consortium for Educational Research and Evaluation–North Carolina

Race to the Top Evaluation: STEM Affinity Network

Second Year Report

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STEM AFFINITY NETWORK: SECOND YEAR REPORT

Executive Summary

Overview of the Evaluation and Progress Made since the Last Report

This second annual report of the RttT STEM implementation activities documents ongoing implementation of RttT STEM initiative in participating schools and assesses intermediate outcomes for students and staff in anchor schools after one year of implementation.

The evaluation is guided by the following two research questions:

1. To what extent have the four key elements of the network of STEM anchor and affinity schools (network structure, professional development, curriculum, and partnerships) been implemented as intended?
2. What are the intermediate outcomes for students and staff in anchor schools after one year of implementation?

In addition, this report notes recommendations from the Year 1 evaluation report that were addressed during the second year of implementation of the initiative. In particular, the implementation team:

- Integrated the six North Carolina New Schools Project (NCNSP) Design Principles with the various components of the STEM vision;
- Provided explicit training for leadership teams on creating a common STEM vision for staff;
- Continued using the four NC Learning Lab Schools as sites for study visits by teams from network schools while eventual anchor schools continued to develop;
- Provided opportunities for schools that joined the network late to catch up via provision of PD necessary for successful implementation of the STEM model;
- Provided more background knowledge to teachers about the STEM themes and the engineering design process prior to their work on projects;
- Engaged instructional coaches in supporting the project work;
- Actively involved IHE and business partners in designing a project-based curriculum;
- Contracted with highly-skilled teachers to develop model projects for each of the four affinity networks; and
- Designed and used a standardized participant evaluation form for evaluations of multiple PD offerings from NCNSP.

Findings and Recommendations

One of the initiative's objectives was to "Work with partners to support the development of a small set of anchor/model STEM high schools that will serve as laboratory schools and sites for professional development around project-based learning." There is definite progress toward this goal, with three of the anchor schools working hard to improve instruction and implement STEM features such as project-based learning, their STEM theme, and additional STEM courses, and also utilizing partnerships for improvement of student learning. The fourth school is welcoming their first students in the 2012–13 school year (with one-year delay). Based on analyses of RttT STEM initiative activities to date, the Evaluation Team concluded that structures for networking, professional development, curriculum development, and partnerships are in place to support both anchor and affinity schools as intended, though some of these activities have been delayed. A summary of findings and recommendations for each of the four areas of implementation strategies and for the intermediate outcomes observed in the three anchor schools are presented here.

I. Structure of the Network of Stem Anchor and Affinity Schools

Baseline characteristics of the RttT-funded STEM schools

- Prior to the initiative's launch, RttT STEM schools offered a lower proportion of advanced STEM courses than did the average high school in the state. In most cases, student achievement in RttT STEM schools was not notably different from all other high schools; however RttT STEM school physical science EOC scores did tend to be higher.
- Since its launch, the RttT STEM initiative has made progress toward its goal of serving minority and poor students, who are traditionally underrepresented in STEM fields. In 2010–11, North Carolina RttT STEM Affinity Network schools served a higher proportion of black and Hispanic students and a higher proportion of students of poverty than did the average high school in the state, hosted the same proportion of female students, and were more likely to be located in an urban area.
- Also, while faculty credentials and experience were similar across RttT STEM Affinity Network schools and all other high schools, per-pupil expenditures for STEM schools typically were slightly higher on average, and school sizes often were smaller.

Face-to-face and online networking

- NCNSP has encouraged and facilitated networking and collaboration by various means, including embedding it in face-to-face PD events, furnishing online collaboration tools, and providing coaching services. Currently, face-to-face meetings have been the most successful networking channels.
- Networking among schools in the STEM network is still in the early stages. Some schools have been networking with other schools outside of the RttT network.
- NCNSP provides multiple opportunities for online collaboration. Edmodo, the original online network for STEM schools, has not been actively used.

Infrastructure developed for schools and their partners to share resources

- As part of the RttT initiative, the NC STEM Learning Network was created and provided a number of services and products, though some of the main products and services have not been finished and require additional sustainable funds to continue in operation.
- There has been little collaboration between the NC STEM Learning Network and the NCNSP STEM network.

Recommendations:

- Leadership coaches should consider making increases in advanced math and science courses a possible emphasis for conversations with administrative teams in RttT STEM schools.
- Implementers should consider various strategies for increasing the appeal of and incentives for visiting a virtual networking hub, including moving some PD elements for content and instruction into the online space, and encouraging instructional and STEM coaches to create online groups for following up on face-to-face visits.
- In order to increase the effectiveness of sharing best STEM practices and resources, the NCNSP Affinity Network and the North Carolina STEM Learning Network should consider a better coordination of their activities. Additionally, creating a central hub (or portal), with access to content resources, professional development, and assessment and lesson planning tools that could serve both networks, might increase the utility and effectiveness of online collaboration for both networks.

II. Professional Development

- Schools are receiving the PD and coaching services outlined in the scope of work.
- Most of the coaching visits to comprehensive schools that joined the network in 2011 happened in 2012, and the number of visits per school was unevenly spread among schools.
- Overall, PD and coaching were seen as valuable and of high quality. Staff at the anchor schools hoped for continuing PD and coaching in the upcoming year.
- Professional development was most appreciated when participants understood its direct application to their classroom.
- The vast majority of coaching time was spent on changing instruction in the classrooms.
- The fact that coaches engaged with schools over an extended period of time gave coaches, teachers, and principals the opportunity to develop trusting relationships that likely increased the coaches' impact.
- Challenges and barriers related to PD included:
  - Sending teams to off-site PD during the school year for schools with small staffs;
  - Balancing the competing demands of different RttT initiatives; and
  - Getting buy-in from teachers around changing instruction.

Recommendations:

- Much of the professional development was perceived by recipients as relevant, but NCNSP may want to explore ways of increasing the relevance of the lowest-rated sessions.
- Because the impact of the coaches increased the longer they worked with teachers, implementers should consider having coaches in larger schools focus initial efforts on working intensively with a sub-set of teachers, instead of working with the entire faculty.
- To better leverage professional development and coaching resources and to create incentives for using online networking, the Implementation Team should consider blended professional development.

III. Development and Implementation of Project-Based Curricula

- A new contract was awarded to the North Carolina School of Science and Mathematics (NCSSM) by NCDPI to design STEM curricula with project units. Between July and August 2012, NCSSM delivered the outlines for all 16 year-long courses and the first units for the four freshman courses in each of the four themes (Aerospace, Security and Automation, Biotechnology and Agriscience, Energy and Sustainability, and Health and Life Sciences).
- NCNSP provided multiple opportunities for teachers to engage in professional development focused on the four themes and on project design and implementation.
- Themes are being incorporated in anchor and affinity schools in a number of different ways, including special sequences of courses on a theme, integrating a theme in all core subjects, and blending two or more courses.
- Three existing anchor schools started to incorporate both cross-curricular projects and projects within individual subjects.
- Scheduling and teacher knowledge on project-based learning (PBL) were identified as challenges for project implementation.

Recommendations:

- The initiative leads should consider identifying additional resources and supplementary funds to support piloting and revisions of and professional development for the 16 year-long STEM courses. NCNSP should consider identifying schools from each of the Affinity Networks that are willing to pilot the courses and provide feedback to the developers. In addition, NCSSM should share the units with Affinity Network schools at scheduled professional development events.
- Based on teacher feedback, incorporation of themes and project design and implementation should be emphasized both in professional development and in resource development efforts.
- Based on principal feedback, the Implementation Team should consider providing schools with tips and examples of schedules that allow for integration of themed and cross-curricular projects in the context of a regular school day.

IV. Partnerships

- Industry Innovation Councils (IICs) for each of the four themes met quarterly to plan and provide support for the networks.
- Industry and IHE partners provided expertise to school staff on themes and on relevance to local community economic development, and they also planned partnership activities with schools.
- NCNSP, with the help of business partners, is developing a sustainable and replicable prototype model partnership to be implemented in the four themed networks.
- Ongoing challenges for schools: building partnerships in rural areas; making partnerships more collaborative and hands-on; and developing teacher content knowledge in the theme and in teaching career-ready skills.

Recommendations:

- The model for partnership building is currently being developed in one of the urban schools; the Implementation Team should consider examining specific issues faced by rural schools.
- There are still a number of questions and issues related to partnerships that anchor schools need to resolve, such as the anchor school's role in providing partners to other schools in the network, or in communicating between schools. The Implementation Team should devote more time both face-to-face and online to the anchors or other groups of schools with common issues and work together to resolve these issues.

V. Intermediate Outcomes for Students and Staff in Anchor Schools

- In all three anchor schools, the initiative remains in the beginning stages of implementation.
- Given the large number of the early college/STEM design features that schools have to implement, the anchor schools each start with different priorities, which are affected by their context and by principals' preferences.
- There is not yet universal buy-in into the STEM initiative among staff in the anchor schools.
- All anchor schools added additional STEM courses, such as engineering, technology, science, and health sciences; some schools are adopting more innovative math and science textbooks.
- Technology is a high-priority area in all three schools, both as a subject of study and as an instructional tool for learning content across subjects.
- Many teachers report that they improved their instruction and implemented instructional strategies emphasized by NCNSP professional development, such as collaboration, classroom talk, inquiry and project-based learning, and higher order questioning.
- Interviews with staff and students indicated that students in anchor schools enjoy personalized attention and exhibit high motivation, engagement, and passion for learning.

- Staff identified a number of challenges to overcome during implementation, such as better defining and understanding the STEM model, improving teacher qualifications, increasing student preparedness, and addressing logistical issues.

Recommendations:

- In acknowledgement of the struggles faced by many participating schools to define what this initiative means for them and how to integrate multiple initiatives from the state, district, and NCNSP, the Implementation Team should consider providing more differentiated help to schools by staggering emphasis on different Design Principles and STEM features, depending on each school's context.
- To help schools faced with logistical issues related to their conversion or start-up, the Implementation Team should create resources and an online blog or discussion devoted specifically to those issues.
- Implementing the STEM initiative's more innovative components such as thematic and cross-curricular projects requires that teachers gain substantial new knowledge about both content and instructional strategies. The Implementation Team should consider differentiating ways of providing professional development devoted to these issues.

Next Steps

- Continue to track changes in the demographic, financial, and academic measures of RttT STEM schools through the administrative data, identify the degree to which any changes are related to efforts connected to RttT, and use this evidence to determine progress toward the stated goals of the North Carolina RttT STEM initiative.
- Continue qualitative data collection and analyses.
- Analyze responses to staff and student surveys that were collected in Spring and Fall of 2012 to provide baseline data.
- Provide a more detailed report about RttT-funded NCSSM curriculum development activities.

Introduction

This report is second in the series of annual reports for the evaluation of the Race to the Top (RttT) STEM initiative. The introduction will provide a brief overview of the STEM initiative, review the goals of the evaluation for the second year and will note how the recommendations from the first year report were addressed by the implementation team.

Overview of the Race to the Top STEM Initiative

RttT STEM initiative has three components:

- NCNSP component – the major component to create a network of STEM schools;
- NC STEM Learning Network component – to create additional network of schools that would benefit from resources developed by the first network and elsewhere; and
- NC School of Science and Mathematics (NCSSM) component – to develop STEM curricula.

As stated in NCDPI's detailed scope of work, the objectives of the NCNSP component of the RttT STEM initiative are (1) to work with partners to support the development of a small set of anchor/model STEM high schools that will serve as laboratory schools and sites for professional development around project-based learning; and (2) to develop a set of STEM "cluster" high school networks. "As the hub of each cluster, the anchor school will accelerate the development of a fully articulated and coherent curriculum, instruction, assessment, and professional development model consistent with the NC vision for STEM education" (NCDPI, 2010).

Thus, RttT funding is applied to the development of the STEM school model consistent with the state's vision for STEM education, the North Carolina STEM Education Strategic Plan, and Attributes of STEM Schools and Programs (NCDPI, 2011). This model is to be scaled up from anchor schools to the "cluster" or affinity schools, and then to other schools in the state. Figure 1 (following page) presents the implementation strategies for the STEM school and network models, as described in the NC Race to the Top Detailed Scope of Work (NCDPI, 2010). The short-term outcomes, presented in Figure 1, summarize the current vision for the STEM school and network models, as related to students, teachers, and principals in the STEM schools, as well as for the schools themselves and the network overall.

Figure 1. RttT STEM Logic Model

Implementation Strategies	**Short-Term Outcomes**
1. Structure a. STEM High Schools: Develop/establish 4 anchor schools and recruit, interview and select 16 network schools. b. Create infrastructure for the face-to-face and online collaboration. c. Support technology purchases to outfit classrooms to support STEM education in the anchor schools.	*Students:* a. Confidence and perseverance when faced with a challenge b. Ability to gather and analyze relevant information and synthesize knowledge and skills to solve authentic problems; exhibit engineering thinking and decision making c. Excitement about coming to school and enthusiasm for learning d. Awareness of and interest in STEM disciplines e. Increased perceived and achieved abilities in STEM disciplines
2. Professional Development a. Principals: Provide on-site leadership coaching for principals in the STEM network schools for approximately 12 days per year to support their development as effective leaders. Provide Leadership Institute for principals. Also, take each principal on one study visit to a national model school. b. Teachers: Teams of teachers from anchor and network schools participate in professional development focused on content and instruction in math and science. Teachers will have access to "Critical Friends Group" and facilitated Peer School Reviews, as well as other programs. c. Instructional Coaching: Provide instructional coaches to work on-site with classroom teachers at the STEM network schools for approximately 60 days per school per year to improve teaching practices. d. Residencies in Model Schools: One-week residencies in national-model schools for staff from each STEM network schools. e. Peer school reviews	*Teachers:* a. Greater skills at instructional strategies and project-based learning b. Teaching strategies that engage students in: • learning through active solving of real problems; communication and collaboration skills • in deep discourse, marked by discipline-based justifications • creativity building *Principals:* a. Leadership skills described in the Leadership Design Principle b. Vision for STEM learning
3. Project-Based Learning Curriculum: Develop a 9th-12th grade integrated curriculum with at least three inquiry-based project unit(s) within the health and life sciences, biotechnology and agriscience, energy and sustainability, and aerospace, security and automation themes.	*Schools:* a. Fidelity to the six New Schools Project design principles b. Culture of collaborative inquiry among faculty and students c. Meaningful integration of technology d. Implementation of integrated curriculum that incorporates theme-based project units and focuses on high-leverage Common Core Standards in math and Essential Standards in Science
4. Partnerships: Work with Industry and other STEM partners to design, evaluate, and disseminate all digital project resources to a broader range of NC schools.	*Partnerships:* a. Strong partnerships with IHE and business organizations to design, evaluate, and disseminate digital project resources b. Online and face-to-face collaboration among teachers, students, and administrators in each network around curriculum, instruction, projects, and leadership c. Adequate technological infrastructures to support such collaboration d. Increased number of students traditionally underrepresented in STEM disciplines enrolled in network schools

Overview of the Evaluation

This report continues to address the evaluation goals outlined in the first year report and covers RttT STEM implementation activities from November 2011 through July 2012.

The four-year evaluation of the RttT STEM initiative has the following goals:

- Provide formative evaluation for all RttT activities performed to develop anchor schools and STEM schools networks during the RttT period;
- Provide a descriptive study and documentation of the implementation of the RttT STEM initiative in participating schools;
- Evaluate the initiative's short-term outcomes for students, teachers, schools, and the school network; and
- Evaluate the sustainability and scalability of the initiative and provide recommendations about the continuation and expansion of this initiative to other schools and districts.

This report focuses primarily on the second goal of providing a descriptive study and documentation of the implementation of the RttT STEM initiative in participating schools in the second year of implementation. Additionally, it focuses on intermediate outcomes for students and staff in anchor schools after one year of implementation. The report also provides formative feedback (Evaluation Goal 1) on the initiative's long-term goal of building an articulated and cohesive model of a STEM school and of a network of STEM schools that can serve as a model for scaling up. Finally, this report summarizes descriptive quantitative analyses of the available background characteristics for the RttT-funded STEM schools in the North Carolina New Schools Project (NCNSP) network, using the data in the Carolina Institute for Public Policy (CIPP) database.

The report will address the following research questions and sub-questions:

Research Question 1: To what extent has the network of STEM anchor and affinity schools been implemented as intended?

1. To what extent has the structure of the network of STEM anchor and affinity schools been implemented as intended? Specifically, we will describe:
    a. The background characteristics of the RttT-funded STEM schools in the NCNSP network, including students' demographic characteristics and achievement, and school characteristics such as size, per-student expenditures, STEM courses offered, and teacher qualifications;
    b. The extent of online and face-to-face networking and collaboration among principals, teachers, and students around curriculum, projects, instruction, and leadership;
    c. The infrastructure developed for schools and their partners in business and in institutions of higher education (IHEs) to share resources via the network.

2. To what extent has the professional development for STEM school teachers and principals been implemented as intended? Specifically, we will describe the structure, amount, participation in, and quality of various professional development (PD) offerings for teachers and principals, including instructional coaching.

3. To what extent has the curriculum of STEM schools been implemented as intended? Specifically, we will describe:
    a. Efforts to develop curriculum with project units that address the four STEM themes;
    b. The extent of implementation of project units that address the four STEM themes in anchor schools.

4. To what extent have the partnerships between STEM schools and IHEs, community, and businesses been developed? Specifically, we will describe:
    a. NCNSP efforts to develop partnerships for the four themed networks;
    b. The extent of implementation of partnerships in anchor schools.

Research Question 2: What are the intermediate outcomes for students and staff in anchor schools after one year of implementation?

1. How well did students and staff in anchor schools develop a common vision for STEM schools and network?

2. What reported changes have occurred as a result of the initiative in:
    a. STEM curriculum;
    b. Technology;
    c. Instructional improvement;
    d. Impact on students?

3. What challenges are anchor schools facing as they continue implementation?

In addition to documenting project activities to date, this report considers whether these activities as implemented are adequate (based on reasoned and evidence-based judgment) to ensure the intended short-term outcomes as well as the long-term outcome of building an articulated and cohesive model of a STEM school and a network of STEM schools that can serve as a model for scaling up.

Addressing the Recommendations of the First Year Report

The Year 1 evaluation report made a number of recommendations for the RttT project staff to consider as they moved forward. In this section, we describe any changes that have been made in Year 2 relative to the areas of recommendations. Some of these changes may have been made even in the absence of the evaluation report, while others may have come as a direct result of the evaluation report. The section is organized by the various recommendations.

Initial recommendations:

- To address the challenges that schools in the network face in terms of learning about and implementing multiple components of the model, NCNSP should integrate the six Design Principles with the various components of the STEM vision.
- To increase buy-in among staff, consider explicit training for leadership teams on creating a common STEM vision for their staff. Part of this involves creating and communicating a well-defined STEM framework with a compelling rationale for its adoption.

  Response: NCNSP addressed these recommendations in a number of ways. During the Anchors Away PD event for anchor school teams, participants engaged in designing a document outlining a vision for STEM anchor schools. They also reviewed and revised rubrics for NCNSP Design Principles to incorporate STEM vision and features into these rubrics. The Design Principles and components of STEM vision were communicated to schools in multiple events. More details are provided in the PD section.

Initial recommendation:

- To address the challenges of designing a new, complex model with a number of schools that are either brand-new or new to the network (including two of the four anchor schools), initiative leads may want to consider continued use of the four NC Learning Lab Schools as sites for study visits by teams from network schools until anchor schools demonstrate excellence in implementing the STEM vision.

  Response: NCNSP has been using and plans to use in the next school year four NC Learning Lab Schools as sites for study visits by teams from STEM network schools.

Initial Recommendation:

- Provide opportunities for schools that joined the network late to catch up via provision of PD they will need for successful implementation of the STEM model.

  Response: School teams participated in multiple PD opportunities focused on various aspects of STEM implementation.

Initial recommendations:

- Provide more background knowledge to teachers about the STEM themes and the engineering design process prior to their work on projects.
- Engage instructional coaches in supporting the project work.

  Response: To address these recommendations, NCNSP provided multiple professional development sessions to STEM schools staff with field experts in STEM focused on engineering design, the four STEM themes, and STEM problems that local community businesses work on. Additionally, STEM coaches provided support to teachers in their project work and in the engineering design process. More details are provided in the PD section.

Initial recommendations:

- Consider more active involvement on the part of IHE and business partners in designing a project-based curriculum.
- Explore the possibility of contracting with a few highly skilled teachers to develop model projects for each of the four affinity networks.
- If the goal is to create a curriculum that is to be used by others, do not rely on school staff to do this unless significant resources are made available for this to occur over the summer.

Response: To address these recommendations, the North Carolina Department of Public Instruction (NCDPI) reconsidered the approach for designing project-based curricula for each of the four themes. This work has been contracted to the North Carolina School of Science and Mathematics (NCSSM). The details of this contract and work are described in the section on project-based curriculum.

Initial Recommendation:

- To improve NCNSP's data collection methods, both participant evaluations and event sign-up should be completed online, with all evaluations following a standardized form, designed in conjunction with the RttT Evaluation Team.

Response: To address this recommendation, the Evaluation Team collaborated with NCNSP on designing a standardized participant evaluation form. This form was then used in evaluations of multiple PD offerings from NCNSP.

Method

The evaluation was conducted using a mixed methods approach. This report includes both quantitative analyses of the baseline characteristics of schools in the affinity network and qualitative and descriptive quantitative analyses of the implementation data collected by the Evaluation Team. The methodology is described separately for each of these two main activities.

School Sample and Participants

Baseline Characteristics

The sample for the analyses of baseline characteristics includes all high schools in North Carolina that serve grades 9 and above and do not serve lower grades[1] (n = 481). Schools that serve grades 6–12, or a subset of middle and high school grades, were excluded; because the quantitative analyses used school-level data, it was important to have a consistent grade span across all compared schools. Data were included for those in the STEM Affinity Network schools for which administrative data were available (n = 15, fort the list of these school see Appendix A) [2]; baseline characteristics for these schools were then compared to the characteristics of all other high schools in the state (n = 466).

Implementation

Documents from PD (sign-in sheets, participant evaluations, coach reports) were analyzed for all affinity schools currently in operation. Site visits were conducted at the three anchor schools open in the 2011–12 school year. During the site visits to the three anchor schools, we interviewed 11 staff and 15 students, and observed nine classrooms.

Data and Measures

Baseline Characteristics

Administrative data for the analyses of baseline characteristics were obtained from a database assembled and managed by one of the CERE–NC partners, the Carolina Institute for Public Policy (CIPP). Teacher, student, and school-level data at CIPP were obtained from NCDPI, the University of North Carolina General Administration (UNC–GA), and several other sources. CIPP has linked student, teacher, classroom, school, and school district data from the 2004–05 school year through the present for all data sets. For this report, data from the 2010–11 school year were used.

The RttT Evaluation Team has identified several measures that will serve as indicators of the key STEM student outcomes outlined above. They include the following.

[1] One of the STEM network schools, North Duplin High School, serves grades 7–12; because it is in the STEM sample, it was included in the data set.
[2] Five of the 20 STEM network schools open in 2011 or later, therefore data were not available for those schools.

Equity of opportunity:

- *Participation of groups typically underrepresented in STEM fields*. School-level demographic measures include: student ethnicity, gender, and free and reduced-price lunch eligibility; and school location.
- *Availability of advanced STEM courses.* School-level measures include proportions of math and science course sections designated as "advanced."
- *Student access to highly qualified teachers and supportive school settings.* School-level measures include teacher credentials and experience, per-pupil expenditures, and school size.

Academic outcomes:

- *Student achievement in math, science, and other courses.* School-level measures include: average End-of-Course (EOC) scores for math and science; and EOC composite scores by poverty rate and minority population.

Implementation

The current report incorporates a variety of data sources collected by both NCNSP and the RttT STEM Evaluation Team.

The STEM Implementation Team (NCDPI, NCNSP, NCSSM, and NC Learning Network) collected and shared with the Evaluation Team the following sets of information:

- Agendas for the professional development workshops;
- Registration and sign-in lists for all professional development workshops;
- Participants' evaluations for professional development workshops conducted by the end of July 2012;
- Leadership and instructional coaches' reports of their activities in the schools;
- Agendas and minutes from Industry Innovation Councils and other partnership development meetings;
- Scope of work, and resources produced by the NC Learning Network;
- Scope of work for and outlines of 16 year-long courses addressing the four STEM Affinity Network themes; and
- The first units of the four freshman courses.

The evaluation team collected the following types of original data:

- Observations of selected professional development events and sessions;
- Observations of Industry Innovation Councils and other partnership building events;
- Observations of STEM classrooms in anchor schools;

- Interviews with NCNSP and NCDPI staff and STEM coaches;
- Interviews with math and science teachers, administrators, and students in anchor schools;
- A focus group with participants at one of the PD events;
- Interviews with North Carolina STEM Network leadership; and
- Systematic review of posts and interactions on the online networking site Edmodo.

To evaluate the general quality of classroom teaching, the Classroom Assessment Scoring System (CLASS) observational protocol (Pianta, Hamre, & Mintz, 2011) was used. The CLASS protocol organizes classroom interactions into 11 dimensions scored on a 7-point scale (Low: 1, 2; Mid: 3, 4, 5; and High: 6, 7; with 4 being the middle of the scale). Observers use the protocol for 15-minute blocks followed by a 10-minute rating time. When allowed by the schedule, the observers conducted two observation cycles during each class period.

CLASS observation protocol was complemented with team-developed scales evaluating classroom features of interest for this project: the Common Instructional Framework and the use of technology. Each classroom was observed by two observers: one focused on the CLASS protocol and the other on the team-developed scales.

Interview protocols for interviewing school staff, students, and coaches were originally developed for this evaluation, as well as a Protocol for Monitoring the Online Networking Site. The interview protocols for teachers and administrators were designed to gather teachers' vision for the STEM programming in their schools, their understanding of the role of the STEM Affinity Network, their perceptions of professional development provided to them, and changes occurring in their schools due to the STEM initiative. The interview with coaches followed an abbreviated version of this protocol. The interview protocols for students gathered their view on changes occurring in their schools due to the STEM initiative. The Protocol for Monitoring the Online Networking Site was designed to evaluate the quantity and quality of online interactions among network participants, as well as the nature and topics of these interactions. The full protocols are provided in Appendix B.

Procedures and Analyses

Baseline Characteristics

For some of the tables (Tables 3, 4, and 8), the unit of analysis is the school, which allows for computations based on simple averages of the values of interest. For example, calculations for Table 8 (Proportion of Schools by Size, 2010–11) are based on a simple count of schools that fall into each school size category.

Because calculations of averages in other tables (Tables 1, 2, 5, 6, 7, and 9) often involve school-level data that were generated from data collected at other levels (such as student-level or teacher-level), averages for these tables have been weighted to reflect variations in population sizes across schools. Notes on weights used are included with each of these tables.

Implementation

Because the RttT STEM initiative is in its beginning phases, the initial emphasis for the evaluation is on describing implementation and perceived intermediate outcomes in anchor schools. As a result, all data sources were analyzed descriptively with an emphasis on understanding the nature of the work that has been completed so far.

The agendas for all meetings were examined to describe the content and intended outcomes of the specific activities. The registration and sign-in lists were summarized to describe school participation levels in the different activities.

The evaluation team conducted one- or two-day site visits to the three open anchor schools. During these visits, team members interviewed math and science teachers, principals, and on some occasions, other administrators leading the STEM initiative at the school. Two of the teachers were interviewed over the phone.

Interviews and focus groups with NCNSP staff and coaches were used to gather providers' perspectives on the initiative's activities—both those that have been completed and those being planned. A focus group with participants at one of the workshops was used to gather their perspectives on the quality and utility of that professional development event.

Interviews with staff and students at anchor schools were used to gather their perspectives on their schools' participation in the network and the extent of implementation happening in the schools. Focus groups and interviews were audio-recorded and transcribed. These transcriptions were then analyzed for relevant information.

Classroom observations during site visits to anchor schools were analyzed both quantitatively (ratings) and qualitatively (observer comments and notes).

PD observations and participant evaluations were used to describe the quality of professional development and participants' perceptions of the utility of professional development provided to teachers and principals in participating schools, as well as face-to-face networking opportunities. These observations and evaluations were analyzed quantitatively and qualitatively.

Leadership and instructional coaches submitted brief reports after each visit. In these reports, the coaches were asked to provide an update on the implementation of the Action Plan; comment as appropriate on actions taken relative to each of the six NCNSP Design Principles; and identify strengths, areas of concern, and next steps. From these reports, evaluators determined the number of visits to different affinity network schools, as well as the focus of visits to anchor schools.

Scaled responses from PD evaluation surveys were analyzed for descriptive statistics, and open-ended responses were coded by theme, topic, and keyword.

Analyses of the interactions among moderators and participants collected from the networking website Edmodo were used to describe the amount and nature of collaboration among the network members. The data were analyzed for the total number of posts by moderators and participants, for the total number of responses to these posts, and for the content of the posts.

Findings

The findings are organized in five sections according to the specific evaluation questions:

1. Structure of the network of STEM anchor and affinity schools
2. Professional development
3. Development of integrated curriculum with project units
4. Partnerships
5. Intermediate outcomes for students and staff in anchor schools

I. Structure of the Network of STEM Anchor and Affinity Schools

In this section, we describe:

1. Baseline characteristics of the RttT-funded schools in the NCNSP STEM Affinity Network, including students' demographic characteristics and achievement, and school characteristics such as size, per-student expenditures, STEM courses offered, and teacher qualifications;
2. The extent of online and face-to-face networking and collaboration among principals, teachers, and students around curriculum, projects, instruction, and leadership;
3. The infrastructure developed for schools and their partners in business and in institutions of higher education (IHEs) to share resources via the network.

Baseline Characteristics of the RttT-funded STEM Schools

This section provides data from 2010–11 on the characteristics of schools participating in the RttT-funded STEM Affinity Network. These data will serve as baselines against which to estimate specific impacts of RttT-sponsored STEM activities over the next two years.

Our analyses reveal the following findings:

- The RttT STEM initiative has made progress toward its goal of serving minority and poor students, who are traditionally underrepresented in STEM fields. In 2010–11, North Carolina RttT STEM Affinity Network schools served a higher proportion of black and Hispanic students and a higher proportion of students of poverty than did the average high school in the state, hosted the same proportion of female students, and were more likely to be located in an urban area.
- Prior to the initiative's launch, RttT STEM schools offered a lower proportion of advanced STEM courses than the average high school in the state.
- Faculty credentials and experience were similar across RttT STEM Affinity Network schools and all other high schools. Per-pupil expenditures for STEM schools were typically slightly higher on average, and school sizes were often smaller.

- Prior to the initiative's launch, student achievement in RttT STEM schools was not notably different from all other high schools, with the exception of physical science EOC scores. STEM Affinity Network schools had a higher mean score on the physical science EOC compared to the mean score from students at all other high schools.

During the reporting period (November 2011–July 2012), the RttT STEM initiative finalized the list of enrolled STEM Affinity Network schools (see Appendix A). All but one of these schools started to receive NCNSP PD services before August 2012. Of the four anchor schools that were supposed to be established before August 2011, according to the RttT scope of work, three are working hard to improve instruction and implement STEM features such as project-based learning, their STEM theme, and additional STEM courses, and also utilizing partnerships for improvement of student learning. The fourth school is welcoming their first students in the 2012–13 school year (with one-year delay).

The following tables provide a comparison of student, teacher, and school demographics for RttT STEM Affinity Network schools and all other North Carolina high schools for the 2010–11 school year. Because 5 of the 20 RttT STEM schools are new as of the 2011–12 or 2012–13 school year, the available data were analyzed for only 15 RttT STEM schools. Only one of these schools received NCNSP services prior to and during the 2010–11 school year.

Participation of underrepresented groups. In 2010–11, North Carolina RttT STEM Affinity Network schools served a higher proportion of black and Hispanic students and a higher proportion of students of poverty than did the average high school in the state, hosted the same proportion of female students as male, and were more likely to be located in cities.

The RttT STEM initiative pursues the goal of serving high needs students and students traditionally underrepresented in STEM fields. There is evidence that the initiative is positioning itself to address this goal when we compare the representation of black and Hispanic students in STEM high schools (31% and 14% of the student populations, respectively) to all other high schools in the state (28% and 10%, respectively; see Table 1).

Table 1. Average of Individual School Proportions of Students by Ethnicity, 2010–11

	RttT STEM Affinity Network schools (*n* = 15)		**All other NC state high schools** (*n* = 466)	
Ethnicity	Mean	Range	Mean	Range
Asian	1%	0%–6%	3%	0%–33%
Black	31%	0%–92%	28%	0%–98%
Hispanic	14%	0%–35%	10%	0%–50%
Multiracial	2%	0%–4%	3%	0%–17%
American Indian	1%	0%–15%	1%	0%–79%
White	51%	5%–94%	55%	1%–98%

Note: Across-school means were estimated by weighting per-school ethnicity proportions; weighting is by total number of students in each school.

Females are also typically underrepresented in STEM fields. As indicated in Table 2, on average, female representation in RttT STEM schools is equivalent to female representation in other schools. This may be due to the fact that prior to the launch of the initiative, all but one of these schools were regular comprehensive schools, not STEM schools. For all current STEM network schools, female representation ranged from 47% to 78% (see Table 2).

Table 2. Student Gender Proportions, STEM and Non-STEM Schools, 2010–11

	RttT STEM Affinity Network schools (*n* = 15)		**All other NC state high schools** (*n* = 466)	
Gender	Mean	Range	Mean	Range
Female	50%	47%–78%	50%	0%–100%
Male	50%	22%–53%	50%	0%–100%

STEM schools also share a common goal of targeting students from lower-income backgrounds. Table 3 indicates that RttT STEM schools are disproportionately high poverty schools (53%) when compared to all of the schools in the state (24% of which are high poverty). As noted in the table, poverty classification was determined by creating quartiles from all high schools in the state, meaning the distribution for all high schools in the state is 25% low-poverty, 50% in the midrange, and 25% high-poverty. The information presented for the RttT STEM schools shows that most of the schools in the RttT STEM Affinity Network are classified in the middle or high quartiles for poverty.

Table 3. Schools by Proportion of Students Eligible for Free or Reduced-Price Lunch, 2010–11

School classification	**RttT STEM Affinity Network schools** (*n* = 15)	**All other NC state high schools** (*n* = 466)
Low-poverty	7%	26%
Middle quartiles	40%	50%
High-poverty	53%	24%

Note: High-poverty = top quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch. Low-poverty = bottom quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch.

STEM schools are located throughout the state, disproportionately in urban areas. Table 4 reveals that STEM schools are located most often in cities (73%), followed by rural areas (20%). The proportion of STEM schools in rural settings is similar to the proportion of the other high schools in the state (25%).

Table 4. Proportion of Schools by Locale, 2010–11

Locale	**RttT STEM Affinity Network schools** (*n* = 15)	**All other NC state high schools** (*n* = 466)
Rural	20%	25%
Town	0%	10%
Suburb	7%	14%
City	73%	51%

Note: Rural = schools located in fringe, distant, or remote rural areas; Town = schools located in fringe, distant, or remote town areas; Suburb = schools located in small, mid-sized, or large suburbs; City = schools located in small, mid-sized, or large cities.

Availability of advanced STEM courses. Prior to the launch of the initiative, STEM network schools offered a lower proportion of advanced-level math and science courses compared to the other high schools in the state (Table 5). These data suggest that expanding access to these advanced courses and providing sufficient supports to students in these courses is an important goal for the STEM schools. However, in cases where STEM network schools offered other types of advanced STEM courses, such as engineering or health, which are not tested subjects, they were not reflected in these data. In the future, depending on availability, the evaluation team will analyze Vocational Competency Achievement Tracking System (VoCATS) and other data to compare course offerings in these areas.

Table 5. Proportion of Math and Science Course Sections Designated as Advanced, 2010–11

	RttT STEM Affinity Network schools (*n* = 15)		**All other NC state high schools** (*n* = 466)	
Course	Mean	Range	Mean	Range
Advanced Algebra 2	18%	0%–38%	34%	0%–100%
Advanced Biology	27%	7%–50%	34%	0%–100%
Advanced Chemistry	51%	0%–100%	55%	0%–100%

Note: The term “advanced” includes honors, advanced placement, and advanced placement preparation courses. The proportion of advanced courses represents the number of courses for a given subject offered at an advanced level, divided by the total number of courses for a given subject offered. This table provides the average proportion of advanced math and science courses in STEM and non-STEM high schools.

Access to highly qualified teachers and supportive school settings. At baseline, faculty credentials and experience were similar across STEM network schools and the other high schools. Per-pupil expenditures for STEM schools were typically slightly higher on average, and school sizes were often smaller.

The comparison of instructional staff across STEM network schools and all other high schools revealed little difference in mean proportions of teachers with advanced degrees, National Board Certified teachers, and inexperienced teachers (Table 6, following page).

Table 6. Proportion of Teachers by Credentials and Experience, 2010–11

	RttT STEM Affinity Network schools (*n* = 15)		**All other NC state high schools** (*n* = 466)	
Credentials and Experience	Mean	Range	Mean	Range
Teachers with an advanced degree (Master's or higher)	25%	11%–53%	26%	0%–78%
National Board Certified teachers	13%	2%–33%	16%	0%–67%
Teachers with three years or less experience	20%	11%–64%	18%	0%–75%

Note: Across-school means were estimated by weighting per-school credential and experience proportions; weighting is by total number of teachers in each school.

The findings in Table 7 suggest that, prior to the initiative, RttT STEM schools were spending more per pupil than the average high school in the state. It is important to note that these differences were not statistically significant.

Table 7. Average Per-Pupil Expenditures, 2010–11

Expenditures	**RttT STEM Affinity Network schools** (*n* = 15)	**All other NC state high schools** (*n* = 466)
Total per-pupil expenditures	$8,682	$8,102
Spending on regular instruction	$4,115	$3,969
Spending on professional development	$52	$43
Spending on instructional support	$371	$326

Note: Across-school means were estimated by weighting per-school expenditure means; weighting is by total number of students in each school.

Finally, most RttT STEM Affinity Network schools fell into the small–medium range for student population (Table 8, following page). Interestingly, a higher proportion of STEM schools were classified as medium (47%, 501–1,000 students), compared to the average proportion of high schools in the state (29%). There were no extra-large STEM schools.

Table 8. Proportion of Schools by Size, 2010–11

School Size	**RttT STEM Affinity Network schools** (*n* = 15)	**All other NC state high schools** (*n* = 466)
Small (500 or less)	33%	34%
Medium (501–1,000)	47%	29%
Large (1,001–2,000)	20%	33%
Extra-Large (2,001 or more)	0%	4%

Student achievement. In general, student achievement data for the 2010–11 school year (Table 9) indicate little difference in mean scores on math and science EOC exams between STEM network schools and the other high schools in the state. The one exception to this is physical science EOC scores. STEM network schools had a higher mean score on the physical science EOC compared to the mean score from students at the other high schools.

Table 9. Average Standardized Scores, Math and Science End-of-Course Exams, 2010–11

Course	**RttT STEM Affinity Network schools** (*n* = 15)		**All other NC state high schools** (*n* = 466)	
	Mean	Range	Mean	Range
Algebra 1	150.47	146.13–155.66	150.59	139.17–165.52
Algebra 2	152.64	143.96–157.11	152.64	135.00–170.67
Biology	151.87	145.26–161.33	152.7	141.62–168.02
Physical Science	152.77*	145.16–158.12	142.58	134.00–168.62

Note: Across-schools means estimated by weighting per-school means; weighting is by total number of students in each school
* Two-tailed unpaired *t*-tests indicated a statistically significant difference ($t = 9.20$, $p < .001$).

Tables 10 and 11 (following page), which compare schools with the highest and lowest proportion of poor and minority students, show that there is work to be done for STEM schools to fulfill their promise of raising the performance of underprivileged and minority students. High poverty STEM schools had slightly higher mean EOC composite score compared to the mean of other high schools in the state, while the mean EOC scores were approximately equal for both high minority STEM network schools and all other high minority high schools in the state. None of the differences in Tables 10 and 11 were statistically significant.

Table 10. End-of-Course Performance Composite Score by Poverty Rate, 2010–11

School Classification		**RttT STEM Affinity Schools** (n = 15)	**All Other State High Schools** (n = 466)
Low-poverty schools	*n*	1	119
	Mean	96.80	85.91
	SD	-	9.01
	Range	-	50.00-100.00
High-poverty schools	*n*	8	112
	Mean	68.70	65.14
	SD	10.52	14.73
	Range	46.80-78.70	25.40-96.20

Note: High-poverty = top quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch. Low-poverty = bottom quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch. Across-school sub-groups means estimated by weighting per-school means; weighting is by total number of students in each school.

Table 11. End-of-Course Performance Composite Score by Minority Population, 2010–11

School Classification		**RttT STEM affinity schools** (n = 15)	**All other state high Schools** (n = 466)
Low-minority schools	*n*	2	118
	Mean	79.06	80.70
	SD	3.75	8.30
	Range	75.20-80.50	44.30-99.00
High-minority schools	*n*	6	114
	Mean	65.78	65.03
	SD	13.90	14.44
	Range	46.80-88.20	33.90-100.00

Note: High-minority = top quartile of schools, as ranked by proportion of students identified as a minority. Low-minority = bottom quartile of schools, as ranked by proportion of students identified as minority. Across-school sub-groups means estimated by weighting per-school means; weighting is by total number of students in each school.

The analyses of baseline characteristics of the STEM Affinity Network schools suggest that the STEM Initiative is generally serving the target population of students underrepresented in mathematics and science, targeting low-income and minority students in particular. The schools are disproportionately urban, tend to be smaller than average, and were comparable on most other characteristics. The analyses also provide baseline outcome data against which future changes can be measured. For example, STEM schools offer fewer "advanced level" mathematics and science courses than the average school, while their test scores are generally comparable. Future reports will determine if there have been any improvements made in these two areas.

In the next section, we describe other aspects of the STEM network structure including opportunities provided for the STEM schools to interact with each other.

Face-to-Face and Online Networking

NCNSP believes that a combination of face-to-face and online networking is the best solution for teacher learning and collaboration for innovative work, so both forms of networking are a part of the STEM network design. Face-to-face interactions provide opportunities for people to get to know each other and each other's interests, and online media provide time flexibility and help to overcome the barrier of distance between network schools.

Our analyses of face-to-face and online networking reveal the following findings:

- NCNSP has encouraged and facilitated networking and collaboration by various means, including embedding it into face-to-face PD events, furnishing online collaboration tools, and providing coaching services. Currently, face-to-face meetings have been the most successful networking channels.
- Networking among schools in the STEM network is still in early stages. Some schools have been networking with other schools outside of the RttT network.
- NCNSP provides multiple opportunities for online collaboration. Edmodo, the original online network for STEM schools, has not been actively used.

Face-to-face networking. NCNSP embeds networking opportunities in all of its PD events and services. It sponsored two large events, a national STEM conference (Scaling STEM: Transforming Education Matters, held in Durham on April 16–18, 2012) and the Summer Institute (June 25–28, 2012), and also a number of smaller scale PD events (see Table 11 for a full list of events). Each of the two large events gathered about 700 participants from NCNSP-supported schools and partners, with one including 63 participants from RttT-funded schools and the other including 85. In one teacher's words:

> A lot of networking starts off really with the professional development. We all have different types of meetings and workshops that we have to go to … and through that you end up meeting other schools …

At all of these events, including study visits to a Lab School in North Carolina, STEM school staff had an opportunity to communicate not only with staff from other RttT-funded schools, but also with staff from early colleges and redesigned comprehensive schools that have been working with NCNSP for a number of years and can share their experience and best practices.

They also had an opportunity to interact with STEM experts and colleagues from out-of-state schools and other organizations. After such face-to-face events, teachers in anchor schools report continuing communication with teachers in other schools over email. As one coach noted:

> [T]he [Lab Schools] study visits have really helped to bridge that networking, as well as professional development activities like Secondary Lenses on Learning for math teachers, because it's very—it's for math teachers and I do see a lot of connections coming out of there, because it's very high-quality programming … with my Critical Friends group, I set up a Facebook page, and so there's been some communication with teachers across schools out of that, because we literally established a network at the training.

Networking among RttT STEM schools is still in early stages. One anchor school maintains a close relationship with an early college high school located in the same county (but not in the RttT network), which school staff referred to as their "sister" school. The principal at another anchor school indicated that she does not do much networking with other STEM principals, although she does go to all events when invited by NCNSP. This principal did not have much communication or networking with schools focused on her school's theme but made a recommendation to NCNSP to increase communication and networking among the schools in her theme network. Staff we spoke to feel that establishing networking will take time. According to a third principal:

> You can't establish a network in one school year; it's going to take five years for a network to really become strong and active. It's one thing to have the context, but it's another thing to get to the point where you're actively sharing back and forth and I think that just takes time. You have to be patient with something like that, but the foundation of those connections and those partnerships and friendships are starting this year.

Some teachers think that the most important part of networking is to observe how model classrooms work, so that they can get all of their teachers on board with a new way of teaching, and otherwise it is not going to be effective at a school level. NCNSP provides such experiences to all schools through two-day site visits to their well-established Learning Lab Schools, which can demonstrate excellence in instructional practices.

While networking is developing, some teachers use coaches as mediators who provide knowledge from other schools and can connect with people who could serve as resources. Teachers indicate that they look forward to building great relationships with other schools in their theme network:

> We're going to have these great relationships with other schools where the learning won't just occur in our classroom but it's just going to be broadened by the people that we work with outside of our school. We've already met them. We met them over the summer and then we've met throughout the different various workshops we've attended. We met other faculty and staff and other schools but I think that even more so, we're going to create this great networking relationship.

Online networking. In the first year evaluation report, the Evaluation Team reported that NCNSP had started to use Edmodo as the main vehicle for online communication and networking among theme networks. This network activity *among* schools has been very slow from November 2011 through June 2012. Some networks *within* schools, on the contrary, have been very active, involving teachers and students in ongoing conversations.

The online Edmodo community hosts several networks, including an overarching STEM Affinity Network, and three theme networks representing the themes of three of the four anchor schools (Biotechnology and Agriscience, Energy and Sustainability, and Health and Life Sciences)—while a network representing the fourth anchor school's theme (Aerospace, Security and Automation) no longer exists, maybe because it only had four members. There are also eight content networks (e.g., Chemistry); and 14 school networks introduced by teachers and students (Table 12). These networks (except for school networks) are moderated by NCNSP staff who post resources and questions for discussion.

Network membership is diverse, and the number of members per network varies across networks. Except for school networks, which are primarily composed of teachers and students, all of the affinity networks may include staff, district staff, school staff, and evaluators. The STEM Affinity Network represents the largest network, but its members may also belong to any of the other networks.

Table 12. Total and Average Number of Online Participants per STEM Network

Edmodo Network Type	Number of Networks	Total Number of Participants	Average Number (Range) of Participants per Network
STEM Affinity Network	1	172	172
Theme networks	3	183	61 (33–82)
Content networks	8	81**	10 (7–17)
School networks	14	282	20 (4–93)

Note: These numbers do not include NCNSP staff and evaluators.
** This number includes members of these networks as of August 2012; at the beginning of the reporting period (November 2011), before some networks became unavailable, the number of members was 195.

Activity in all networks, reported in Appendix C, has been very limited, except in some of the school networks. Teachers in most school networks use them to communicate with students and to post class resources. Students are actively responding to teachers' and classmates' posts as well as posting questions and sharing resources. Seventy-nine percent (79%) of the post were related to the network's work/project development, STEM, or the network theme; 20% to Professional Development; and 2% to teaching in general. The most popular type of post was a hyperlink to a website containing information about a STEM-related issue or event (e.g., links to an online article about the Local Farms, Food, and Jobs Act, and to a website with information about a symposium on local and global food studies).

While Edmodo was set up as a primary online communication tool specifically for the RttT STEM schools, there are other tools to facilitate online networking within the NCNSP's larger network of schools, such as NCNSP Commons. In 2010, NCNSP developed a virtual workspace called The Commons, where NCNSP staff and partner school and district staff can connect, post questions, and share ideas to benefit schools and accelerate innovation. The Commons has 1,021 users, with about 350 open discussions and nearly 1,500 new discussion comments. NCNSP also employs social media tools, including Twitter, Facebook, YouTube, and blogs, to share innovative practices and approaches and to spotlight the importance of transforming education in order to graduate all students ready for college, careers, and life. As an example, one coach created a Facebook page for her Critical Friends Group (a particular type of school-based professional community aimed at fostering members' capacities to undertake instructional improvement and school-wide reform).

Affinity networks had multiple opportunities for online collaboration, including Edmodo, The Commons, and networks developed around specific PD experiences. While having multiple online networks can be seen as an advantage, it may also pose a challenge if NCNSP would like to use one of these networks as a key vehicle for disseminating information for STEM schools.

The Infrastructure Developed for Schools and Their Partners to Share Resources

Our analyses of the networking infrastructure reveal the following findings:

- As part of the RttT initiative, the NC STEM Learning Network was created and provided a number of services and products.
- Some of the main products and services started under RttT funds have not been finished and require additional sustainable funds to continue in operation.
- There has been little collaboration between the NC STEM Learning Network and the NCNSP STEM network.

As part of the RttT initiative, NCDPI awarded a RttT-funded contract to the NC STEM Learning Network then based at MCNC and now part of NC Science, Mathematics and Technology Education Center, which was charged with scaling effective practices across North Carolina school districts. The contract period was from August 2011 through June 2012.

The NC STEM Learning Network's goals were to create additional networks of STEM schools and their partners in the state, to develop resources and tools to help the state move forward with its STEM initiative, to catalog the STEM assets currently present in North Carolina, and to build a statewide STEM portal for distributing these resources. During the first three months of the contract, the NC STEM Learning Network helped to develop a state STEM Education Strategic Plan, including statewide STEM attributes for schools, which was approved by NCDPI and the State Board of Education in November 2011.

In accordance with the scope of work (Appendix D), by the end of this contract, the following products and services were developed and delivered.

1. The design document for the STEM web portal, detailing its architectural plan, content, and technical specifications. To develop this document, NC STEM Learning Network staff conducted two focus groups with end users to get their input on the content of the portal. The focus groups included representatives from schools (teachers and students), higher education,

business leaders, parents, and NCDPI. To finish the work of actually building the portal, NC STEM Learning Network will have to obtain additional funds.

2. Support for the work of building the NC STEM Learning Network to an additional (to NCNSP) 45 schools, often in rural areas, and to national businesses and universities (such as Cisco, Lenovo, Project Lead the Way, Harvard, etc). These 45 schools and districts were chosen by NCDPI from those that applied because they are either especially interested in, or are prepared for, or are doing innovative STEM work. Other than webinars, communication among network members is mostly conducted through individual emails or phone calls, with NCDPI or NC STEM Learning Network staff often serving as mediators. To maintain the network and move it forward, NC STEM Learning Network will have to obtain additional funds.
3. Cataloging organizations that can provide STEM-related resources for students, schools, and parents in the state. The current catalog lists 650 organizations. The catalog was created as organizations responded to an email, sent by the NC Learning Network, that asked whether the organization provided STEM-related resources nationally and in North Carolina. The list includes many school districts, state universities, businesses, foundations, afterschool centers, and non-profit organizations. The list contains only organizations' names with no descriptions of services provided, and has limited utility. This catalog is planned to be hosted on the future STEM portal; additional funding will be needed to support personnel who can maintain and update this list.
4. Creation of the *Do-it-Yourself Guide for Community Engagement* resource for NC schools.
5. Five monthly webinars, conducted by the NC STEM Learning Network, that provided information to schools and districts on the state-wide STEM strategic plan, on NC STEM Learning Network, on scorecard and rubrics for the state STEM attributes, introduced the *Do-it-Yourself Guide for Community Engagement* resource, and shared presentations on innovative STEM schools in and out of the state. The one-hour webinars had an average attendance of 95 sites per webinar, with groups of participants attending at some of the sites.

It is expected that in the future, the NC STEM Learning Network will share among its members best STEM practices, including those developed in NCNSP-supported schools; however, only two schools have been members of both networks during the life of this contract. According to implementation leads, there has been little collaboration between the NC STEM Learning Network and the NCNSP STEM network up to this date. To carry on its future plans, the NC STEM Learning Network will need to secure funding from private partners or other sources.

II. Professional Development

Overall Findings

In this section, we examine the nature and quality of the professional development and coaching provided through the RttT STEM initiative from November 2011 through the end of July 2012. We also begin exploring some of the ways in which the professional development has been utilized onsite, focusing on the experiences of the four anchor schools that are the emphasis of this Year 2 evaluation report. During the school year, the professional development provided by NCNSP primarily takes the form of onsite instructional and leadership coaching, supplemented by a limited number of more formal workshops and conferences. The majority of the intensive formal PD activities occur during the summer months so that teachers do not have to miss instructional days with their students.

Our analyses of the professional development activities reveal the following findings:

- Schools are receiving the PD and coaching services outlined in the RttT scope of work.
- Most of the coaching visits to comprehensive schools that joined network in the summer-fall of 2011 happened during 2012 year, and the number of visits per school was unevenly spread among schools.
- Overall, PD and coaching were seen as valuable and of high quality. Staff at the anchor schools hoped for continuing PD and coaching in the upcoming year.
- Professional development was most appreciated when participants saw the direct application to their classroom.
- The vast majority of coaching time was spent on changing instruction in the classrooms.
- The fact that coaches engaged with schools over an extended period of time gave coaches, teachers, and principals the opportunity to develop trusting relationships that likely increased the coaches' impact.
- Challenges and barriers around PD included:
    - Sending teams to PD during the school year for schools with small staffs;
    - Balancing the competing demands of different initiatives; and
    - Getting buy-in from teachers around changing instruction.

This section of the report is organized into three main subsections:

1. Formal professional development;
2. School-based coaching; and
3. Potential barriers and additional support needed for implementing the knowledge and materials from the professional development activities.

Each section describes the level of participation in each activity, the content and delivery, and the perceived quality of the activity.

Workshops and Other Formal Professional Development

From November 2011 through July 2012, teachers and administrators from the STEM Affinity Network had the opportunity to participate in a variety of external professional development activities, ranging from conferences to networking meetings to multi-day study visits at other schools.

Structure and content of professional development sessions. Starting in November and going through the 2011–12 school year, the schools in the STEM Affinity Network participated in 18 primary sessions: a regional Common Practices Symposium, a Critical Friends Group training, the national Scaling STEM conference, training in Secondary Lenses on Learning, a meeting for counselors and college liaisons, the Anchors Away study visit, and study site visits to other schools. Activities provided during the summer of 2012 included the following: an out-of-state study visit for staff from the four anchor schools; the NCNSP Summer Institute; Integrated Math I; Integrated Math II; Integrated Math III; Investigations in Environmental Science; Science and Global Issues: Biology; and Modeling Instruction. Table 13 presents the formal professional development sessions, their content, and the number of RttT network participants at each session.

Table 13. Professional Development Sessions Offered to Network Schools, January–July 2012

PD Event	Dates	Content	# RttT Participants	# RttT Schools
STEM Affinity Network study visits	January–March, 2012	Structured visit to a model school in the NCNSP network	47	13
Common Practices Symposium (two regional meetings)	February 8 and 15, 2012	Supporting college readiness, included presentations by schools	9	5
Critical Friends Group	February 21–23, 2012	Use of Critical Friends Group protocols to guide problem-solving discussions	23	13
Counselor/College Liaison Support Session	February 21 and February 23, 2012	Defining and supporting college readiness	11	8
Project-Based Learning (PBL) Conference and Student STEM Symposium	April 16, 2012	Learning about PBL and sharing teachers' work; examples of projects created by students	67	13
Scaling STEM Conference	April 16–18, 2012	Implementing STEM education; presentations by students; breakout sessions on assorted topics by schools, NCNSP staff, and researchers; school visit to local schools	26	9
Secondary Lenses on Learning	April 25, 2012	Training designed to build leadership teams for quality algebra instruction	42	11
Atlanta study visit	April 2012	Structured visit to STEM-focused schools in Atlanta	10	10

PD Event	Dates	Content	# RttT Participants	# RttT Schools
Summer Institute STEM sessions	June 26–28, 2012	Sessions focused STEM network themes and specific strategies to implementing STEM	85	17
Anchors Away study visit	June 18–21, 2012	Understanding and clarifying the role of the anchor schools; visiting different STEM-focused schools in Ohio, New Jersey, New York, and Illinois	12	4
Leadership Innovation Network	March 22, 2012	Strategic planning	1	1
LEAD	July 17–19, 2012	Intensive summer experience for principals, focusing on developing individual leadership skills.	7	7
Integrated Math I	July 9–13, 2012	Content of Integrated Math I curriculum and Core-Plus text	13	11
Integrated Math II	July 16–20, 2012	Content of Integrated Math II curriculum and Core-Plus text	12	11
Integrated Math III	July 23–27, 2012	Content of Integrated Math III curriculum and Core-Plus text	9	9
Investigations in Environmental Science	July 9–13, 2012	Inquiry-based instruction in environmental science and the Investigations textbook	12	10
Science and Global Issues—Biology	July 16–20, 2012	Inquiry-based instruction in biology and the Science and Global Issues textbook	12	9
Modeling Instruction in Physics, Chemistry, or Biology	July 9–27, 2012	Inquiry-based instruction in science	4	4

Within each of these PD events, the structure varied, although almost all incorporated a hands-on, applied component. Both the Scaling STEM and the Summer Institute sessions were conferences that included keynote presentations and breakout sessions organized in strands, many of which were relevant to the STEM schools. The Critical Friends Group session gave participants hands-on experience using different protocols to guide group discussions and decisions. The content-based workshops included the participants doing mathematics and science activities and understanding the instructional practices that were used. The school study visits involved the use of structured protocols to examine certain features of the schools that were visited. Finally, the Anchors Away session focused on understanding the role of the anchor schools and helping schools identify their priorities for development.

This year, the evaluation team focused their observations on two sessions that were offered for the first time and that had a strong STEM focus: the Scaling STEM conference and the Anchors Away study visit.

The Scaling STEM conference was a national conference focused on STEM education. The three-day conference began on a Monday afternoon with a keynote presentation concerning architectural design projects being done in Bertie County, NC. This was followed by a session during which students from six schools presented STEM-focused projects; two of those schools were part of the RttT-supported STEM Affinity Network. The projects were in a variety of areas, including energy, food and nutrition, and health care. The end of Day 1 and most of Day 2 included breakout sessions in six strands:

1. Instruction, which centered primarily on problem- or project-based learning;
2. Assessment, which had a strong emphasis on performance assessment;
3. Extra/co-curricular, which included supplemental STEM-focused activities students could do, such as robotics;
4. Scaling STEM, which focused on different approaches that can be used to bring STEM to more schools, including distance learning, increasing the pool of STEM teachers, etc.;
5. Policy and Research, which included a mix of sessions focusing on research and evaluation results of different initiatives, building partnerships, and other topics;
6. Curricular Resources, which included sessions on the content of the courses.

These sessions were generally a combination of lecture/presentations and activities/discussion. Day 2 also included a keynote session with two presenters focused on creativity and innovation. Day 3 included a site visit to one of two schools in Durham that have been low-performing and are using STEM as the vehicle for turning themselves around.

The other new, explicitly STEM-focused experience offered during the evaluation report period was the Anchors Away event. Participants in this session included teams from the four RttT anchor schools and one other school in the health and life sciences network. The overall goal of the session was to gain clarity on the role and structure of the anchor schools and to visit other STEM-focused schools. The two-day site visit was bookended by one day on either side to permit for discussion and work. During these two days of discussion, the participants discussed the role of the anchors, identified areas in which they would like to become leaders, and worked on rubrics that would assess their progress toward the areas of leadership. The anchor schools were expected to be leaders in partnership development and in instruction ("Powerful Teaching and Learning"). Within the instruction area, schools are expected to develop in at least one of the following areas: meaningful use of technology, pervasive integration of the theme, and performance assessment. This particular professional development involved extensive dialogue and work by the individual schools. In comments afterwards, participants in Anchors Away found that the opportunity to meet for a day before and after the site visit allowed for much richer conversation than if only the visit had occurred. The agenda for the Anchors Away event is presented in Appendix E.

Perceived quality of the professional development. Overall, participants believed that the workshops were of high quality and useful. Because of the number of professional development offerings, the RttT Evaluation Team did not collect feedback on all of them. Table 14 presents participants' ratings of the workshops for which we have evaluation data.

Table 14. Participants' Ratings of the Quality of the Workshops, % Agree or Strongly Agree

The session…	**Critical Friends Group** (*n* = 27)	**STEM Network conference** (*n* = 25)	**Integrated Math** (*n* = 30)	**Investigations in Earth Science** (*n* = 10)	**Science and Global Issues (Biology)** (*n* = 8)
…had a clear purpose.	100%	92%	97%	90%	75%
…was of high quality.	100%	96%	97%	100%	75%
…was timely.	96%	96%	93%	90%	50%
…was beneficial and relevant to my needs.	100%	84%	100%	100%	50%
…was well structured and paced.	96%	96%	87%	90%	75%
…helped me gain new knowledge and/or skills that I will be able to apply in my classroom/school.	100%	88%	100%	100%	75%
…provided useful resources.	100%	92%	97%	100%	62%
…enhanced my ability to incorporate or support projects in my classroom/school.	93%	76%	100%	100%	50%
…enhanced my ability to teach or support using inquiry-based or problem-based learning strategies.	89%	84%	100%	100%	62%
…enhanced my ability to integrate or support my school's STEM theme in my classroom/school.	70%	72%	83%	90%	50%

Scale range: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree

Participants' comments about the most beneficial aspects of the training tended to focus on the opportunities to practice what they were learning and to network and share with other schools. Sample comments made by the participants included:

> "I loved the way these protocols were able to get everyone involved. The protocols empowered me by helping me come up with strategies and solutions to problems."—Critical Friends Group participant
>
> The most beneficial part was "Going through lessons and planning with other teachers how we would implement those lessons/activities/projects."—Integrated Math participant
>
> "Witnessing authentic, tried and tested examples of classrooms that have undertaken projects gives me a much clearer picture of how to implement this in my classroom."—STEM conference participant

The workshop with the lowest participant satisfaction was on Science and Global Issues, where participants were frustrated by the fact that the workshop centered on using a text and materials to which they would not have access. One teacher's recommendation was, "Make it a little more relevant to the participants—possibly a little less emphasis on the particular 'text' and a little more emphasis on powerful teaching and learning that would be usable for all teachers and not just the teachers that already have this program in place." Similarly, when participants had suggestions for improvement of PD sessions, these recommendations tended to focus on ensuring that the content and materials were very relevant to helping them learn to do STEM more effectively. For example, one participant at the Scaling STEM conference wanted "[m]ore productive and hands on experience like what we are supposed to do for our students." Another participant at the same conference wrote, "I would include more strategies on *how* to incorporate PBL into the classroom rather than presentations of PBL projects and/or how you can include parents and community members. I feel that the conference concentrated more on what they did (project) versus how they did it (came up with it, brought in core classes, etc.)" A participant at one of the mathematics workshop wanted "[b]etter explanation (at the beginning of the workshop) of the focus of our workshop, what we are going to do and why it is helpful/important to learning Common Core and Core Plus."

Some trainings had very few recommendations for improvement. For example, the only substantive recommendation for the Critical Friends Group training mentioned by more than one person was to provide more time to become familiar with all of the protocols.

In interviews, the PD sessions (including the coaching) were perceived as very valuable and worthwhile experiences. One participant in the Anchors Away event commented that the structure of this particular kind of professional development was particularly important because it made the participants wrestle with real issues, and it also created a network of schools working toward the same goals:

> [F]or most adult learners immersion into an issue is far, far better than bringing in someone as an outside expert and sitting passively … and there's not an expectation with this type of event that you're going to learn how to do this but the emphasis on a collaborative network that we're creating to help our schools first in North Carolina generate ways to address these issues and issues even beyond STEM; issues involving student engagement, issues involving making the curriculum something that the students feel engages them with the world they live in, issues involving getting the outer world that can frequently be very critical of us to understand the work we're doing and to help participate in that work.

Another participant commented after the Anchors Away training:

> I hope that the resources will continue to be there to offer this type of training for staff members for STEM school members and they need to expand upon that because I think it's very, very valuable for me. I mean I'm reinventing myself as we speak and I have more experience than probably everyone in here and I'm looking forward to the opportunity to start something very fresh and very new all over again. It's kind of like my first teaching job.

School-based Coaching

STEM Affinity Network schools receive a combination of leadership and instructional coaching. Leadership coaches work primarily with principals on implementing the Design Principles and creating an environment that supports quality teaching and learning. The instructional coaching is broken out into services provided by a general instructional coach and services provided by subject-specific coaches in mathematics and science (STEM coaches). The instructional coaching activities focus on the Common Instructional Framework, on developing content expertise, and on implementing key instructional practices in mathematics and science.

Structure and content of coaching. The number of coaching visits a school receives is primarily a function of the size of the school, with larger schools expected to receive more visits over the course of the RttT funding. In the 2011–12 school year, the number of visits received by a school was also a function of when the school enrolled in the network. Schools enrolled in the network in the summer of 2011 started to receive coaching in August 2011. Comprehensive schools that joined the network in August 2011 or later started to receive coaching between August 2011 and February 2012. Typically, a leadership coach would start working with a school prior to instructional coaches. Each school also has a portfolio manager, a NCNSP staff person who is charged with overseeing the services for the school and providing technical assistance. Table 15 shows the number of total coaching visits for the group and the ranges for individual schools by school type and by type of coaching. Although zero appears in some of the ranges, all but three new to the network schools received multiple days of coaching from at least one kind of coach.

Table 15. Number of Coaches Visits to RttT Network Schools

Type of School	Time Period	Leadership Total (Range)	Instructional Total (Range)	STEM Total (Range)
Anchor schools*	August 201l – June 2012	33 (7–11)	88 (27–31)	37 (18–19)
Affinity schools	August 201l – June 2012	51 (0–6)	121 (0–36)	64 (0–13)

*The anchor school that opened in the 2012–13 school year received only leadership coaching. Therefore, the ranges for this group include only three schools in all categories other than leadership. The totals and ranges for affinity schools include all 16 schools.

When they were in the schools, the coaches predominantly worked one-on-one with individual staff, although there were times when they offered professional development sessions for the entire staff. A review of the coaches' reports showed that across their visits, they engaged in the following types of activities:

- Observing in classrooms and providing feedback;
- Sharing information and resources;
- Conducting model lessons;
- Suggesting strategies;
- Conducting orientations;
- Providing professional development;
- Facilitating meetings;
- Collaborating with teachers on developing or reviewing lesson plans;
- Collaborating with teachers on reviewing assessment data;
- Facilitating strategic planning; and
- Attending and participating in staff meetings.

The core emphasis of the coaching was to address Powerful Teaching and Learning design principle. The primary approach through which this was attained was by using the Common Instructional Framework. This is a set of six instructional strategies that are designed to ensure, according to NCNSP, that "every student reads, writes, thinks, and talks in every classroom every day." The specific instructional practices include:

- Collaborative group work
- Writing to learn
- Literacy groups
- Questioning
- Scaffolding
- Classroom talk

A detailed description of the instructional strategies as they apply particularly to mathematics and science can be found in Appendix F. A review of the coaches' reports in the anchor schools showed that the instructional coaches spent the majority of their time working with individual teachers on implementing the Common Instructional Framework.

The STEM coaches also worked on the Common Instructional Framework, but they supplemented it with subject-specific needs. They worked with both math and science teachers to build teachers' content expertise and implement inquiry-based instructional strategies in their classrooms. The STEM coaches also worked with other high school teachers to implement STEM instruction in their classrooms. One of the coaches described how his work involved helping teachers:

> [They are] incorporating STEM thinking into those classes, the critical thinking, problem solving, collaboration with their fellow classmates and kind of incorporating those STEM skills … that kind of open collaboration, communication, group problem solving, and producing the kind of real world products from projects that we do in class.

The STEM coaches have also been helping all of the staff in the schools implement the engineering design process. According to one of the coaches:

> One of the big centerpieces is trying to incorporate the engineering design process in all classes as a tying theme between all classes. So, not only [at the] health and life science school, but as a history teacher, how can I get students to solve problems? And then, here's a way to engage them in that solving process, problem-solving process ... it's just a cyclical process of solving problems. And the way I've sort of explained it to my students and to the teachers that I work with, you're basically really trying to define a problem, and once you have the problem where you feel like it's fully defined, you start with lots of ideas and you systematically narrow it down to one idea that you then do and test, and maybe you come back around.

In addition to working with teachers, the instructional and STEM coaches would often work with principals, with the goal of helping them develop and utilize a common language for instruction in the schools.

The coaches also see their role as "professional support and kind of redefining what it means to be a teacher." One of the advantages to being onsite is that they could individualize their work with the teachers more effectively. One of the coaches described it like this:

> We want to move any teacher along the powerful teaching and learning rubric that we've developed no matter where they are, we're going to meet them where they are and use whatever supports necessary, whether that's visiting another's classroom, whether that's coming to a professional development, whether it's one-on-one planning, whether it's a classroom visit and collecting data on what's going on with the students during that class, our work is really meant to be supportive in nature and not evaluative in nature.

The teachers who were interviewed agreed that the coaches would customize their work with them according to the needs of the individual teacher, but still within the general framework of inquiry teaching and the Common Instructional Framework. A math teacher in an anchor school described how the coach worked with her on a need that she identified:

> I needed to work on questioning … I needed to get to questions that really showed learning over time or applications as well … .one of the things that I told her was, in this specific class she was observing, I realized that they learned something on Monday. We'd go through the motions. We'd take the test. They'd do okay. Then that next following Monday, it was gone. So we talked about asking questions that made connections so that that learning just occurred throughout and so that's basically what we worked on and so we talked about some different strategies. She gave me a couple of different strategies. I used those strategies. We talked about how they were successful and then I just made them … a routine part of my instruction … I think it was extremely

> useful and I'll tell you why … we did our own little private, personal form of a lesson study and so what I felt was helpful was to have the communication because like I said, I don't have a teacher partner this year so having the communication, having that second brain, having somebody to say, "Okay, I noticed that this group did this, maybe next time you can do this differently" and so I felt like it was extremely helpful … I'm already thinking about how I could use her next year.

The leadership coaches worked primarily with the school's principal on the development and implementation of a strategic plan to develop the school in needed areas. The focus of the plan may be different depending on the needs of the school. For example, one anchor school is focusing on strategic planning, the Common Instructional Framework, and moving from individual teachers who are doing excellent work to trying to create excellence across the board. For newer schools, the leadership coaches worked with the principals and their staff on understanding the Design Principles.

Perceived quality of the coaching. Overall, teachers and principals in the anchor schools believed that the coaching was very valuable. The teachers commented on how they valued the extent to which the coaches served as a reflective mirror in which they could consider their teaching practices. A teacher in an anchor school commented, "But what I really liked was … having a STEM coach on hand to run ideas by … they're definitely very hands on … I'm very heavy on reflective practices. So I look back on stuff I've written and I'm able to run it past [the instructional coach] or talk about structure with [the math coach] of how would you handle this and things like that." Another teacher agreed, saying, "I'm new to teaching math, and having someone right there to answer any questions and to give me feedback immediately has been just wonderful."

One of the most frequent comments was how the extended relationship with the principals and teachers allowed the parties to develop trust and potentially increase the impact of the coaches' services. Coaches commented on how their role has evolved over time, beginning as more of an observer and then, as trust developed, moving to a co-teaching and modeling role. A teacher in one of the anchor schools agreed, commenting:

> [J]ust being honest, it was a little annoying at first to have somebody sitting there looking at everything you did every day for three or four days at a time. It was just irritating but really, we built a relationship with her, or I know I did and my teaching partner did, we built a pretty good relationship with our coach over the year and got a lot of valuable input from her.

A principal in a different school highlighted how the value of the coach increased as she spent more time with her and began to trust her:

> [At the beginning, it was like] I've got another one I've got to talk to every three weeks, like I've got to go to therapy sessions every three weeks, I don't need this, but then I think after about six weeks it's sort of like, okay, I think this person is saying things to me and she has a credibility, she has a knowledge base, she is going to be someone that I can utilize, strengths, skillsets. And so actually she said, "I would like to come and be part of some planning that was going on." I said, "Okay, fine." … It was with teachers,

> planning period by planning period, and she became this great reflective voice for the whole group.

These comments suggest that it takes time before an external individual, such as a coach or consultant, is able to gain the trust of school staff. One possible implication here is that there might be a minimum amount of time that coaches need to spend in a school in order to be effective.

While the vast majority of participants thought the coaching was valuable, one teacher commented that the professional development sessions provided by the coaches were of mixed benefit: "In-house professional development is hit or miss just because … there is such a spectrum of … needs and abilities and buy-in to the whole idea of STEM. So some really get it, really love it, are all about it. Others are saying, I've heard this before, why are we still talking about this? And then others are kind of lost."

Potential Barriers and Additional Support

In interviews and open-ended comments on surveys, participants identified a series of challenges and barriers to implementing what they learned in the professional development.

For the small schools, the small number of staff limited the level of participation in offsite PD during the school year. Two of the anchor schools found it challenging to send teams of staff to PD during the school year because this meant that much of their staff would be missing from school. As one principal said, "Now, we can't participate in every single opportunity because we're starting a new school and we only have five teachers, and we've got to make sure that everything is covered."

An additional challenge faced by participants was balancing what they were learning in PD with the other expectations coming from the state and the district. As one teacher commented:

> There's somewhat of a disconnect between what [the district] wants us to do, what New Schools wants us to do, and what [the higher education partner] has their hand in the pot, being that little triangle.

The challenge of balancing all of the different initiatives and their PD expectations was described by a principal in one anchor school:

> [W]e try to respond to all of those masters, all of those expectations and it dilutes our effectiveness. So there are some things that I'm going to be working with for our Memorandum of Understanding with New Schools that should be releasing us from some things from the district, but that's hard right now because we're moving to Common Core.

As noted in the Year 1 report, getting teacher buy-in to changing their instruction was seen as a challenge. This was still a challenge in at least one of the anchor schools, where the principal commented:

> I know that the challenge is getting a 100% buy-in from everybody because a lot of the staff say, "Hey I'm Board Certified. I know I'm a good teacher. Why do I have to change?"

This challenge is potentially larger in the comprehensive schools that are new additions to the STEM and NC New Schools Project networks. For example, after the Lenses on Learning training, participants were asked to write about where they and their school were, relative to the ideas learned in the training. In general, the comments from the smaller schools indicated that they may be in the early stages of implementing these strategies but that they were open to doing it. An administrator in a new STEM-focused small school said, "Well, we are a designated innovative school in our first year. We are definitely at the beginning stages of innovation. I believe teachers understand the concept and realize the value but are not sure how to move in this direction and prefer to take baby steps." In general, comments from the larger schools tended to indicate that this was a totally new approach for them, and there was some question about how well it would be received. One teacher commented, "It would take a pretty big paradigm shift for this to happen large-scale in our school. Perhaps simply 'piloting' this as a math department next school year would be a feasible goal." A teacher in a different comprehensive high school said she was open to trying some of the ideas she had learned, but also stated, "My school is not currently open to this idea. I would estimate that in the mathematics department, three out of eight teachers are willing to try new ideas."

In general, anchor school staff wanted to continue with existing coaching and PD and get more of it. One school found the existing PD very valuable but felt like they needed additional support, particularly in effective instructional strategies within the content area.

In all three anchor schools, the staff wanted to continue working with the coaches. A teacher said, "Well, I personally need to learn more about the aerospace and security and more of the STEM Affinity because I am newer to it, but I feel like we do have great coaches and great help already. I think just meeting with them more—and I know that we're going to a STEM conference to learn more about it this summer—that would help me a lot."

III. Development and Implementation of Project-based Curricula

There are two different components to the initiative's work on STEM curricula. The first component is focused on supporting teachers in instruction with nationally benchmarked mathematics and science curricula such as Core Plus Mathematics or Investigations in Environmental Science. These curricula are geared toward the inquiry- and problem-based learning that are at the heart of NCNSP's Powerful Teaching and Learning Design Principle. NCNSP provides support for teaching with these curricula with summer content-focused workshops and instructional coaching. The second component of curriculum work is focused on designing a 9^{th} through 12^{th} grade integrated curriculum with at least three inquiry-based project units per course within each of the four STEM themes (Agriscience and Biotechnology, Health and Life Sciences, Aerospace, Security and Automation, and Energy and Sustainability). The second component is described and analyzed in more detail in the following section. The first component is discussed in sections on PD and intermediate outcomes.

Our analyses of the curriculum development and implementation activities reveal the following findings:

- A new contract was awarded to the North Carolina School of Science and Mathematics (NCSSM) by NCDPI to design STEM curricula with project units.
- During July–August 2012, NCSSM delivered the outlines for all 16 year-long courses and the first units for the four freshman courses in each of the four themes.
- NCNSP provided multiple opportunities for teachers to engage in professional development focused on the four themes and on project design and implementation.
- Rubrics for the Pervasive Theme design feature of STEM schools are currently being developed.
- Themes are being incorporated in anchor and affinity schools in a number of different ways, including special sequences of courses on a theme, integrating a theme in all core subjects, and blending two or more courses.
- Three existing anchor schools started to incorporate both cross-curricular projects and projects within individual subjects.
- Scheduling and teacher knowledge on project-based learning (PBL) were identified as challenges for project implementation.

This section is divided in four subsections:

1. Development of curriculum with project units that address the four STEM themes
2. NCNSP professional development focused on themes and projects
3. The extent of implementation of themes and project-based units in anchor schools
4. Challenges

Development of Curriculum with Project Units that Address the Four STEM Themes

As a result of re-evaluation of the scope of work, and expertise and resources needed and available for designing STEM curriculum with project units, NCDPI awarded a new contract in the late spring of 2012 to the North Carolina School of Science and Mathematics (NCSSM) to design these curricula.

According to this contract, NCSSM agreed to develop a total of 16 year-long courses with authentic assessments, with grades 9-12 courses in each of the four STEM areas:

- Agriscience and Biotechnology
- Health and Life Sciences
- Aerospace, Security and Automation
- Energy and Sustainability

These 16 courses should each provide 150 hours of instructional time and be completed by May1, 2014. All courses are required to satisfy 14 conditions, which include online delivery, a variety of digital content, inquiry-based units, alignment with all state Essential Standards, and others. The details of the scope of work for this contract can be found in Appendix G.

During July–August 2012, NCSSM delivered the outlines for all 16 courses and the first units for the four freshman courses in each of the four themes. The Evaluation Team reviewed these documents and summarized them below.

The outlines of the courses indicate that they will integrate multiple subjects, including physics, biology, chemistry, earth science, engineering, writing, computer science, and mathematics. The courses will address a wide range of topics, including:

- Health and Life Sciences: biomedical systems, biomaterials, tissue engineering, neuroscience, medical imaging, and biomechanics;
- Energy and Sustainability: types of energy and efficiency of its use, biodiversity and sustainability, climate change, biogeochemical cycles, population growth and urban future, types of waste and its management, agriculture, and national and international sustainability programs;
- Agriscience and Biotechnology: agricultural ecology, agricultural genetics, agricultural biotechnology, agricultural solutions, and sustainable agriculture;
- Aerospace, Security and Automation: history of flight, aerodynamics, hydraulics, technical communication, motors and engines, rocketry, programming in various languages, electricity, computers, and communication systems.

The first set of online units in four freshman courses became available for review in late August 2012. A brief review of the design of these courses reveals the following features. These courses use a variety of modes of digital delivery of content such as PowerPoint presentations, videos, links to websites, online programming language (Scratch), and PDF materials for teachers and students. In addition to PowerPoint presentations and information sheets, students will be involved in many individual and group exercises, hands-on projects and lab activities, demonstrations, discussions, and assessments.

By July 2013, eight courses for two years of instruction in each theme are scheduled to be delivered. The Evaluation Team will examine these courses in more detail in next year’s report. While there is a clear plan for designing 16 year-long courses for four themes, the plans for PD for teachers using these courses have not been yet specified.

NCNSP Professional Development Focused on Themes and Projects

NCNSP devoted a number of sessions in PD events to the four STEM themes, to project design, and to project-based learning (PBL). The full day PBL conference, in conjunction with the National STEM conference in April 2012, included students and allowed participants to share knowledge and classroom experiences related to STEM-focused project work. Students from various schools in the network showcased projects that they had completed in their classes. Students from one anchor school, for example, spoke about and demonstrated an engineering project that they designed in their engineering class and which was awarded third place in a national competition in Pennsylvania.

During the Summer Institute, there were a number of sessions devoted to the design of projects addressing Grand Engineering Challenges, PBL, and student senior projects. Additionally, participants from STEM schools were engaged in sessions with field experts on each of the four themes and in consensus-building sessions with peers from schools with the same theme.

Among other topics of anchor school development at the four-day Anchors Away event in June 2012, teams from the four anchor schools worked on rubrics for the Pervasive Theme design feature of STEM schools.

The Extent of Implementation of Themes and Project-based Learning in Anchor Schools

Theme. NCNSP does not prescribe how themes should be incorporated into a school's schedule. From the observations of one of the coaches, schools currently take three different approaches to incorporating their theme.

One approach is to have a strand of courses focused on the content of the theme and separate from the core courses. Two of the anchor schools have taken this approach, with all students taking a sequence of courses in the theme content (health or engineering). One of the challenges arising from this approach is in integrating the study of issues within the theme into the core classes, because these teachers may believe that the theme is being adequately covered in these targeted classes. At the same time, there are some examples of overlap in themes and projects between the theme sequence and core subjects such as math or science.

The second approach, which one anchor and some other schools have taken, is to integrate the theme into all core classes. This second approach requires schools to overcome a number of challenges, such as providing theme content knowledge to core subject teachers and adjusting schedules to allow teachers to plan together.

The emerging third approach is to create courses that blend two or more subjects, such as engineering and physics, or health sciences and biology. These blended classes are taught by both teachers, are scheduled for double the amount of time (the whole year into a semester-type schedule), and require common planning time for scheduling.

Project-based learning. All three anchor schools have started to incorporate project-based learning to some extent. In all schools, teachers are trying to incorporate both cross-curricular projects and more projects within their subjects. In one of the schools, project-based learning is very prevalent. Most projects last three to four weeks, and students are graded by a strict rubric that they must follow. Teachers usually provide some instruction, assign a project, and then provide the rest of the instruction after the project is complete. In another school, one teacher acts as the lead project-based learning teacher. Students complete projects in a math, engineering, and World Dynamics class, which integrates three subjects.

Many of the extracurricular activities in these two schools are focused on designing and presenting projects addressing some problems that are authentic to their community. A group of students who developed an automated water management system, named HydroPAL, took an allexpenses-paid trip to Philadelphia to present their project at a competition sponsored by a school partner, where they were awarded third place. A team from another school created a project, related to energy and an environmental concern in North Carolina, for the eCYBERMISSION competition, sponsored by the U.S. Army, and won second place in it (eCYBERMISSION project, 2012). Both projects were also presented at the Scaling Up STEM national conference in Durham, NC, in April 2012.

The third school incorporated a cross-curricular Sustainable Food Project with 9th graders, because they are grouped together in specific classes. Students worked on science, social studies, and health components in corresponding classes. In the words of one staff member:

> They did research, they built an interactive website, and the [theme] teacher brought in her piece about the [theme] issues related with whatever foods they were studying … but each student was responsible for a different aspect of that project … a lot of the projects have been technology-based.

The principal of the school is now working on changing a master schedule to integrate pairs of subjects in other grades and create common planning time for teachers to work together.

Additionally, in this school, teachers used projects in their classes to conduct performance-based assessments. For example, senior students are working on a real-life issue about prescription drug addiction and are going to present to a council meeting and do a public service announcement about solutions to this problem. This work has been done as a part of their health sciences theme class.

All schools either started this year, or plan to start next year, with the integration of different subjects in their curricula, which would incorporate cross-subject projects. With this purpose, principals have designed the schedule to include common planning time to allow teachers of different subjects to plan lessons together.

Challenges

Teachers noted that they need to learn about how to use projects as both a means for learning and as a performance assessment tool. They need more professional development on this, and some coaches plan to do common planning about the use of projects in the next year.

Some teachers also suggested that they need more direct learning experiences in the real applications of their schools' themes so that they can effectively implement lessons related to the career field. Other teachers expressed a need to learn more about how to prepare students to be career-ready.

School principals indicated that scheduling blended courses or cross-curricular project units may present a logistical challenge both in terms of assigning the same groups of students to multiple classes and in terms of assigning common planning time for teachers.

IV. Partnerships

Building partnerships with businesses and with institutions of higher education (IHEs) is one of the major strategies of this initiative to ensure that schools are able to provide relevant STEM education of high quality. Both NCNSP and anchor schools are working on building these partnerships and helping other schools in the network to build theirs.

Our analyses of partnerships reveal the following findings:

- Industry Innovation Councils (IICs) for each of the four themes met quarterly to plan and provide support for the networks.
- Industry and IHE partners participated in NCNSP PD events, where they provided their expertise to school staff on themes and on relevance to local community economic development and also planned partnership activities with schools.
- NCNSP, with the help of business partners, is developing a sustainable and replicable prototype model partnership to be implemented in the four themed networks.
- The challenges that schools face involve building partnerships in rural areas, making partnerships more collaborative and hands-on, and developing teacher content knowledge in the theme and in teaching career-ready skills.

This section is divided in three subsections:

1. NCNSP efforts to develop partnerships for the four themed networks
2. The extent of implementation of partnerships in anchor schools
3. Challenges in building partnerships

NCNSP Efforts to Develop Partnerships for the Four Themed Networks

NCNSP is seeking to develop partnerships that provide different types of support to the affinity networks, including, but not limited to, financial support, subject-matter expertise, and job-shadowing opportunities. They do this through two primary mechanisms: Industry Innovation Councils (IICs) and their professional development and partnership building events.

Industry Innovation Councils. To ensure that the partners provide consistent and regular support that is geared towards STEM schools' needs, NCNSP established four IICs, one for each affinity network. Each council has between 24 and 29 members, consisting of representatives from businesses and IHEs. The councils are scheduled to meet quarterly and include staff from the corresponding theme anchor schools.

The first year report described the first meeting of three of the councils; here we describe the second meetings for these councils, which occurred in November and December 2011. During the discussion on private sector engagement in the STEM Affinity Network, NCNSP outlined its vision, detailing two tiers of partner involvement (the draft document is provided in Appendix H). The goal is to have partners to be more involved in Tier 1 activities *directly* impacting teaching and learning, such as structured teacher externships in the corporate environment, STEM workplace experts co-designing authentic projects with teachers, and work-based learning activities (such as field studies, internships). Council members at the IIC meetings discussed barriers that their companies face in making a partnership that is meaningful and engaging.

During those meetings, STEM schools and partners identified the following next steps:

- Expectations for partners need to be clarified.
- Standard models/procedures for partner-school relationships need to be created.
- There is a need for additional partners and council members.

The first organizational meeting for the Aerospace, Security and Automation IIC, the only council that did not meet in Year 1, occurred on May 4, 2012, and followed the agenda of providing introductory knowledge and setting goals, similar to the first meeting of the other theme councils. In the spring and summer of 2012, IIC members participated in sessions within NCNSP-organized conferences, the Scaling Up STEM conference and the Summer Institute, in place of their regular meetings. During these conferences, IIC members participated in panels and workshops and served as keynote speakers.

To address the recommendations of the IIC members, NCNSP has started prototyping a partnership model with one of the themed networks. After being created and tested, this sustainable and replicable network model will be implemented in all four themed networks. As the process gets underway, a business partner funded a full-time employee to work with NCNSP to help access resources across many universities and build partnerships. Additionally, NCNSP hired a STEM field coordinator who is housed in an anchor school to help leverage partnerships for the themed network, making sure that they are strategic and will impact teaching and learning.

Building partnerships at PD events. In addition to IIC meetings, NCNSP also involved businesses and other partners in their PD events. For example, the Scaling Up STEM conference had approximately 170 business, state government, and IHE participants, interacting and networking with staff from NCNSP-supported schools. A number of members of business, state government, and IHEs also participated in the Summer Institute.

During the conferences, there were explicit sessions dedicated to building partnerships. The RttT Evaluation Team observed two such sessions at the Summer Institute: (1) Business Industry Partnerships that Support Powerful Teaching and Learning, and (2) Relevant Topics from STEM Field Experts. During the first session, schools and business members shared what they can offer in a partnership and what they are looking for out of the partnership. Some schools also shared its best practices for building partnerships. In the second session, which was for STEM schools only, experts in the field shared their content knowledge about the themes with school teams.

Partnership-building events. In January, February, and March 2012, NCNSP hosted three Strategic Conversations in School Innovation meetings devoted to Workforce Development and Technology Strategic Planning. About 50 to 100 people participated in each of these meetings. These meetings aimed at developing a strategic plan for NCNSP and building partnerships with the NC private sector and colleges and discussed questions such as:

- How might NCNSP effectively employ technology to create and sustain virtual communities of practice among teachers engaged in STEM networks of schools?
- Should the goal of academies and thematically focused schools be to prepare students for specific careers or to more broadly engage and motivate students with explicit connections to the adult world? The debate about at what age a child should choose a career pathway remains ever present.

The Extent of Implementation of Partnerships in Anchor Schools

All four anchor schools are charged with developing partnerships not only for themselves but also to serve as resources for the themed networks. Since the three existing schools are at different stages of maturity, the number of partnerships and extracurricular opportunities they provide for students varies significantly. All three schools have at least one IHE and one business partner with which they work closely. The current major partners include North Carolina State University, the University of North Carolina–Chapel Hill, North Carolina Central University, Duke Medical Center, Durham Regional Hospital, Durham Tech Community College, Craven Community College, Fleet Readiness Center East (a provider of global vertical-lift aviation industrial, logistics, and engineering support services for Navy and Marine Corps aviation), and Phoenix Contact, an engineering firm. These partners are quite intensely involved with at least one of the three anchor schools.

Partners provide support to schools in various ways. They support teachers in the development of authentic projects. For example, the NC State University Eastern Regional Director for Distance Engineering Programs provides support on curriculum development to teachers in one school. In another school, a Duke University researcher, who is currently developing a device for early AIDS detection in third world countries, collaborates with a science teacher. Together they are planning a lesson on HIV immunology. The innovative feature of this kind of support is its collaborative nature and its focus on building teachers' and school capacity instead of a single, isolated presentation by an outside visitor.

Partners also provide a number of extracurricular opportunities for students, such as job shadowing, field trips, STEM-related clubs, scholarships, mentorships and visits to school by business partners, and internships, some of which are in the planning stage. For example, personnel from Fleet Readiness Center East often come to the campus of one of the schools and arrange work-shadowing opportunities for students at the military base. Through job shadowing experiences at the base, students have learned more about and confirmed their interest in STEM careers. In one particular case, a student who wanted to major in sports medicine shadowed a physical therapist, but after the experience, he said to himself, "I don't think I want to [do] that for my life." Staff at one school commented that their access to field trips is more than the average high school would have. And, partners often provide financial support for various extracurricular activities.

Additionally, in one of the schools, undergraduate students from a partner university come to the school to tutor struggling students, who are referred by their teachers. In the words of one of the staff members:

> Just last week, we took a group of students to the [Campus] Health Summit, where they got to hear the students' voice on some of the issues that are facing not only the district, but our county at large. They looked at homelessness, poverty, and education, and actually got to talk to some of our kids on a panel discussion, to have some of our kids speak out about their take on the dropout rate, what is it that's causing this, from their peers.

Partners also provided two- to six-week externships in the summer for teachers representing schools in three of the networks: Health and Life Sciences, Biotechnology and Agriscience, and Energy and Sustainability. Teachers worked in chemical, public health, and energy companies to participate in the companies' work and to develop their own project units related to the school theme. These experiences allow teachers to make their lessons more relevant to real life in their communities, to connect their subject matter to their STEM theme, and to get a better perspective on future job opportunities for students and on skills that graduates need in the workplace. These externships also provide lasting connections and opportunities for future collaborations between teachers and researchers (Kennedy, 2012; Silberman, 2012). Details about two of these externships are provided in Appendix I.

Establishing partnerships. Principals of anchor schools shared their experiences with the process of establishing partnerships within their community. In the words of one of the principals:

> Partnerships have to be identified, established, nurtured, fed. They don't happen, and then they often just happen. That's the problem. They're not sustained. They're not thoughtful, sort of purposeful, and they need to have goals and they need to be evaluated and then they need to be tweaked and people need to talk about it so that everybody feels like they get something out of it.

In one school, the principal and the curriculum coordinator, with the help of a parent who is the president of the School Improvement Team, initially did all of the work to establish partnerships. To establish partnerships, the principal and Student Services staff talk with potential partners at various events and present the school and what it is doing. Now that the school is more well known in the community, potential partners initiate communications, offering their help to the school. When students are giving their presentations at events, it creates positive publicity for the school. This school also has several partnerships through alumni that have offered their support.

Another school established most of its connections, including those with local businesses, through its partner university. It established a business advisory board for the school that meets monthly and is composed of 16–17 individuals who work for different STEM-related companies in the area.

The process of establishing partnerships was one of the key topics at the Anchors Away four-day PD event for anchor schools. During the event, NCNSP staff, four anchor school members, and some partners discussed a partnership process and developed rubrics for creating partnerships.

Staff raised a number of questions and issues related to partnerships that they feel anchor schools need to resolve, such as:

- Is the role of anchor schools to share their partners with the rest of schools in the network or to model the process of building partnerships?
- How are the anchor schools going to implement a communication role for the theme network?
- What is the role of affiliated IHEs in the anchor concept? How do partners develop shared goals and a shared definition of college readiness (vertical alignment)?
- How can a process of matchmaking between businesses interested in helping education and schools that need such help be facilitated and streamlined?
- How can schools involve parents in this process?

Challenges

During the interviews, teachers and principals of anchor schools identified a number of challenges that they face as they build partnerships with businesses and universities:

- Some schools are still at the stage at which they get mostly financial contributions from their partners but have less close collaboration with partners. Hands-on partner involvement is one of the goals of partner involvement that was discussed with businesses at the IIC meeting, but it is still in the planning stage in some of the schools.
- Schools also mentioned certain logistical issues as barriers for student entry into work settings, such as patient confidentiality at the hospital or security at the military site.

V. Intermediate Outcomes for Students and Staff in Anchor Schools

This section presents the analyses of the Evaluation Team visits to the three anchor schools in Spring 2012 and interviews with STEM coaches. During the visits, the team interviewed principals, math and science teachers, and students, as well as observed STEM classrooms. The fourth school will open its doors in August 2012 and will be included in next year’s report.

Our analyses of intermediate outcomes reveal the following findings:

- In all three anchor schools, the STEM initiative is in the beginning stages of implementation.
- Given the large number of the early college/STEM design features that schools have to implement, the anchor schools start with different priorities, which are affected by their context and by principals’ preferences.
- There is not yet universal buy-in into the STEM initiative among staff in the anchor schools.
- All anchor schools added additional STEM courses, such as engineering, technology, science, and health sciences.
- Some schools are adopting more innovative math and science textbooks.
- Technology is a high-priority area in all three schools, both as a subject of study and as an instructional tool for learning content across subjects.
- Many teachers report that they improved their instruction and implemented instructional

strategies emphasized by NCNSP professional development, such as collaboration, classroom talk, inquiry and project-based learning, and higher order questioning.

- Interviews with staff and students indicated that students in anchor schools enjoy personalized attention and exhibit high motivation, engagement, and passion for learning.
- Staff identified a number of challenges to overcome during implementation, such as better defining and understanding the STEM model, improving teacher qualifications, increasing student preparedness, and addressing logistical issues.

This section is divided in four subsections:

1. Overview of the anchor schools
2. Development of a vision for STEM schools and the STEM Affinity Network by students and staff in anchor schools
3. Perceived outcomes of the initiative in:
    a. STEM curriculum
    b. Technology
    c. Instructional improvement
    d. Impact on students
4. Challenges that anchor schools are facing as they continue implementation

Overview of the Anchor Schools

A major goal of the STEM initiative is to establish four STEM anchor schools—that is, STEM-focused high schools that will serve as regional leaders in STEM education, each of which is focused on a major area relevant to North Carolina economic development (Health and Life Sciences, Agriscience and Biotechnology, Energy and Sustainability, and Aerospace, Security, and Automation). Three of these schools were in operation in the 2011–12 school year, and the fourth one (Agriscience and Biotechnology) opens its doors for students in the 2012–13 school year. In this section, we talk about the three anchor schools open during the reporting period.

In addition to STEM features, two of these anchor schools are also implementing the early college model, allowing their students to complete a significant number of college-level courses by graduation. One of these two schools is in its first year, and another is in its second year of existence. Both of them are in their first year of participation in the NCNSP network. One has approximately 50 students and the other has 100 students, and both have few teachers, some of whom are not certified to teach math and science subjects to which they are assigned. Last year, one of these schools scored at 99% proficiency on state standardized assessments, which made it difficult to achieve growth in the current year.

The third school, which joined the NCNSP network four years ago after being a theme academy within a comprehensive school for a number of years, is bigger and more mature. This school moved to a new building in the beginning of the 2011–12 school year and is expanding, adding nine new teachers to its staff this year. This school was a finalist for the Urban Excellence Award and is already hosting visitors who want to learn from its experiences and achievements.

Two of the schools are urban, and one is a rural school. All three schools are schools of choice to which students have to apply. Students at all three schools are then selected through a lottery process, sometimes with initial screening.

Development of a Vision for STEM Schools and STEM Affinity Network by Students and Staff in Anchor Schools

Building a common vision for the outcomes of change is the first necessary step on the road to implementing change and obtaining teachers' buy-in into the initiative. It is important, therefore, for staff in the anchor and network schools to build a common understanding of the goals of the RttT STEM initiative, of all of the elements that constitute the vision for STEM schools, and of their school's role in the STEM Affinity Network. The NCNSP STEM vision combines the NCNSP Design Principles (implemented in the schools' early college and redesign reform models) with elements of STEM (such as a schoolwide STEM theme and cross-curricular projects addressing authentic STEM problems).

Although one of the three anchor schools is not officially an early college, it has partnered with a community college, where juniors and seniors take college-level classes. Therefore, in practice, all three schools combine an early college model (or some of its elements) with the STEM vision.

Analyses of interviews indicate that staff understanding of the early college vision and the NCNSP Design Principles was at a much higher level than their understanding of the STEM vision. This makes sense since STEM was overlaid onto their existing school model. The implementation of the STEM vision and the anchor school vision is thus in the beginning stage.

Many of the staff did not have a clear understanding of their school's role in the STEM Affinity Network. Staff in two of the schools commented on their uncertainty in their school's role and their somewhat weak knowledge of the Design Principles. Additionally, staff mentioned as a challenge a need to reconcile their school's role as an early college with STEM elements.

Shared understanding of what it means to be a STEM school is still being developed, with staff often pointing out different, although related, aspects of the NCNSP's vision as characteristic of a STEM school. One staff member talked about STEM as meaning "that we are working to integrate science, technology, engineering and math, and we're working on doing that cross-curricular, making sure that there are lots of connections in the various departments that we have." Another talked about "the science, technology, engineering, math thought processes … [p]ractically it means that as much as possible I'm trying to give my students like real world problems." For the third, being a STEM school meant an inquiry-based, project-based approach, but now it is under a different name. In the words of another staff member:

> If you look at the North Carolina NSP anchor definition, the expectation is that a STEM school is one in which there is a culture that fosters innovation, creativity, problem solving, collaboration, takes on challenges. I think that culture, those kinds of

> expectations, can happen in calculus and in health life science. It can happen across all content areas …

In another school, the vision for the school is to wrap learning around the Grand Challenges for Engineering. This is a way to get students to see the relevance of their learning; according to one teacher, "I see it as a way to make sure the kids are seeing the relevant pieces."

In two of the schools, staff were excited about the goals and activities of the initiative, but in the third, there was mixed buy-in. Staff members in this third school explained that teachers feel overburdened by a number of initiatives simultaneously adopted by the school. In this school, staff had not yet started talking to students about what STEM means and how the school is becoming a STEM school. As a result, students didn't have a good understanding of the school's future STEM direction. In the words of one of the students, "I think we're a little lost on what 'STEM school' really means or how it applies to our school."

In all three schools, staff expressed hopes that summer PD will be helpful in defining and further developing the STEM vision, and that the following academic year will see a more intense and focused implementation of the STEM vision. And, in fact, the subsequent Anchors Away PD event in June 2012 did focus in large part on development of the STEM vision for the network, with teams from all four anchor schools participating. Participants discussed vision documents and developed rubrics for STEM design features that did not have them. As part of this event, a representative from NCDPI presented the statewide STEM attributes and the draft rubrics for these attributes, which schools can use for self-assessment. State STEM attributes were previously reviewed by NCNSP staff and benefited from their contributions. Now, NCNSP and anchor staff are considering state STEM attributes and rubrics as they further develop the STEM Affinity Network's vision and rubrics.

Perceived Outcomes of the Initiative in Anchor Schools

STEM curriculum. Two of the anchor schools utilize engineering as a unifying subject. One of these schools is working with its partners on developing four sequenced engineering design courses and integrating them with four science courses (taught as year-long combined courses). Another school hired an engineering teacher, and all freshmen in the school are required to take an Engineering Design Principles class; this school has the goal of incorporating the engineering design process in all subjects taught. This school also offers a World Dynamics class that integrates the subjects of math, humanities, and engineering.

In the third school, the main theme is health sciences, and students receive a Certified Nursing Assistant license at graduation. The curriculum involves a clear pathway through seven health-related courses (25% of all courses in the school) and a number of clinical experience opportunities. The school offers additional science classes related to health: anatomy and physiology, pharmacy technology (through which a student could graduate with a pharmacy tech certification), fundamentals of nursing, forensic science, and biomedical technology. Additionally, as part of Career and Technical Education (CTE), this school offers technology-based courses that will result in certification in Microsoft Office Suite.

With regard to math and science classes, one school has started and two other schools are planning to implement integrated math curricula (using the Core Plus textbook) to align more closely with the Common Core State Standards in math and the Powerful Teaching and Learning Design Principle. According to a coach:

> …the schools that have the integrated math and the teachers that have had the Core Plus training, it's a lot easier conversation about how to implement Common Instructional Framework. They kind of have a richer experience to that. The schools that have the more traditional track and have not had the Core Plus training, it's a lot more difficult conversation.

When using the Core Plus textbook, teachers don't have to create additional rigorous problems that make students think, because the book does it for them. A math teacher also noted that this textbook consists of a number of small math projects. In the words of this teacher:

> What I like most about Core Plus is that I'm not creating problems that force kids to show how they think about things. Core Plus by themselves allows choice, encourages multiple representations … it does its best at getting to relevance.

While schools are encouraged to use innovative curricula in math and science classes, the schools do not always select the textbooks recommended by the NCNSP and used in the content training institutes. Two of the anchor schools do not yet use math and science curricula used in the content training, although some math and science teachers, encouraged by their coaches, will start using these curricula in the next school year. Additionally, one of the schools intentionally decided not to use paper textbooks in the one-to-one environment, so the teachers create their own curricular materials to use with laptops.

Technology. Technology seems to be one of the high-priority areas in all three schools, both as a subject of study and as an instructional tool for learning content across subjects. Two of the anchor schools implemented a one-to-one technology initiative during the reporting period, and the third will implement it in the upcoming school year (not funded through the RttT but with the help of partners).

Use of technology was prevalent across most classes observed in the three schools. We observed the use of the following tools: iPads, PowerPoint, graphing calculators, videos, online quizzes, online search engines, the Polycom videoconferencing system, a wiki class site, personal laptops, LEGO MINDSTOMS Education NXT software, Google spreadsheets, Moodle, and word processing software.

During observations, evaluators rated the extent of use of technology for various purposes using a 4-point scale: 0 = not observed, to 4 = very descriptive of the observation. Technology was being used in most classrooms, but the role it played, and the degree to which it was being used, varied across classrooms. Across classrooms, technology was most often used to practice skills or knowledge (44% of the classrooms scored a 4). It was least used to explore or confirm relationships (only a third of all classrooms scored 3 or 4 on that scale).

Observers commented that in most instances, technology appeared to be making learning more interesting, dynamic, and memorable for students. For example, in an engineering class, "students were using LEGO MINDSTOMS Education NXT software on laptops to create a program they later tested on a robot. They also used the laptops to access the class wiki and to retrieve resources." In a humanities class, "students were using their laptops to download materials that the teachers had shared with them through Moodle. They used Microsoft Word in order to provide their peer review feedback, the "Critical Friends/Peer Review."

Some of the teachers utilized the flipped classroom model, recording lectures and making them available for students' access at home, while doing projects and problem solving in class.

According to teachers, technology has changed how they are able to differentiate lessons for students:

> I feel as a staff we've grown a lot in our teaching practices, and differentiating's a whole different level now because you have all the tech so you can hit kids in all kinds of—their different learning styles. It's been very beneficial. I can't think of any negatives. We just work really hard.

At the same time, not all teachers embraced technology yet, with younger teachers being more comfortable with it. At the Anchors Away event, two of the four anchor schools selected technology as their major focus for the anchor school model development.

Instructional improvement. Professional development aimed at instructional improvement is a major component of this initiative. The extent of instructional improvement as a result of professional development to date was judged based on the following sources:

- Interviews with teachers about perceived changes in their instruction
- Interviews with coaches who work in anchor schools about their observations of changes in instruction
- Focus groups with students
- Observations by the Evaluation Team in selected classrooms

Teachers in anchor schools are trying to incorporate new instructional strategies such as real-world applications, project work, experiments, inquiry learning, open-ended and higher order questions, and student-centered approaches. Some administrators and teachers saw changes in teaching as a result of multiple supports from coaches and school staff:

> My practice changed a lot towards getting them to do things, to debate, to practice, to work on problem solving … There's a lot of observation and there's a lot of feedback so I guess hearing all this and having the influences of New Schools Project and STEM and all that stuff constantly as my influencers has definitely pushed my practice forward, I think.

As reported by all respondents, teachers are changing their instruction to incorporate more Common Instructional Framework (CIF) strategies. Both students and coaches also reported that students were engaged in active learning, working on their mathematics, science, or engineering projects. Students confirmed that their teachers ask them to figure out their answers on their own or with their groups, to explain how they solved problems, to consider different solutions, and to explain their reasoning. They also reported that they did many experiments in science and projects in math classes and enjoyed working on those projects.

At the same time, we heard that instructional improvement has not been consistent across teachers and classrooms. Suggested reasons for these inconsistencies were:

- Some teachers are used to teaching in traditional ways and resist change.
- In some cases, the school's focus is on areas other than teaching and learning, as teaching and learning is perceived as an already strong area by the school leaders.

Observations of instruction. During visits to the three anchor schools, evaluators observed the following nine classes: math (three classes), science (one), engineering (two, with one of them blended with Global Issues), health occupations (one), and blended humanities (two, with one of them blended with science). The nine classes observed included a total of 159 students (62 males and 97 females). Two of the three schools were new and only had 9th and 10th graders, so the grade distribution was 9th grade (seven classes), 10th grade (one class), and 10th–12th (one class).

Evaluators rated the focus of instruction with regard to whether: (1) most of the time was spent on practicing algorithms/basic skills and procedures/vocabulary, (2) most of the time was spent on inquiry/meaningful learning and genuine problem solving, or (3) about equal time was spent on each of these. Of the nine classes observed, four spent the most time on inquiry/meaningful learning and genuine problem solving, two spent the most time on practicing skills and procedures/vocabulary, and three spent about equal time on both. Student engagement was mixed, with higher levels of engagement in hands-on activities (e.g., writing a robotics computer program in an engineering class and taking a pulse in a health professions class) and some group discussions.

To evaluate the general quality of classroom teaching, the CLASS observational instrument was used. The CLASS instrument organizes classroom interactions into 11 dimensions scored on a 7-point scale (low: 1, 2; midrange: 3, 4, 5; and high: 6, 7, with 4 being the middle of the scale). CLASS observation protocol divides observation time into 25-minute periods with 15-minute observations and 10-minute rating time.

Analysis of 29 15-minute CLASS observation segments conducted in nine classrooms showed that most CLASS dimensions received an average score in the midrange (3, 4, or 5). Table 16 (following page) provides average scores for 11 instructional dimensions and for student engagement.

Table 16. CLASS Observation Mean Scores for STEM Anchor Schools

Dimension	Mean (1 – 7)	Dimension Description
Positive Climate	4.97	Positive climate reflects the emotional connections among teachers and students and the warmth, respect, and enjoyment communicated by their shared interactions.
Negative Climate	1.10	Negative climate reflects the overall level of negativity among teachers and students in the class.
Teacher Sensitivity	4.62	Teachers demonstrate sensitivity by noticing when students need support and actively responding to their needs.
Regard for Adolescent Perspectives	3.93	Teachers show regard for adolescent perspectives when they provide opportunities for student autonomy, promote peer interactions, communicate usefulness of content, and value student ideas and opinions.
Behavior Management	5.66	Teachers manage the classroom well when they communicate and fairly enforce rules and expectations and when they redirect minor behaviors.
Productivity	5.17	In productive classrooms, teachers manage time and routines effectively so that instructional time is maximized.
Instructional Learning Formats	4.48	In classrooms with high-quality instructional learning formats, teachers are enthusiastic about their material, provide instruction using many modalities (e.g. visual, oral, movement) and a variety of activities, and look for opportunities to actively engage students.
Content Understanding	4.24	Content understanding refers to both the depth of lesson content and the approaches used to help students comprehend the framework and key ideas in an academic discipline. Teachers develop content understanding through an integrated understanding of facts, concepts, and principles rather than knowing basic facts or definitions in isolation.
Analysis and Problem Solving	3.41	The “analysis and problem solving” dimension assesses the degree to which the teacher facilitates students' use of higher level thinking skills through the application of knowledge and skills to novel problems, tasks, and questions.
Quality of Feedback	3.69	High-quality feedback expands and extends learning and understanding, is focused on the process of learning and not merely on correctness or the end product, provides students with specific information about their work, and helps them reach a deeper understanding of concepts.
Instructional Dialogue	3.45	Instructional dialogues are content-focused discussions that build in complexity, extend over sustained periods of time, and involve many students.
Student Engagement	5.14	Students are engaged when they are focused and participating in the learning activity. The goal is for all students to be actively engaged, as reflected in behaviors such as: answering and asking questions; contributing to discussions; volunteering; performing expected tasks; and showing enthusiasm.

* A lower Negative Climate score reflects a *less* negative climate.

Keeping in mind that the number of CLASS observations was relatively small, and reported differences might not be statistically significant, the summary of the data is as follows:

- Most of the average instructional scores (7 out of 11) and the student engagement score were above the midrange score of 4.
- Behavior Management and Productivity received the highest scores (5.66 and 5.17, respectively).
- Analysis and Problem Solving and Instructional Dialogue received the lowest scores, below the mid-score (3.41 and 3.45, respectively).
- When the data were disaggregated based on subject (math, STEM, non-STEM), math classes appeared to score slightly higher than other subjects on instructional support dimensions, such as Content Understanding, Analyses and Problem Solving, Quality of Feedback, and Instructional Dialogue (4.1–4.8).

In addition to CLASS ratings, observers rated classrooms on the extent to which teachers implemented strategies from the Common Instructional Framework (CIF).

Evaluators rated the use of CIF strategies (Collaborative Group Work, Writing to Learn, Literacy Groups, Questioning, Scaffolding, and Classroom Talk) in each classroom using a 4-point scale: 0 = not observed, to 4 = very descriptive of the observation.

CIF strategies were used in all classrooms, but some of them were used more frequently than others. The two most often used strategies were Collaborative Group Work and Classroom Talk, with six and five out of nine classrooms, respectively, scoring a 4. Literacy Groups was the strategy least used in the classrooms, mainly because it did not apply to the activities happening in the classroom.

Teachers commonly used high- and low-level questions (Questioning). In an Algebra I class, for instance, the teacher asked many high-level questions, such as, “What does that mean?” and in an earth and environmental science class, the teacher asked many “why” and “how” questions. In other classes, however, the questions did not require the students to engage in deep thinking, or the teacher did not elicit further dialogue through questioning.

Across classes and schools, teachers utilized various approaches for facilitating sharing and collaboration among students. Small-group work (such as writing a robotics program in pairs and creating a poster in small groups) and whole-class sharing/discussion were used often, with small-group work preferred in classes where hands-on activities were the focal point (e.g., engineering and health professions classes). Individual work was very frequent, especially in math classes, and tended to be followed by whole-class sharing/discussion, which was the most common approach.

Impact on students. The extent of perceived changes in students’ attitudes, behavior, and achievement as a result of the initiative was judged based on the following sources:

- Interviews with teachers

- Interviews with coaches who work in anchor schools
- Focus groups with students
- Observations by the Evaluation Team in selected math and science classrooms

All three schools are small schools, and teachers and students both like it this way. Some teachers attribute many positive student outcomes to the small school size and more personalized attention to students. In one teacher's words:

> I think the biggest change we've seen in our students is just being in this small environment where the anonymity is gone ... Honestly, I would say directly from the STEM initiative, what little change there is, is overshadowed by the amount of positive change that comes from being in an environment where they do have access to all of these things and they all are in a smaller setting where everybody knows everybody else.

Students said that they most like three features of these schools:

- Small size and personalized attention from and positive relationships with teachers and staff
- Opportunity to earn college credit and challenging classes in general
- Hands-on activities and projects

Below are the quotes from five different students in all three schools.

> I like the small setting, knowing everyone who's here, and being able to have that connection or that relationship with teachers … all of the students at least know each other.
>
> I think that our school is a family. Like every staff member took the time to actually get to know every single student.
>
> Mainly you get to do hands-on activities. You get to really explore your options before you make one decision, and the classes are really small. So, you get the—not technically the attention you need, but you can ask more questions and the teachers, they invest their time in making sure you get something.
>
> I also like the fact that they challenge us as far as taking honors and AP classes. I've never had a standard class here. So, I like the fact that they actually push us to take more challenging classes.
>
> All right, I came here by choice and I wanted to because I knew I wanted to go to college, so this was a good way for me to save some money and get an associate's degree to get started off with.

Both staff and students commented on students' high motivation and passion for learning. Independent observers also highly rated student engagement in the classrooms (5.17 on a 7-point scale). Students enjoy independent learning opportunities and responsibilities.

Some teachers saw the increased engagement of their students with learning as results of changes in their teaching. In words of one teacher:

> So they have grown so much. They're feeling comfortable talking in front of a group, working as a team, and I've never had that in a regular school.

Another teacher said:

> It is a great environment. It's challenging but we've seen a difference in the kids, we've seen a difference in us.

Some administrators saw an increase in student achievement as a result "of the work that the teachers are doing … [a]nd definitely a very strong focus on higher order thinking and making those connections." They also commented on an increase in student achievement as a result of the tutoring provided by the partner college students.

Challenges Faced by Anchor Schools

The challenges mentioned by teachers, staff and coaches in anchor schools fall into four main categories: 1.) logistical issues, 2.) clarifying the meaning of being an anchor and STEM school and implications of this initiative for the schools, 3.) increasing teacher preparedness to implement STEM vision, and 4.) increasing student preparedness for high expectations in the school.

1. Schools are facing logistical problems related to being a new school or to changing scheduling to accommodate new aspects of STEM instruction. Specifically:
    - Being a new school and dealing with setting up a school, including space, transportation, and hiring qualified teachers, may shift staff's attention away from the STEM implementation issues.
    - Scheduling to allow for cross-curricular projects to be planned and executed is a challenge. Integrating two or more subjects may sometimes be difficult due to the physical distance between teachers in three different buildings.
    - Some staff worried about communications with parents about a school's move to become a STEM school, as sometimes parents may feel the STEM focus is not a good fit for their child.
    - Principals struggled to manage numerous available resources.

2. Anchor schools are still struggling to define what this initiative means for their schools, and how to integrate it with other demands, while NCNSP staff is trying to figure out how to scale it up to comprehensive schools. Specifically staff mentioned the following challenges:
    - Defining what it means to be a STEM school and an anchor school, and how to implement a theme in the school.
    - Navigating multiple components of the NCNSP initiative.
    - Juggling, prioritizing, or integrating multiple initiatives from the state, district, and NCNSP, such as Common Core State Standards, STEM, early college, one-to-one laptop initiative, anchor school designation, etc.

- Scaling up to larger comprehensive schools, as there is not yet a road map for this process.
- Integrating an engineering or health focus with the rest of the school goals, while engineering or health teachers may come from outside of the school and not be involved in building a shared vision and knowledge of the STEM model.

3. Implementing the initiative's more innovative components such as theme and cross-curricular projects require that teachers buy into the model and gain substantial additional knowledge both about the content and new instructional strategies. Specifically staff mentioned the following challenges:
   - Getting all teachers on board with the initiative.
   - Having access to highly qualified teachers who know the content and instructional strategies to teach it.
   - Lack of knowledge in schools on how to create cross-curricular projects.
   - Need for sufficient training to implement the STEM initiative's components.
   - Integrating non-core STEM teachers (engineering, health) into the initiative, including professional development.
   - Finding a way for coaches to establish relationships with teachers and be effective in bigger schools.
   - Providing the best alignment between content training in math and science and curricula that teachers use in their schools.
4. As anchor schools combine the early college model with STEM and incorporate intensive use of technology, they struggle to increase student preparedness for higher expectations:
   - Getting students ready to take college classes while they are in high school.
   - Making sure students have the technology skills that they need.

All three anchor schools have made a significant progress towards implementation of STEM design features, however, they all are still at the beginning of their journey to becoming model STEM schools. The schools are still refining their STEM vision, getting all staff on board for the implementation, solving logistical and other challenges. But even within the first year of implementation, staff and students in the anchor schools report changes in teaching practices and student engagement and learning. They all look forward to continuing implementation of STEM features in their schools.

Discussion

The Year 1 evaluation report made a number of recommendations for the RttT project staff to consider as they moved forward. At the beginning of this report, we described changes that have happened in Year 2 relative to the areas of recommendations. We hope that the recommendations in this report will be useful for the Implementation Team and will help them think through the best ways to move this initiative forward.

Conclusions and Recommendations

One of the initiative's objectives was to "Work with partners to support the development of a small set of anchor/model STEM high schools that will serve as laboratory schools and sites for professional development around project-based learning." There is definite progress toward this goal, with three of the anchor schools working hard to improve instruction and implement STEM features such as project-based learning, their STEM theme, and additional STEM courses, and also utilizing partnerships for improvement of student learning. The fourth school is welcoming their first students in the 2012–13 school year. Based on analyses of RttT STEM initiative activities to date, the Evaluation Team concluded that structures for networking, professional development, curriculum development, and partnerships are in place to support both anchor and affinity schools as intended, though some of these activities have been delayed. In this section, we summarize the conclusions and recommendations for each of the four areas of implementation strategies reviewed above and for the intermediate outcomes observed in the three anchor schools.

I. Structure of the Network of Stem Anchor and Affinity Schools

During the reporting period (November 2011–July 2012), the RttT STEM initiative finalized the list of enrolled schools (see Appendix A). All but one of these schools had started to receive NCNSP PD services before August 2012. According to an analysis of administrative data collected by NCDPI, the RttT STEM initiative fulfills its goal of serving minority and poor students, populations who are traditionally underrepresented in STEM fields. In 2010–11, RttT STEM Affinity Network schools served higher proportion of black and Hispanic students and higher proportion of students of poverty than did the average high school in the state, hosted the same proportion of female students as male, and were more likely to be located in urban areas. RttT STEM Affinity schools started with lower numbers of advanced level math and science courses, an area for potential influence by the initiative.

NCNSP has encouraged and facilitated networking and collaboration by various means, including embedding it into face-to-face PD events, online collaboration tools, and coaching services. Currently, face-to-face meetings have been the most successful networking channels.

A contract with NC STEM Learning Network resulted in creation of an additional network of schools interested in or in the process of developing STEM programming; the design document for the STEM web portal; the cataloging of available STEM resources for students, schools, and parents in the state; the creation of a resource, *Do-it-Yourself Guide for Community Engagement*; and assistance to NCDPI for sharing these resources and some best practices from STEM schools through the series of monthly webinars. One of the main proposed products of this contract, the

STEM web portal for hosting resources, dissemination, and networking capabilities, has not been finished and needs additional funds to be fully implemented.

The STEM network does face some challenges. Challenges identified in this evaluation are listed below, accompanied by recommendations to help address those challenges.

1. Currently, participating STEM schools offer on average a lower number of advanced math and science courses than are offered on average by all other schools in the state. Leadership coaches may want to consider this as a possible emphasis for their conversations with the administrative teams in these schools.
2. While there are plenty of face-to-face networking opportunities for the schools, online networking is experiencing slow development. The initiative may consider various strategies for increasing the appeal of and incentives for visiting a virtual networking hub. One such strategy could be moving some PD elements for content and instruction into the online space. For example, summer content institutes could require additional online follow-up sessions so that participants can share their teaching experiences and/or lesson plans in particular topics or with certain instructional strategies. Additionally, instructional and STEM coaches could create online groups for following up on face-to-face visits.
3. There has been limited collaboration between the NCNSP Affinity Network and the North Carolina STEM Learning Network. In order to increase the effectiveness of sharing best STEM practices and resources, these networks may consider a better coordination of their activities in the future. Additionally, creating a central hub (or portal), with access to content resources, professional development, and assessment and lesson planning tools that could serve both networks, might increase the utility and effectiveness of online collaboration for both networks.

II. Professional Development

The Evaluation Team found that STEM Affinity Network schools had access to extensive PD opportunities through Race to the Top. STEM schools participated in 18 formal professional development opportunities that occurred outside of the school setting, including trainings on STEM content and instruction, STEM model development, and more generic sessions focused on college readiness and Critical Friends Groups. PD included extensive onsite coaching provided by leadership and instructional coaches. These coaches provided services related to improving instruction and strategic planning in STEM schools.

Participants generally saw the overall quality of the PD activities as very high and were looking forward to participating in more experiences in the upcoming year. Some specific sessions were not seen as useful or relevant.

The analyses of the Evaluation Team have resulted in several recommendations for the RttT project staff to consider while moving forward:

1. Participants valued the professional development most highly when they saw that it was directly relevant to their specific needs and when they were given the opportunity to think about how they might apply what they had learned in their school or classroom. Much of the

professional development did include these qualities, but NCNSP may want to explore ways of increasing the relevance of some sessions to participants.

2. Participants saw the impact of the coaches increase the longer that the coaches worked with the teachers in the schools. One possible implication of this for larger schools is that coaches could focus their efforts on working intensively with a smaller number of teachers.
3. Most of the professional development has been delivered face-to-face. To leverage professional development and coaching resources and to create incentives for using online networking, the Implementation Team may consider blended professional development.

III. Development and Implementation of Project-Based Curricula

In Summer 2012, a new contract was awarded to the North Carolina School of Science and Mathematics (NCSSM) by NCDPI to design STEM curricula with project units. During July–August 2012, NCSSM delivered the outlines for all 16 year-long courses and the first units for the four freshman courses in each of the four themes.

At the same time, NCNSP continues to provide PD focused on the four themes and on project design and implementation. Teachers in anchor schools design and implement both cross-curricular and within-subject projects in their classrooms. At the Project-based Learning conference, organized by the NCNSP in April 2012, teams of students presented their cross-curricular projects to many schools in the NCNSP network.

Anchor schools are exploring different ways of incorporating the theme into their school schedule. Two schools devote a special sequence of courses to their theme, another incorporates the theme into all core subjects, and two schools are blending two or more subjects in a single course.

To address identified challenges, the Evaluation Team suggests several recommendations for the RttT Implementation Team to consider while moving forward:

1. While there is a clear plan for designing 16 year-long courses in four themes, the plans for piloting and revising these courses and for PD for teachers using these courses have not been specified. The initiative leads may consider identifying some additional resources and supplementary funds to support piloting and revisions of and professional development for the STEM courses.
2. While NCSSM develops16 year-long courses in four themes, some of the anchor schools are also developing their own sequence of courses in engineering or incorporate theme into science and other core classes. This parallel development may interfere with these schools using the courses developed by NCSSM. NCNSP should consider identifying schools from each of the Affinity Networks that are willing to pilot the NCSSM courses and provide feedback to the developers. In addition, NCSSM should share the units with Affinity Network schools at scheduled professional development events.
3. Interviews with teachers indicated that they still feel a need for additional knowledge and training on a number of content and instructional issues related to themes and project design and implementation. It is recommended that these topics be emphasized in professional development and also additional resources be provided to teachers.

4. School principals indicated that scheduling blended courses or cross-curricular project units may present a logistical challenge both for assigning students and scheduling a common planning time for teachers. The Implementation Team may consider providing schools with tips and examples of schedules that allow for integration of the theme and cross-curricular projects within a school day.

IV. Partnerships

NCNSP is developing multiple venues for bringing in partners and having them provide support to the STEM schools and networks. One such venue was to establish Industry Innovation Councils (IICs) for each of the four themes; these IICs now meet quarterly to plan and provide support for the networks. NCNSP also involved businesses and other partners in its professional development events, where partners interacted and networked with staff from NCNSP-supported schools.

Anchor schools also developed partnerships with local businesses and IHEs on their own, and these partners provided support to schools in various ways. Partners provided a number of extracurricular opportunities for students such as job shadowing, field trips, STEM-related clubs, scholarships, mentorship and visits to school from business partners, and internships, some of them in the planning stage. They also supported teachers in the development of authentic projects and provided summer externships for teachers.

Both NCNSP and anchor schools collaborated on exploring different ways of building partnerships. NCNSP and one of the anchor schools, with the help of a business partner, established a full-time STEM field network coordinator position, located in the anchor school, to establish and sustain partnerships for the theme network. Additionally, a business partner funded one of its employees to work on building partnerships for a theme network. This process of building partnerships, after being established and refined, will serve as a model for other anchor and affinity schools.

To address identified challenges in building partnerships, the Evaluation Team suggests several recommendations for the RttT Implementation Team to consider while moving forward:

1. Rural schools may potentially have more logistical issues and difficulties finding partners than urban schools. While the model for partnership building is currently being developed in one of the urban schools, the Implementation Team may consider paying attention to specific issues faced by rural schools.
2. There are still a number of questions and issues related to partnerships that anchor schools need to resolve, such as the anchor school’s role in providing partners to other schools in the network or in communicating between schools. Anchor schools’ staff found it useful to think through these issues as a group during the Anchors Away event. It is recommended that the Implementation Team devote more time both face-to-face and online to the anchors or other groups of schools with common issues and work together to resolve these issues.

V. Intermediate Outcomes for Students and Staff in Anchor Schools

In all three anchor schools, the STEM initiative is in the beginning stages of implementation. Given the large number of the early college/STEM design features that schools have to implement, they are starting with different priorities that are affected by their context and their principals' preferences. There is not yet universal buy-in into the STEM initiative among all staff in the anchor schools.

All anchor schools added additional STEM courses, such as engineering, technology, science, and health sciences. Schools are adopting more innovative math and science textbooks. Technology is a high-priority area in all three schools, both as a subject of study and as an instructional tool for learning content across subjects.

Many teachers reported that they improved their instruction and implemented instructional strategies emphasized by NCNSP professional development, such as collaboration, classroom talk, inquiry and project-based learning, and higher order questioning. Interviews with staff and students indicated that students in anchor schools enjoy personalized attention and exhibit high motivation, engagement, and passion for learning.

To address identified challenges in continuing implementation, the Evaluation Team suggests several recommendations for the RttT Implementation Team to consider while moving forward:

1. Schools are still struggling to define what this initiative means for the school, while initiative leads are thinking through how to scale it up to comprehensive schools. They need to find ways to prioritize or integrate multiple initiatives from the state, district, and NCNSP, and to ensure buy-in from the staff. The Implementation Team may consider providing more differentiated help to schools by staggering emphasis on different Design Principles and STEM features, depending on the school's context.
2. Some schools are facing logistical problems related to being a new school or to changing scheduling to accommodate new aspects of STEM instruction. To help schools with these issues, the Implementation Team could create resources and an online blog or discussion devoted specifically to logistical issues that schools face.
3. Implementing the STEM initiative's more innovative components such as thematic and cross-curricular projects require that teachers gain substantial new knowledge about both content and instructional strategies. The Implementation Team may consider differentiating ways of providing professional development devoted to these issues.

Limitations

This report is qualitative and descriptive in nature, and it presents data about initial steps in the development of the STEM school and network model and the implementation of the proposed STEM activities. It should be considered a formative evaluation report at this stage of project development; our conclusions and recommendations are suggestions, though carefully considered and evidence-based ones.

Next Steps

Based on administrative data from the 2010–11 school year, along several different axes—demographic, financial, and academic—North Carolina's STEM schools appear to be similar to other high schools in most respects, with exceptions in the proportion of lower-income students and minority students served.

As noted at the beginning of this document, one of the four major guiding goals for the evaluation of the RttT STEM initiative is to evaluate whether the RttT STEM anchor and network schools have expanded the academic opportunities and improved academic outcomes for students in the anchor and affiliated network schools. Over the next two years, CERE–NC will continue to track changes in these measures, identify the degree to which any changes are related to efforts connected to RttT, and use this evidence to determine progress toward the stated goals of the North Carolina RttT STEM initiative.

The Evaluation Team will also continue qualitative data collection and analyses. The next evaluation report of the RttT STEM initiative is scheduled to be finalized in December 2013. By that time, we will be able to analyze data collected through the end of the 2012–13 school year. The team will continue to analyze project documents received from NCNSP related to all professional development and partner activities, as well as monitor online and face-to-face networking.

In addition, the team will conduct site visits at the STEM Affinity Network schools to observe classroom teaching and project development and conduct interviews with the principal, teachers, and students. We will analyze coaches' reports and interview selected instructional and leadership coaches about their work and about the effects on schools of participating in the STEM network. Responses to staff and student surveys that were collected in Spring 2012 will be analyzed to provide baseline data. A more detailed report about RttT-funded NCSSM curriculum development activities will also be provided in the Year 3 evaluation report.

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List of Appendices

Appendix A. STEM Affinity Network Schools, August 2012

LEA/ School Code	School System	School Name	STEM Theme
250314	Craven County	Early College EAST[a]	Aerospace, Security and Automation
320317	Durham County	City of Medicine Academy[a]	Health and Life Sciences
920582	Wake County	Wake NCSU STEM Early College High School[a]	Energy and Sustainability
94Z000	Washington County: Beaufort, Martin, Pitt, Tyrell, and Washington	Northeast Regional School of Biotechnology and Agriscience[a]	Biotechnology and Agriscience
060302	Avery County	Avery County High School	Energy and Sustainability
080312	Bertie County	Bertie High School	Biotechnology and Agriscience
240334	Columbus County	East Columbus High School	Biotechnology and Agriscience
240371	Columbus County	South Columbus High School	Biotechnology and Agriscience
240380	Columbus County	West Columbus High School	Biotechnology and Agriscience
290389	Davidson County	Yadkin Valley Regional Career and College Academy	Aerospace, Security and Automation
300312	Davie County	Davie High School	Health and Life Sciences
310344	Duplin County	East Duplin High School	Biotechnology and Agriscience
310352	Duplin County	James Kenan High School	Biotechnology and Agriscience
310364	Duplin County	North Duplin High School	Biotechnology and Agriscience
310392	Duplin County	Wallace Rose Hill High School	Biotechnology and Agriscience
320368	Durham County	Southern Durham High School	Energy and Sustainability
410569	Guilford County	Guilford STEM Early College High School A & T	Energy and Sustainability
410579	Guilford County	Middle College at UNC–Greensboro	Health and Life Sciences
860352	Surry County	Surry Central High School	TBD
920318	Wake County	Athens Drive High School	Health and Life Sciences

[a] An anchor school

Appendix B. Measures Used for Data Collection

Appendix B contains five protocols developed by the project: (1) Administrator Interview Protocol, (2) Teacher Interview Protocol, (3) Student Focus Group Interview Protocol, (4) STEM Classroom Observation Protocol, and (5) Protocol for Monitoring the Online Networking Site. Protocols provided in the first year report are not copied here.

Administrator Interview Protocol: 2011-2012 School Year

Participant's Name: Role:

School Name: School Network:

Date of Interview: Start Time: End Time:

Interviewer's Name:

Your school (or district) is part of (fill in name) Affinity Network under the Race to the Top STEM Initiative. This Initiative has several different components and we are interested in your experience with these components.

<u>STEM Mission and Vision</u>

1. What is your understanding of what it means for your school to be a [Affinity Network] school? What does it mean to be a STEM school? What will make your school different from other schools?
   If not mentioned in the answer, ask additionally:
   a. What will you and the school be doing as part of the [Affinity Network] network?
   b. How did your school/district get involved with the STEM network, whose initiative this was and what was the process?
   c. How much emphasis is there in your school on implementing the Design Principles?
   d. What is your school doing to increase students' interests and knowledge in STEM areas and careers?
   e. What do you hope your school will look like in 2-3 years as a result of participating in the network?

<u>Professional Development</u>

2. What professional development have you and your school received as part of this STEM initiative?

   Follow up: What has been the quality of these services? How useful and relevant have they been to your school's needs?

3. Please describe the services you have received from the leadership and/or instructional coaches this year.

[*Probe for frequency of visits, specific activities completed by the coaches; help with project development.*]

Follow up: What has been the quality of these services?

Instruction and Project-Based Learning

4. What curriculum are you using in your math and science classes?

5. What are you doing as an administrator to help teachers implement strategies requiring in-depth thinking and complex problem-solving in math and science?

6. To what extent have you been able to implement projects into your school's curriculum?

[*Probe for issues affecting implementation*]

a. Describe a typical project that your teachers are implementing. Are these collaborative projects for teachers?
b. With regard to project design: who and how decides on topics, number of projects per year, their duration, amount of work involved. How are they graded? How is design documented for future use?
c. What kind of help have you received for the project design and implementation from NSP, coaches, business partners, and STEM network?

7. Are you offering any new STEM-related courses in your school? Which students participate in these courses?

[*Probe for engineering, computer science, theme-related integrated courses]*

Technology

8. What is the role of technology in your school? How, if at all, do you see that role changing as you become more involved with the network?

9. Have you received any technology as part of your participating in RttT? If so, please describe.

Partnerships

10. Describe any partnerships between your school and colleges/universities or businesses that have developed as a result of your work with the affinity network.

[Probe for nature of the partnership, specific activities, whether or not there is a formal agreement.]

Network

11. Describe the interactions you have with other schools in the network. To what extent are you able to collaborate with them?

Impact

We'd like to you to discuss the impact of these activities on your school.

12. How, if at all, has the [Affinity Network] participation influenced your leadership in the school? What are you doing differently, if anything, because of this participation?

13. To what extent has the Race to the Top work influenced instruction in your school? How, if at all, are teachers teaching differently?

14. What impact (if any) did this participation have on students?

15. What has been the overall impact on the school of your participation in the network?

16. What challenges do you face and what help will your school need to become a high quality STEM school?

17. How does your school integrate Common Core standards and other state initiatives (such as use of data, formative assessment, etc.) with STEM work?

18. What else would you like to tell us about your experiences with this Initiative?

Teacher Interview Protocol: 2011-2012 School Year

Participant's Name:

Subject and Grade Level Taught:

School Name: School Network:

Date of Interview: Start Time: End Time:

Interviewer's Name:

Your school is part of (fill in name) Affinity Network under the Race to the Top STEM Initiative. This Initiative has several different components and we are interested in your experience with these components.

<u>STEM Mission and Vision</u>

1. What is your understanding of what it means for your school to be a [Affinity Network] school? What does it mean to be a STEM school? What will make your school different from other schools?

   a. What will you and the school be doing as part of the [Affinity Network] network?
   b. How much emphasis is there in your school on implementing the Design Principles?
   c. What do you hope your school will look like in 2-3 years as a result of participating in the network?

<u>Professional Development</u>

2. What professional development have you received as part of this STEM initiative?

   Follow up: What has been the quality of these services? How useful and relevant have they been to your needs?

3. Please describe the services you individually have received from the instructional coach this year.

[*Probe for frequency of visits, specific activities completed by the coaches, instructional vs content math and science coaches; help with project development.*]

   Follow up: What has been the quality of these services?

Instruction and Project-Based Learning

4. What curriculum are you using in your classroom?

5. *(For math teachers).* To what extent do you ask your students to solve open-ended problems that can be solved using multiple approaches? To what extent do you ask students to justify their reasoning?

(For science teachers). To what extent do you have students generate hypotheses and then develop and carry out a plan to test those hypotheses? To what extent do you ask students to justify their conclusions?

6. To what extent have you been able to implement projects into your curriculum?

[*Probe for issues affecting implementation.*]

7. What kind of help have you received for the project design and implementation from NSP, coaches, business partners, and STEM network?

Follow up if implementing projects: Describe a typical project that you might implement in your classroom. Are you implementing any projects with other teachers?

8. How were the scope and expectations for these projects defined?

Technology

9. How do you use technology in your classroom? How, if at all, do you see that use changing as you become more involved with the network?

10. Have you received any technology for you or your students to use? If so, please describe.

Partnerships

11. Have you received any support from businesses, organizations, or colleges/universities as part of the Network?

[Probe for specific activities including guest speakers, field trips, internships and externships for students and teachers.]

Network

12. Describe the interactions you have with teachers in other schools in the network.

Follow up: Are you able to collaborate with teachers in other schools? If so, what do you collaborate on?

Impact

We'd like to you to discuss the impact of these activities on you and your classroom.

13. How, if at all, has the participation in the STEM network influenced your teaching and your classroom? What are you doing differently, if anything?

14. What is your school doing to increase students' interests and knowledge in STEM areas and careers?

15. What other changes have occurred because of your school's participation in the Network?

16. As a teacher, what challenges do you face and what additional support do you need to become a strong teacher in a [Affinity Network] school?

Follow-up: How does your school addresses Common Core standards and other state initiatives (such as use of data, formative assessment, etc.)?

17. What else would you like to tell us about your experiences with this Initiative?

Student Focus Group: 2011-2012 School Year

Number of students:

School Name: School Network:

Date of Interview: Start Time: End Time:

Interviewer's Name:

Your school is [is becoming] a [name of Affinity Network] school. We are interested in what things have been happening to make this school a [name of Affinity network] school. So let's start.

1. What grade are you in? (If a school of choice) Why did you come to this school?

> *Facilitator: Have everyone in the group answer this first question in order. The rest of the questions don't have to be answered by everyone, and students can volunteer when to respond.*

STEM Mission and Vision

2. What does it mean that your school is a (network type) school? What does it mean to be a STEM school? What, if anything, makes your school different from other schools?

Project-Based Learning and Instruction

3. A big part of this program is supposed to involve projects. Do you do projects in this school? If so, what do they look like?

[*Probe for classes in which they might see projects, duration and number of projects, point of projects, any collaborative projects; engineering design; presentation of projects to outside community members; amount of work, reading, and writing involved.*]

4. Do you have any additional courses related to science, technology, engineering, math, or your school's theme?

5. In your math classes, how often do your teachers have you solve problems that require you to come up with your own approach to solving the problem and then explain that approach?

> Follow up: In your science classes, how often do they ask you to develop and conduct your own experiments and justify your conclusions?

Technology

6. What access do you have to computers and other technology? How do you use computers or other technology in this school?

> *[Probe for technology as a tool for learning, online collaboration with other students, scientists, etc.]*

College courses

7. Have you taken any college courses? If so, please describe. If not, do you plan to take any?

Impact

8. How interested are you in science, math, engineering or technology? Has that interest changed since you came to this school?

9. How much do you know about careers in science, math, engineering, or technology? Does the school do anything to help you learn more about careers in these fields?

[*Probe for guest lectures, field trips, additional after school activities with outside partners (such as FirstRobotics teams), work internships, etc.*]

10. What do you like best about this school? *Probe: and least?*

11. Is there anything else you would like to tell us about this school?

STEM Observation Protocol January 2012

Observers: This protocol is to be completed for the ***entire*** observation session, in addition to standard CLASS Observation Protocols (provided at the end).

Observer/Interviewer:__________________ School Name:_______________

Observation date: _____________ Time Start: _________ End: _______

Teacher: Teacher Gender: Male___ Female__

Teacher Ethnicity: _____

Grade Levels of students: ________ Course Title:_______________________

Students: Number of Males _____ Number of Females _____

Classroom Race/Ethnicity: % Minorities (approximate) ____________

Class Context

Please give a brief description of the class observed, including:

- the classroom setting in which the lesson took place (space, seating arrangements, environment and personalization, *etc*.),
- when in the overall lesson sequence this class takes place (toward the beginning of a unit, in the middle of a unit, toward the end)
- any unusual context of the lesson (interruptions, etc.)

Use diagrams if they seem appropriate.

Lesson Topic(s), Goal(s), and Structure

Topic(s) of today's lesson:

Lesson Goal(s):

According to the teacher (written or spoken), the purpose of the lesson was . . . .

Lesson Structure:

1. Briefly describe the structure of the lesson (*e.g*. 5-minute quiz, followed by 25 minutes of homework review, followed by 10 minutes of whole-class discussion, followed by 15 minutes of individual work on worksheets). Also, please note whether there was a conceptual summary at the end of the lesson.

2. Instructional Style (choose one):
   - ☐ Most time spent on practicing algorithms/basic skills and procedures/vocabulary
   - ☐ About equal time spent on practicing algorithms/basic skills and procedures/vocabulary and on concept development and meaningful learning
   - ☐ Most time spent on inquiry/meaningful learning and genuine problem solving

Common Instructional Framework

Select one from scale: 0 = not observed to 4=very descriptive of the observation. NA = not applicable to activity being observed

Students worked collaboratively in teams or groups.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	
Students used writing to communicate what they had learned.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	
Students participated in guided reading discussions.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Teachers asked open-ended questions that required higher level thinking.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	
Teachers provided assistance/scaffolding when students struggled.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	
Students engaged in discussion with each other.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	
Summary: Quality of Common Instructional Framework implementation	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	

Record specific examples below.

Use of Technology

Select one from scale: 0 = not observed to 4=very descriptive of the observation. NA = not applicable to activity being observed or "don't know"

Students used technology to explore or confirm relationships.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Students used technology to provide multiple representations.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Students used technology as a tool to support a specific instructional goal.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Students used technology to practice skills or knowledge.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Technology was used but did not appear to provide any added benefit.	(0) ☐	(1) ☐	(2) ☐	(3) ☐	(4) ☐	NA ☐
Summary: Use of technology						

Record specific examples below.

CLASS-Secondary Scoring Sheet Segment 1, Time:

Domain	*Dimensions: Description:*	*Rating (1-7)*
Emotional Support	**Positive Climate** Relationships Positive affect Positive communications Respect	
	Negative Climate Negative affect Punitive control Disrespect	
	Teacher Sensitivity Awareness Responsiveness Effectiveness in addressing problems Student comfort	
	Regard for Adolescent Perspectives Flexibility and adolescent focus Connections to current life Support for student autonomy and leadership Meaningful peer interactions	

Domain	***Dimensions: Description:***	***Rating (1-7)***
Classroom Organization	**Behavior Management** Clear expectations Proactive Effective redirection of misbehavior Student behavior	
	Productivity Maximizing learning time Routines Transitions Preparation	
	Instructional Learning Formats Learning targets/organization Variety of modalities, strategies, and materials Active facilitation Effective engagement	
Instructional Support	**Content Understanding** Depth of understanding Communication of concepts and procedures Background knowledge and misconceptions Transmission of content knowledge and procedures Opportunity for practice of procedures and skills	
	Analysis and Problem Solving Inquiry & Analysis Opportunities for novel application Metacognition	
	Quality of Feedback Feedback loops Scaffolding Building on student responses Encouragement and affirmation	
	Instructional Dialogue Cumulative, content-driven exchanges Distributed talk Facilitation strategies	
	Student Engagement Active engagement	

Protocol for Monitoring the Online Networking Site

For each network in the online community, the following data was collected in an Excel spreadsheet:

- Network name
- Name of reporter
- Date of the report
- Number of members
  Date of the first post
- Date of the last post
- Number of Postings by moderators
- Number of Postings by participants
- Average number of responses per post by moderator
- Average number of responses per post by participant
- Topics that generated most responses
- Topics that had the greatest numbers of posts
- Name and number of new technology features/interactive features added (e.g., polls, newsletter sign-up, calendar, and RSS feeds)
- Overall impressions/description of changes
- A list of resources shared

Appendix C. Number of Posts in Various Edmodo Online Networks

Online Network Activity	STEM Affinity Network*	Theme Networks	Subject Networks	School Networks**
Average number of members	173	61	10	20
Date of the first post	11/17/11	11/9/11	1/17/12	11/1/11
Date of the last post	6/28/12	6/27/11	5/16/12	6/26/12
Total posts	37	9	11	**
Total posts by moderator(s)	23	7	0	**
Total posts by participants	14	2	12	**
# of different participants	18	1	8	**
Largest number of replies for a single post	16	4		
Post focus				
# of posts related to the network's work/project development, STEM, or the network theme	27	8	9	**
# of posts related to professional development	10	3	1	**
# of posts related to teaching in general	1	0	0	**

* The STEM Affinity Network column reflects data from a single network, while the other columns show the totals for a group of networks with the same theme or content.
** We have not recorded the number of posts in school networks due to the very large amount of activity.

Appendix D. NC STEM Learning Collaborative Scope of Work

NC STEM scope of work supporting NCDPI in scaling effective STEM practices across NC school districts:

Creating and managing a Network of K-12 Districts, Schools & Partners

1. <u>CREATING THE NETWORK:</u> At NC DPI's direction, NC STEM will define the standards for inclusion and the identification process. Deliverables include:

a. Developing the criteria and application for inclusion in the Network
b. Identifying and mapping the existing STEM programs, schools and networks
c. Defining research-based attributes for STEM Schools, Programs & Networks
d. Creating STEM Readiness Self-Assessment tools for programs, schools and district hubs
e. Managing the identification process for initial cadre of network schools and districts, expected to include consideration of elementary, middle, and secondary school/districts, including Academies, Affinity, Innovative, Comprehensive, Charter and other K12 school types

2. <u>MANAGING TECHNICAL ASSISTANCE FOR THE NETWORK:</u> Provide framework, content and expertise for ongoing Technical Assistance to the Network members & NC DPI. Deliverables will include:

1) Manage the creation of content framework and STEM expertise for Network Technical Assistance*, including:
   a) Monthly Webinars on Effective STEM Practices
   b) Strategic planning to support districts connecting current STEM programs with existing and new programs across K-12 to reach NC's Race to the Top STEM goals. Support will include access to STEM partners, leaders and educators for districts in all seven economic development regions, through both virtual and face-to-face components.
   c) Recommendations for web-based communication platform and/or tools* for network members, to include:
      i) Existing and emerging collaborative tools and social media applications have been underutilized in the education sector. In order to scale innovative practice from the STEM anchor schools and STEM network districts and schools, Collaborative tools and social media applications should be deployed in a strategic and proscriptive manner. NC STEM will survey the existing the tools and applications deployed throughout the K12 enterprise in NC and make recommendations for employing these tools and applications in a manner to assist scaling of innovative practice.
      ii) When possible, technical assistance (webinars, etc.) will occur utilizing existing technical infrastructure of NC DPI or its partners.
   d) Facilitated meetings for NCDPI to review STEM Network and partners' efforts and progress
2) Developing research-based tools, modules & templates to assist LEA's in creating community support for effective practices
3) Researching and communicating effective STEM practices from districts, RttT and the Network

Recruiting and managing out-of-state investments in DPI's innovation efforts

1. DEVELOPING A RESOURCE PLAN: The plan will include:

a. At the direction of NCDPI, NC STEM will deliver a STEM Operational Plan, collaboratively developed with NC DPI Race to the Top leadership and key STEM partners, including NC New Schools Project, to align STEM across the four pillars of Race to the Top and set NCDPI STEM goals for 2014.
b. A vetted list of NCDPI priority projects/practices for resource recruitment. (See page two for expectations of current priority focus for the first year consideration.)
c. Approved process for recruitment and dispersal of public and private funds for network
d. A coordinated plan, design, logo and collateral materials for NC STEM, NC DPI and Network

2. RECRUITING INVESTMENTS: Identification of potential partners and assisting NCDPI to secure investments to spread effective practices, including:

1) Educating federal and out-of-state partners on needs and opportunities, including:
   a) Coordinating at least 3 in-state meetings for NCDPI and leadership
   b) Coordinating up to 3 out-of-state meetings or study trips for NCDPI and leadership (NC STEM facilitation, travel included. NC DPI attendees travel not included.)
   c) Attendance at up to 3 national conferences, convenings for NC STEM, NCDPI or network members (NC STEM staff registrations, travel and coordination included. DPI or network registration, travel not included.)
2) Grant application support for NCDPI and/or network members, including resource connections, letters of support, and up to 2 application reviews

3. MANAGING OUT-OF-STATE INVESTMENTS: Serve as public-private partner for distribution of resources raised in this recruitment. This includes matching the human, technical and financial investments to specific programs, and coordinating the State's K12 innovation projects. *(These projects will require incremental funding from RttT or other investors.)*

The scope of work exceeds the contracted amount from DPI. Private sector partners (including Battelle Memorial Institute with support from the Bill & Melinda Gates Foundation) have committed $500,000 in financial and infrastructure support to MCNC to support the efforts of NC STEM in 2011. The committed funds seed and support the activities outlined in this scope of work and will be used prior to the close date of this contract.

NC STEM will continue to identify opportunities for public and private sector support for the future maintenance and activation of this scope, future funding will be based on performance, need and other factors. No commitments beyond the close date of the contract for any party are legally or otherwise implied.

Accountability: NC STEM will provide monthly reports, as directed by NC DPI, of progress, resource opportunities, and network efforts, and welcomes measures and evaluation by NC DPI on these deliverables.

Budget Notes

1) *The deliverables above are for the contract period only, concluding February 29, 2012.*
2) Funding must be obtained for managing the network for efforts to continue in future years.

3) Resources for implementing projects are NOT included in this contract. The expertise, size and scope of implementing priority projects on the network will vary. Resources recruited for scaling priority projects across the network of districts must include additional incremental funding for the management of the network during project implementation(s). This applies to current and future years.

Priority Project/Practices List will be determined in contract period. Based on discussions with NC DPI, existing considerations include:

Priority Project	Reference	State Board Priority	Potential Metrics
Literacy By Design	BMGF College Ready Tools	1.1	# Schools, # Students, #Teachers receiving PD/TA
Explorer Plan ACT Diagnostic Assessments for STEM Acceleration	ACT/College Board	1.2	Students, Districts, Interventions
Student Survey tool(s) for Effective Teaching Measures	Ron Ferguson, Harvard University Steve Cantrell	2.2	Questions, Integration with Existing, Response Rate, Outcomes
"Preparation for Tomorrow" Integrated STEM	Southern Regional Education Board (SREB)	1.0	Pilot Districts

Appendix E. Agenda for the Anchors Away Professional Development Event

Anchors Away
June 18 – 21, 2012

Outcomes:

- Develop a shared understanding of the roles of an anchor
- Consider beginning steps of development as an anchor
- Select a focus area for leadership (year 1) (component, focus area, leadership area) (participate in phase one anchor network development)

Monday, June 18

Breakfast	All	8:15 a.m.
Welcome and Introductions	Tony Habit President	9:00 a.m.
Review and seek understanding around the Outcomes, look at four days of work, phase one of anchor development	Dana Diesel Wallace Vice President, School Development	9:10 a.m.
K/Q/L Activity	Sofi Frankowski Senior Program Director	9:30 a.m.
Refining the roles of an anchor	All	9:50 a.m.
Investigating focus areas for anchor leadership	STEM Team Led by: Rebecca Stanley Program Director	10:10 a.m.
Lunch		12:00 p.m.
Create rubrics for focus areas	Robin Marcus Program Director	1:00 p.m.
Break		3:00 p.m.
Framing the Study Visit	Diesel Wallace	3:15 p.m.
Adjourn		4:00 p.m.

Outcomes:

- Shape a vision for what is possible related to one or more of the five anchor focus areas
- Learn and identify strategic steps to accelerate the development of one or more of the five focus areas in the anchor schools
- Articulate key takeaways to inform the refinement of the rubrics for one or more of the five focus areas
- Network with peers in similar school environments as well as with other STEM professionals and stakeholders from North Carolina and across the nation

Guiding Questions:

- How is technology used to create collaborative communities that breakdown where and when school traditionally happens?
- What opportunities are given to students to use technology in ways similar to the uses of STEM professionals?
- What evidence is there of a rigorous and relevant STEM curriculum for all students?
- To what extent and in what ways is the school theme pervasive?
- How do students demonstrate proficiency in both academic content and 21st century skills?

<u>Monday June 18 (Evening)</u>

Board Shuttle to RDU Airport from NCNSP	All	4:15 p.m.
Latest possible check-in for flight at Terminal 1 of Raleigh-Durham International Airport (RDU)	All	5:00 p.m.
Depart RDU for Philadelphia International (PHL) airport on US Airways Flight #1093 • Dinner at choice location in airport	All	5:56 p.m.
Arrive at PHL in Philadelphia	All	7:25 p.m.
Depart PHL for Newark Liberty International (EWR) airport on US Airways Flight #750	All	8:55 p.m.
Arrive at EWR in Newark	All	9:54 p.m.
Depart for hotel in Eatontown, NJ	All	10:30 p.m.
Arrive at Courtyard by Marriott Tinton Falls (Eatontown)	All	11:00 p.m.

Tuesday, June 19

Breakfast at hotel – *will receive voucher at check in.*	Independently	8:30 a.m.
Depart from hotel in Eatontown, NJ	All	9:35 a.m.
Arrive at High Technology High School (HTHS) Lincroft, NJ • Meeting with Principal Daniel Simon • Q& A session w/ teacher (TBD) • Guided tour of facility	All	10:00 a.m.
Lunch on your own	All	12:15 p.m.
Depart for Monmouth County Vocational School District (MCVSD)	All	1:30 p.m.
Arrive at MCVSD • Meeting w/ Superintendent or Asst. Superintendent	All	2:00 p.m.
Depart for hotel	All	3:15 p.m.
Arrive at hotel	All	4:15 p.m.
Group Networking Dinner at Bogart's Bistro Bar and Grill (across from hotel)	All	6:00 p.m.

Wednesday, June 20

Breakfast at hotel *Will receive voucher upon check in*	Independently	
Depart from hotel	All	9:00 a.m.
Arrive at Biotechnology High School (BTHS) Freehold, NJ • Meeting w/ Principal Linda Eno • Tour of facility	All	9:30 a.m.
Depart BTHS for EWR Airport	All	12:30 p.m.

Arrive at EWR Airport and Lunch	All	1:30 p.m.
Depart EWR for Douglas Airport (CLT) on US Airways Flight #720	All	3:30 p.m.
Arrive at CLT	All	4:49 p.m.
Depart CLT for RDU on US Airways Flight #1915	All	6:00 p.m.
Arrive at RDU and adjourn for day	All	6:54 p.m.

<u>Thursday, June 21</u>

Seeing what we saw and present key findings	All	9:00 a.m.
Refining Rubrics	Matt Sears Program Director	10:00 a.m.
Gallery Walk	De McKenzie Program Director	11:00 a.m.
Refining Rubrics	Rebecca Stanley	11:30 a.m.
Lunch		12:00 p.m.
School teams (where are our strengths, how do we share, what does this mean for us)	Jodi Anderson Director, NC Center for Educational Development	1:00 p.m.
Reflection – K/Q/**L**	Lynne Garrison Vice President, Strategic Partnerships and Engagements	2:30 p.m.
Next steps and deadlines, where does this fit in with larger cycle	Diesel Wallace	3:00 p.m.
Adjourn		3:15 p.m.

Site Descriptions:

Biotechnology High School (BTHS) is the newest member of the Monmouth County Vocational School District's (MCVSD) Career Academy division. MCVSD Academies are a collection of theme-based public schools. The life science theme emphasizes scientific research, critical thinking, problem solving, technology, and team work. BTHS has articulation agreements with New Jersey universities as well as internship partnerships with many top bio/pharmaceutical companies in the state.

For more information, please visit the school website at www.bths.mcvsd.org/

High Technology High School is a specialized school concentrating on the disciplines of science, mathematics, and technology. The school is located on the campus of Brookdale Community College. It is a pre-engineering career academy that emphasizes the interconnections among mathematics, science, technology, and the humanities, and it prepares students to become creative problem solvers, effective communicators, and tomorrow's leaders through a rigorous, specialized curriculum and collaborative partnerships.

For more information, please visit the school website at www.hths.mcvsd.org/

Appendix F. NCNSP's Descriptions of Common Instructional Framework in Math and Science Classrooms

NORTH CAROLINA NEW SCHOOLS PROJECT

Common Instructional Framework and *Core-Plus Mathematics*

Strategy	Attributes in a Mathematics Classroom
Collaborative group work	• Students work in pairs or groups of 3 or 4 • Students have defined roles [see sample group role cards] • Guidelines for collaborative group work are communicated to students [see Core-Plus Mathematics Course 1 Teacher Resources on TeacherWorks CD] • Activities incorporate individual and group accountability • Teacher circulates, using this time to assess students' understanding
Writing-to-Learn	• Daily low stakes writing (worth little to no part of course grade; focus is on practicing and developing writing skills) • Prompts may come from the Reflection section of the On Your Own tasks in the text, or students may develop skill in writing mathematical explanations (how) and/or justifications (why) to support problem solutions [Note: writing explanations and justifications in mathematics may include combinations of words, symbols, tables, graphs and/or diagrams; however, at times it is appropriate and beneficial to request an answer in a complete sentence] • Students receive feedback on how to improve written responses and the opportunity to revise writing [see constructed response (CR) feedback form] • Helps teacher see level of understanding or confusion
Questioning	• Elicits student thinking, makes student reasoning public • Asks students to make conjectures • Presses students to explain and justify their responses • Asks students to evaluate claims • Focuses on process more than on the answer • Probes for evidence of understanding • Asks students to make connections to previous knowledge or experience • Encourages student-to-student discussion • Provides plenty of wait/processing time

Strategy	Attributes in a Mathematics Classroom
Scaffolding	• During the launch of an activity, vocabulary is discussed, task expectations clarified, relevant background knowledge elicited and reviewed • Student ideas are solicited for how to start or restart on a task • Teacher monitors student frustration and engagement levels and asks questions to help students get unstuck or refocused—starting with general, open questions and gradually simpler or more guiding questions until students are challenged to think at an appropriate level, without reducing task complexity • Students are allowed adequate time to grapple with tasks before the most minimal effective assistance is offered • Teacher plans include subquestions for complex investigation tasks • High level performance is modeled by students, with teacher support • As multi-day lessons and daily investigations unfold, activities progress from more structure to less, moving from more frequent whole class discussion and shorter launch-explore-share & summarize cycles to more extended group work and longer launch-explore-share & summarize cycles
Classroom talk	• Focus on building a shared understanding of mathematical ideas • Students share diverse strategies and ways of thinking; students make connections among diverse approaches • Students listen to, question, and respond to one another • Students use mathematics to support or challenge a claim • Teacher listens and facilitates student-to-student discussion • Students may be in small groups or discussing as a whole class
Literacy groups	• Students read daily, whether they are reading the sections of the text or provided materials that establish context, or articles about math or data. • Students are assigned roles to facilitate interpretation, analysis, and discussion of readings.

Common Instructional Framework in Science

Strategy	Attributes in a Science Classroom
Collaborative Group Work	• Students work in pairs or groups of 3 or 4 • Students have defined roles • Guidelines for collaborative group work are communicated to students • Activities incorporate individual and group accountability • Teacher circulates, using this time to assess students' understanding
Writing-to-Learn	• Daily low stakes writing • Writing is used as a mechanism to enhance fluency of scientific terminology • Students reflect on their learning and make connections to the real world • Helps teacher see level of understanding or confusion
Questioning	• Elicits student thinking, makes student reasoning public • Presses students to explain and justify their responses • Asks students to evaluate claims • Probes for evidence of understanding • Asks students to make connections to previous knowledge or experiences • Encourages student-to-student questions • Provides plenty of wait/processing time
Scaffolding	• Students' prior knowledge is elicited and built upon • Students participate in shared concrete experiences to gain prior knowledge through direct observations • Student ideas are solicited for how to design investigations • Teacher monitors student frustration and engagement levels and asks questions to help students get unstuck or refocused – starting with general, open questions and gradually simpler or more guiding questions until students are challenged to think at an appropriate level, without reducing task complexity • Students are allowed adequate time to grapple with tasks before the most minimal effective assistance is offered • Teacher plans include subquestions for complex investigation tasks
Classroom Talk	• Focus on building a shared understanding of scientific ideas • Students share diverse strategies and ways of thinking; students make connections among diverse approaches • Multiple representations of knowledge are valued • Students listen to, question, and respond to one another
Literacy Groups	• Students read daily, whether they are reading sections of text, scientific journals, or other print and electronic resources about science • Students are assigned roles to facilitate interpretation, analysis, and discussion of readings

Appendix G. Scope of Work for STEM Curriculum Development

To develop 16 curriculum courses with authentic assessments for four year-long courses in each of the four STEM areas:

- Agriscience and Biotechnology
- Health and Life Sciences
- Aerospace, Security and Automation
- Energy and Sustainability

REQUIREMENTS *

The 16 courses must include all of the following 14 conditions per course:

1. Clearly defined standards and clarifying objects.
2. 150 hours of instruction.
3. Designation of alignment with the following new standards implemented for the school year 2012-2013:
    a. Science Essential Standards
    b. Technology Essential Standards
    c. Engineering Standards
    d. Mathematics Common Core
    and
    e. English Language Arts Common Core
    f. Other Essential Standards as appropriate in courses in Arts, Career and Technical Education, Healthful Living, Music, Social Studies, World Languages.
4. Modular curriculum components available for inclusion in other courses in the Standard Course of Study
5. Inquiry-based units including all clarifying objectives. Multiple objectives may be used in a unit with a minimum of three units per course.
6. Digital content used throughout the course (including video, computer animations, graphics, and other media).
7. Units of concern to high school students in finding solutions in a global society.
8. Courses reviewed and supported by industry experts, museums, postsecondary education, research centers, and other STEM-capable community partners.
9. Authentic assessments developed for each unit and course.
10. Grand Challenges of Engineering used as appropriate in units.
11. Postsecondary education and career opportunities in STEM in each unit with a consideration for assisting the underserved especially females, minorities, and economically disadvantaged.
12. Courses reviewed by appropriate school personnel in the twenty schools in Race to the Top (RttT) and other interested schools offering the applicable courses in the four STEM areas identified in the Scope of Work.
13. List of curriculum writers and a separate list of curriculum reviewers by course.
14. Review and approval by NCSBE Project Coordinator of all courses. NCSBE Project Coordinator will send written approval of courses by date listed in Attachment B.

Appendix H. NCNSP Vision for Partnership Engagement

NORTH CAROLINA NEW SCHOOLS PROJECT

Private Sector Engagement in STEM Affinity Networks

Involvement by business and industry partners sustains the relevance of teaching and learning in STEM schools. Participation in North Carolina's STEM affinity networks by business and industry strengthens the state's workforce development pipeline by extending student learning to the world of work.

As students engage in authentic projects relevant to the current and emerging economy and gain experience through involvement with business and industry, they become better equipped for the jobs of the future.

As teachers become more connected with the private sector through externships and work with industry professionals on classroom projects, they are better equipped to bring the world of work into the classroom, improving teaching and learning and ensuring that students graduate college- and career-ready.

The North Carolina New Schools Project (NCNSP) values deep engagement by business and industry and higher education partners in STEM schools. Partnerships linked to effective teaching and to deep student engagement are the top priority for NCNSP. To prioritize business and industry engagement, NCNSP has developed definitions for Tier One and Tier Two activities:

Tier One Activities

Tier One activities are partnerships that offer direct alignment with the instructional outcomes of STEM schools, especially the focus on inquiry and project-based learning. NCNSP directs most of its resources to advance activities that provide a high-leverage impact on teaching and on student learning. Examples might include:

- **Structured teacher externships** to provide teachers direct experience in the corporate environment, enabling them to develop curriculum suited for project-based learning and to reflect the world of work in the classroom.
  STEM workplace experts co-designing with teachers authentic projects or problems for students and serving on panels to judge or evaluate student presentations.

- **Work-based learning activities**, such as field studies, int**ernships, and research** opportunities with scientists.

Tier Two Activities

Tier Two activities are partnerships that are general or supportive of STEM schools but not deeply connected to teaching and learning. Examples might include:

- **Career awareness activities,** such as job shadowing, career fairs, mentoring, or advising career-oriented clubs
- **Career preparation coaching,** such as resume-writing and mock job interviews
- **Field trips,** special events, classroom speakers or other general STEM-related activities

NCNSP's vision is to ensure that every North Carolina student graduates ready for college, careers, and life. We are focused on school and district transformation and human capital development to prepare teachers, school and central office administrators to deliver educational services aligned with new economic realities. We leverage networks of schools and deep ties to higher education and the private sector to prepare students for the high-skilled, high-wage jobs of the emerging economy.

Appendix I. Stories about Partnerships Published by NCNSP

Summer Externships Help Teachers from Innovative Secondary Schools Connect Classrooms to the Workplace

By Todd Silberman, NCNSP (July 26, 2012)

Few buzzwords in education are more popular these days than "relevance." Students demand it. Schools struggle to convey it. Employers expect graduates who understand it.

Teachers from schools across North Carolina – including several that are partners with the NC New Schools Project (NCNSP) – are getting valuable lessons in relevance themselves this summer though first-hand experience in the "real world" of math and science. Through exposure to working science labs, day-to-day operations of big-league employers and the inner workings of public service organizations, teachers are gaining perspective to help students bridge the gap between the classroom and the workplace.

They're using what they're learning, along with the connections they're making with experts in their fields, to develop lessons to engage their own students and to share with other teachers and schools.

Kirk Kennedy has spent nearly 20 years teaching high school biology in rural Duplin County, where his students are more likely to associate agriculture with driving a tractor than with the science behind genetically modified crops. For two weeks this summer, Kennedy worked beside scientists at BASF in Research Triangle Park. One week he was seeing biotechnology in action; the next it was agriscience.

"My students can have an opportunity for jobs like these," said Kennedy, who teaches at East Duplin High School. "They don't know about them. I've lived in Duplin County for 41 years, and when I've seen signs marking fields, I didn't realize I was looking at genetically modified crops."

As one of three teachers from NCNSP partner schools with externships through the Kenan Fellows Program for Curriculum and Leadership Development at NC State University, Kennedy has also gained from opportunities to network with other teachers.

"I'm able to meet other educators from across North Carolina who share the same passion," he said. "The big thing about Kenan Fellows is developing a network with other teachers and professionals, like the scientists at BASF."

Sean McAdams, a research manager at BASF Plant Science who worked with Kennedy, said the externship was productive for everyone involved.

"Kirk is genuinely enthusiastic and eager to use the information he gained from the visit," McAdams said. "He's intelligent, passionate about science education and is committed to being an effective teacher. I can speak for many of the 20-plus scientists that he met with when I say that we would welcome the opportunity to participate in the program again. It allows us to contribute to science education in our community and share the chemistry that we create at BASF."

Through NCNSP's partnership with the Kenan Fellows program, the three teachers each represent schools with a particular focus in STEM (science, technology, engineering and math): health and life sciences, biotechnology and agriscience and energy and sustainability. They will share the project-based lessons they're developing this summer with other schools that are partners with NCNSP.

For Carrie Horton, who teaches English at Wake NC State University STEM Early College High School, spending two weeks at Progress Energy in downtown Raleigh has given her lots of good ideas for helping her students connect skills needed for communication to the school's broader focus on the theme of energy and sustainability.

Horton worked in a department of the utility focused on energy conservation and alternative energy, which she said is a good fit for the project-based lesson she's developing that will include a public awareness and marketing campaign students will develop to promote residential energy conservation and efficiency.

"Working in a STEM school has really changed the way I teach," Horton said. "It's changed the way I think about how all the subjects are connected." At Progress Energy, Horton said, she's gotten valuable perspective on those connections and on how the kinds of skills she teaches are applied. "They must know how to write to different audiences. They have to do reports on compliance. They must understand policy and how policy really drives things. They need to be able to communicate well."

Vance Kite is developing a project-based unit in public health for his school, City of Medicine Academy in Durham, as part of an externship at NC Prevention Partners, a Chapel Hill-based nonprofit focused on public health issues.

"The biggest benefit is the resources that I can now draw on," Kite said. "I made really good connections with people who can help throughout the year. And from an instructional stand point, it helped define what should be in the course."

The experience also gave him a concrete perspective on the kinds of skills seen as critical for high school graduates, such as the importance of writing, quality of presentations, the importance of being able to work collaboratively on a team, the ability to form connections and networks.

Kelly Estes, who taught earth science last year at South Granville High School of Health and Life Sciences, is seeing how science is applied at the National Institute of Environmental Health Sciences in Research Triangle Park during a six-week externship.

"It's been really awesome," Estes said. I'm getting a good understanding of what basic research is and what NIEHS offers that I can take back to classroom and translate for my students.

"Hopefully that will help make the content relevant to them," she said, "to be able to learn about what's going on in our science world right now. I want to make my kids excited about science. There are so many different career paths they can follow."

Other teachers from NCNSP partner schools participating in externships this summer:

Leigh Ciancanelli, Wake NC State STEM Early College High School, at ABB, also in partnership with the Professional Engineers of North Carolina; as well as Erin Cyr, Early College EAST, Havelock, at the U.S. Army Research Laboratory at Aberdeen Proving Ground, Maryland, through an Army educational outreach program called Gains in the Education of Math & Science.

The North Carolina New Schools Project is a statewide public-private partnership that sparks sustainable innovation in North Carolina secondary schools. Its vision is to ensure every student graduates ready for college, careers and life. The North Carolina New Schools Project partners with school districts, businesses and higher education to link innovation in education to the emerging economy. NCNSP administers the early college high school initiative in cooperation with the State Board of Education and the NC Department of Public Instruction.

Lesson from the Field: Why Science Matters

By Kirk Kennedy, East Duplin High School (August 15, 2012)

What do a chemical company in the Research Triangle Park and a biology classroom in Beulaville in rural Duplin County have in common? That is the question I was asking myself before entering into a two-week externship this summer with BASF. But after working with the scientists there, it became clear that they - like my own students - conducted experiments and recorded observations on a daily basis. Though I always knew that the skills I teach my students are important ones, now I know that they are also relevant with real-world applications.

I was awarded the opportunity to observe at BASF after being selected as a Kenan Fellow through a partnership with the NC New Schools Project and the NC Department of Public Instruction. My work with the fellowship requires me to construct a project-based lesson on genetics, and BASF is a rich environment to study biotechnology in action. While I observed a great deal of work in the field of genetics, I took away a great deal more that I can share with my students. The first thing I noticed when entering BASF was that science concepts such as gene mapping, cloning, gel electrophoresis, experimental design, and many others were actually being used in the "real world." This was the first time I had ever seen "real" science taking place outside of the classroom. Now, I can do more than just tell students about gene mapping, cloning, and recording observations, I can give them examples of how it is being applied.

One of the biggest questions I get from my students is, "Why do I need to know this?" or "Why is biology important in my life?" Students want to see that what they are learning in the classroom has a direct impact and relevance in their lives. If I can help make this connection, their interest and desire to learn takes a real jump. Teachers don't often see techniques and concepts that they are teaching applied in the workforce. The externship allowed me to see actual science practices, such as the scientific method, experimental design, and other science techniques taking place outside the classroom. I believe that being able to experience this will allow me to make connections that I have never made before for my students. For example, scientists at BASF keep a lab book where they record their observations and data. These lab books become legal documents that could mean the difference in millions of dollars for the company if a dispute occurred or are simply used to trace how certain genes have been created and tested. In the classroom, I plan on stressing the importance of keeping good records and creating accurate lab reports by making references to what I saw at BASF.

Not only will my students benefit indirectly from the scientists at BASF, they may also be able to interact with these professionals directly. One of the most important resources I acquired during my time at BASF was the network of professional contacts. I feel confident that most of the scientists I worked with would be willing to collaborate with me when I am developing new projects and experiments for my classes. Perhaps even more exciting is the possibility of them skyping with my students. Giving a group of teenagers from rural North Carolina a chance to talk to a scientist who works in the field could help to make their world just a little bit bigger.

But the most lasting lesson for me was an introduction to potential job opportunities available to my students when they graduate from college. I will be able to tell them about jobs they can get with a biology degree other than becoming a doctor. Most of my students' favorite part of biology class is the experiments. If they chose to pursue a job at BASF or in a laboratory elsewhere, they can do experiments everyday for a living. In a word, that's relevance.

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