Consortium for Educational Research and Evaluation–North Carolina

Race to the Top Evaluation: STEM Affinity Network

Third-Year Report

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Executive Summary

Overview of the Evaluation and Progress Made since the Last Report

This third annual report on the North Carolina Race to the Top (RttT) STEM initiative documents ongoing implementation of the initiative in participating anchor and affinity schools and assesses intermediate outcomes for students and staff in the third year of implementation.

Two research questions guide the evaluation:

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 network schools in the third year of implementation?

In addition, this report notes recommendations from the Year 2 evaluation report that were addressed during the second year of implementation. In particular, the Implementation Team:

- Created additional opportunities for staff in network schools to interact online through Edmodo professional development networks and Twitter chats; and
- Added a number of online professional development opportunities, such as webinars for principals and counselors, and virtual sessions for Secondary Lenses on Learning course.

Findings and Recommendations[1]

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 anchor and affinity schools, as intended. While all four areas of implementation have received attention from the Implementation Team, some progressed more than others. In many cases, there are components within each area that moved faster or slower relative to other components. Additionally, staff and student surveys reveal that after one year of implementation, a subset of the affinity schools (the comprehensive schools) lag behind the anchor schools and the other affinity schools (small new schools and STEM Academies) in all four areas of implementation, as well as in intended student outcomes.

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

- The greatest amount of activity on the online networking platform Edmodo was produced by the two new content-focused networks (created by NC New Schools staff in fall 2012) and two school networks composed of teachers and students.

[1] A response from North Carolina New Schools to these findings and recommendations is included in Appendix J of the main report.

- Twitter chats, a newly-introduced mode of communication among schools, have been successful in attracting participants and fostering discussion of STEM-related topics.
- Staff in two Local Education Agencies (LEAs) that adopted the RttT STEM initiative for their high schools LEA-wide saw increased collaboration among those schools.
- Overall, one year into the project, teacher surveys indicate that the rates for both face-to-face and online collaboration among schools were not high. Networking among RttT STEM schools lagged behind implementation of other initiative components.
- The extent of face-to-face networking and collaboration was higher than the extent of online networking.
- While teachers and principals found face-to-face networking at various professional development events very valuable, they also found these encounters too brief to provide a basis for the subsequent ongoing collaboration.

Recommendations:

- To increase networking among school staff, the Implementation Team should continue to explore various online modes of communication—such as online follow-up sessions to professional development events and online groups created by instructional coaches—for follow-up after face-to-face visits.
- To increase collaboration among school staff, the Implementation Team should consider facilitating cross-school working groups that have a common goal of creating products for the participants' schools, such as unit plans, common authentic assessments, or planning extra-curricular STEM activities.
- To address geographical isolation of rural schools, the Implementation Team should consider facilitating collaboration within themed networks by combining face-to-face and online modes of collaboration.

II. Professional Development

- Schools are continuing to receive the professional development and coaching services outlined in the RttT scope of work. Based on staff surveys, 86% of staff participated in workshops or professional development offered by NC New Schools Project, and 70% of staff participated in instructional coaching provided by STEM network coaches.
- In most cases, both participants and outside observers perceived the professional development to be relevant and in the medium to high range of quality (3.4 on a 5-point scale). In many cases, the Scaling STEM Conference and on-site professional development at one particular school lowered the average observational quality ratings.
- Sessions at the Scaling STEM Conference received the lowest average ratings (2.67) among all observed professional development events on three of the four indicators for STEM content quality, as well as on the quality of design, implementation, and culture of professional development.
- Instructional coaching in STEM schools mostly focused on the Design Principles and Common Instructional Framework (CIF), with much less attention paid to student project

work or to developing each school's STEM theme.

- Challenges and barriers related to professional development included:
  - Providing effective professional development to all teachers;
  - Limited high-quality coaching time; and
  - Lack of sufficient time for teachers to effectively implement and explore new instructional strategies in the classroom.

Recommendations:

- The Implementation Team should consider expanding opportunities for participants to engage more actively during sessions at future STEM Conferences.
- The Implementation Team should consider increasing the flexibility of the coaching content based on each school's specific needs, as well as either increasing the amount of STEM-specific coaching or combining CIF with STEM-specific coaching.
- The Implementation Team should consider new ways of bringing the most essential professional development events (such as the New Teacher Institute, Critical Friends Group, or Common Practices Symposium) to all teachers in each school. For example, the Team could increase coaching efficiency by coaching teachers in teams in addition to individually.
- The Implementation Team should consider devoting more coaching time to lesson- and project-planning that incorporates new instructional strategies.

III. Development and Implementation of Project-Based Curricula

- Curriculum design work was completed in accordance with the contract awarded to the North Carolina School of Science and Mathematics (NCSSM) by the North Carolina Department of Public Instruction (NCDPI).
- Reviews by non-participating STEM teachers of the newly-developed STEM curricula point to many strengths as well as areas for improvement of the materials.
- A number of anchor and small new schools are developing integrated STEM courses that parallel those being developed by NCSSM.
- Implementation of the newly-developed curricula presents the following challenges:
  - Finding opportunities to pilot test STEM courses with targeted population of students and teachers and to fine-tune them to better serve the needs of the users.
  - Finding teachers with the right background knowledge to teach Career and Technical Education courses with the intended levels of rigor and depth of STEM content coverage.
  - Finding ways to provide necessary professional development for teachers of STEM courses to familiarize them with the new themed content and the new teaching strategies these materials call for.
- NC New Schools devoted a number of sessions in professional development events to the four STEM themes, to project design, and to project-based learning. NC New Schools also

conducted a special event to bring together STEM curriculum developers and users.

- One year into the initiative, the majority of teachers have not yet participated in the development of STEM cross-curricular projects. Participation was much higher in the anchor and small new schools.

Recommendations:

- To address concerns about the level of rigor in math and science covered in the integrated courses, the Implementation Team should consider including in the Teacher Guide a clear guidance to schools on the level of rigor in STEM content areas teachers of these courses are expected to provide.
- The Implementation Team should consider finding opportunities to conduct pilot testing of the integrated STEM courses and curriculum revisions before making the courses available for broader use.
- To address the issue of finding qualified teachers with sufficient background knowledge for teaching integrated courses, the Implementation Team should consider including in the Teacher Guide a clear description of the background teacher knowledge desirable for teaching each of the courses to provide guidance to schools implementing these courses. Additionally, the Implementation Team should consider offering multiple ways to implement these courses (e.g., via team-teaching).
- The Implementation Team should consider finding ways to provide necessary professional development for prospective teachers of STEM courses to familiarize them with the new themed content and the new teaching strategies these materials call for.
- To address the duplication of efforts by the various organizations and schools that are developing integrated STEM curricula, the Implementation Team should consider conducting regular meetings of curriculum developers to encourage collaboration.

IV. Partnerships

- Industry Innovation Councils for each of the four themes met quarterly to plan and provide support for the networks; additionally, various business partners also supported teachers and students in a variety of ways (e.g., student internships, teacher summer externships, etc.).
- One year into the program, most staff in the 20 affinity schools have not yet participated in a collaborative activity with partners, such as collaboratively designing a unit or project for the classroom. Anchor schools participated in partnerships at a higher rate than did other schools.
- Three of the affinity schools visited by the Evaluation Team established their own partnerships with local businesses and colleges. The initiative strengthens the focus and breadth of these partnerships.

Recommendation:

- To increase levels of participation in partnerships with businesses, the Implementation Team should consider helping schools to set up certain goals and foci for such collaborations and to facilitate sharing of successful stories of collaborations with staff in every participating STEM school. Webinars or online chats may be conducive to engaging a wider audience.

V. Student and Staff Responses to Implementation and Outcomes Surveys

Survey responses from students in 20 STEM network schools suggest that one year into program implementation:

- Many students placed a very high value on learning in general and on learning mathematics in particular. Students had a moderately high level of confidence in their ability to be successful in their studies of mathematics, science, and technology. Areas with the most room for improvement include: enjoyment of learning (in general, and of STEM subjects in particular) and student engagement in the engineering aspects of STEM (from initial exposure to development of confidence in learning about engineering).
- The quality of classroom instruction and school culture was mixed. Students generally reported high expectations and care from their teachers and high levels of meaningful use of technology. At the same time, a number of desired activities were not reported as frequent, such as student engagement in cross-curricular or real-life projects, in rigorous instructional practices, or in STEM-related activities supported by the school.
- Student outcomes, the quality of the classroom instruction, and the school culture differed among the types of schools, with students in comprehensive schools consistently reporting lower levels of desired features than did students in anchor schools, small schools, and academies.

Survey responses from staff in 20 STEM network schools suggest that one year into the program implementation:

- Many teachers felt that they were comfortable with many of the target instructional strategies, and implemented them fairly frequently. Additionally, many teachers reported having positive relationships with students.
- There were few extra-curricular STEM activities, additional STEM courses, cross-curricular projects for students, or staff meetings devoted to STEM issues. Staff also reported that not everyone at their school understood what it meant to be a STEM school. At the same time, two-thirds of respondents reported that their schools were focused on a STEM-related goal for students and that their schools emphasized their STEM theme in a number of different ways.
- Staff responses differed among types of schools on many of the dimensions, with staff in comprehensive schools typically giving lower ratings than did their peers on staff-student relationships, meetings about STEM issues, using technology, extra-curricular STEM activities, and STEM vision.

VI. Site Visits to Affinity Schools

- In all of the affinity schools visited by the Evaluation Team, the STEM initiative is in the beginning stages of implementation.

- In all four of these schools, a common vision for the STEM initiative focuses on instructional improvement that includes the following elements:
  - Incorporation of project-based learning; and
  - A focus on the development of students' critical thinking, understanding, problem solving, and communication skills.
- In two schools, staff exhibited a high degree of initiative buy-in. In the other two schools, buy-in is still an area for improvement.
- The primary focus of implementation is on changing instruction to incorporate Common Instructional Framework (CIF) across subject areas; a secondary focus is on development of STEM projects and themes.
- Regarding technology use, a common goal among schools is to shift away from use by teachers and to increase technology use by students.
- The single most notable impact of the initiative on students reported across all schools was an increase in student engagement.
- The challenges for implementation fall into five main categories: 1) logistical, time, and resource challenges; 2) student, faculty, and community buy-in; 3) implementation of STEM curriculum and instruction; 4) sustainability; and 5) relationships with the wider community.

Recommendations:

- To address logistical problems faced by some schools related to transportation, lack of resources for technology and projects, geographical isolation, and lack of time for planning, the Implementation Team should encourage other schools to share their best practices in solving these problems either face-to-face or online.
- To help schools define what this initiative means for the school and to get community, faculty, and student buy-in, the Implementation Team should consider identifying schools and communities with those issues and providing them with more opportunities for visiting model STEM schools.
- To address schools' concerns about the sustainability of funding for program components post-RttT, the Implementation Team should consider including discussions about sustainability in professional development events.

Next Steps

- Continue qualitative data collection and analyses.
- Analyze responses to staff and student surveys that will be collected in fall 2013 and compare them to earlier survey responses.
- Provide a summative evaluation of the initiative's components and intermediate outcomes, as well as recommendations related to the sustainability of the initiative.

Introduction

This report is the third in a series of annual reports for the evaluation of the Race to the Top (RttT) STEM initiative. This introduction provides a brief overview of the STEM initiative, reviews the goals of the evaluation for the third year, and notes how the Implementation Team addressed the recommendations from the second-year report.

Overview of the Race to the Top STEM Initiative

The RttT STEM initiative was comprised of two major components for the period under review in this report:

- Ongoing creation of a network of STEM schools—the primary component of the initiative (North Carolina New Schools [NC New Schools]); and
- Development of STEM curricula (NC School of Science and Mathematics [NCSSM]).

As stated in the North Carolina Department of Public Instruction's (NCDPI's) original RttT proposal (2010) and most recent Detailed Scope of Work (2012), the objectives of the NC New Schools 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."

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. 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 North Carolina Race to the Top Detailed Scope of Work (NCDPI, 2010). The short-term outcomes presented in this figure summarize the current vision for the STEM school and network models, as it relates to students, teachers, and principals in the STEM schools, as well as to the schools themselves and the network overall.

Additionally, NCDPI continued the work of implementing the State STEM Education Strategic Plan, which includes adoption of a STEM Attributes rubric developed with the help of NC STEM Learning Network. In previous years, some of the work of the NC STEM Learning Network was funded under RttT; its work is now sustained by other funds. NC STEM Learning Network activities funded under RttT were evaluated in the Year 2 report.[2] Since that report, not much progress has been made towards providing a web-based platform for communication or collaboration and comprehensive STEM resource database.

[2] http://cerenc.org/wp-content/uploads/2011/11/STEM_Second-Year_Report_FINAL_11_13_12.pdf

Figure 1. RttT STEM Logic Model

Implementation Strategies

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.

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

3. Project-Based Learning Curriculum:

Develop a 9^{th}-12^{th} 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.

4. Partnerships:

Work with Industry and other STEM partners to design, evaluate, and disseminate all digital project resources to a broader range of North Carolina schools.

Short-Term Outcomes

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

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
   - deep discourse, marked by discipline-based justifications
   - creativity building

Principals:

a. Leadership skills described in the Leadership Design Principle
b. Vision for STEM learning

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

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- and second-year reports and covers RttT STEM implementation activities from August 2012 through June 2013.

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

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

While this report addresses material pertinent to all of these goals, it focuses primarily on the second goal of providing a descriptive study and documentation of the implementation of the RttT STEM initiative in participating schools during the third year of implementation. It also focuses on the third goal of intermediate outcomes for students and staff in affinity schools after one year of implementation. Additionally, the report provides formative feedback (Evaluation Goal 1) on the initiative's efforts to design integrated STEM curricula in four themes. Finally, this report summarizes the baseline data on the student and staff surveys designed to evaluate both the short-term outcomes and selected initiative activities.

Specifically, this report addresses 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?
2. To what extent has the professional development for STEM school teachers and principals been implemented as intended?
3. To what extent has the curriculum of STEM schools been implemented as intended?
4. To what extent have the partnerships between STEM schools and institutions of higher education (IHEs), communities, and businesses been developed?

Research Question 2: What are the intermediate outcomes for students and staff in affinity 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; and
   d. Impact on students?
3. What challenges are affinity schools facing as they continue implementation?

Addressing the Recommendations of the Second-Year Report

The Year 2 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 3 relative to the areas of recommendations. The section is organized by the various recommendations made in the second-year report, although not all changes made were necessarily a direct result of findings made at that time.

Initial recommendation: 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 various content- and instruction-related professional development elements into the online space.

Response: The NC New Schools professional development facilitator of the Lenses on Learning workshop series created two online networks for workshop participants. The moderator utilized these networks mainly to post session resources and announcements. Additionally, NC New Schools hosted a series of 12 Twitter chats covering the topics of innovative schools, staff collaboration, and instructional improvement.

Initial recommendation: Professional development has been delivered primarily in face-to-face settings; to leverage professional development and coaching resources and to create incentives for using online networking, the Implementation Team may consider blended professional development.

Response: The NC New Schools added a number of online professional development opportunities, such as webinars for principals and counselors, and virtual sessions for the Secondary Lenses on Learning course. Evaluating the quality of these online professional development opportunities was beyond the scope of this evaluation.

Method

This ongoing evaluation is conducted using a mixed-methods approach. The present report includes both quantitative analyses of the baseline responses to student and staff surveys in STEM network schools and qualitative and descriptive quantitative analyses of the implementation data collected by the Evaluation Team. Below, the methodology is described separately for these two key data sources.

School Sample and Participants

Student and Staff Surveys

The sample for survey analysis includes staff and students from all 20 schools in the RttT STEM Network. A list of these schools (with themes) is provided in Appendix A. In cases in which the whole school started implementation simultaneously, surveys were sent to all staff and students in the school. When principals indicated plans for staggering implementation (as was the case at six schools), the surveys were sent only to those staff who were planning to participate for the full life of the project, as well as to their students. The response rate for students varied by school from 31% to 100% with an average of 72%, and the response rate for staff varied by school from 11% to 100% with an average of 91%.

Implementation Data

Sign-in sheets for the professional development sessions and professional development observations were analyzed for all affinity schools. Site visits were conducted at four affinity schools. After consultation with the Implementation Team, two comprehensive schools and two STEM Academies were selected to represent various themes. In each school, the principal and one math and one science teacher selected by the principal were interviewed. Math, science, and sometimes an additional STEM-related class, selected by the principal, were observed. During the site visits to these schools, evaluators interviewed 21 staff and 29 students, and observed 12 classrooms.

Data and Measures

Student and Staff Surveys

Student Surveys. Based on this evaluation project's Logic Model (included in Appendix A of the first-year report), the RttT Evaluation Team identified several constructs to serve as indicators of key STEM student short-term outcomes. These constructs are included in the student surveys:

1. Attitudes towards school and learning;
2. Perception of school's impact on growth of the students' 21st Century skills (critical thinking, problem solving, technology and work-related skills, communication and collaboration skills, etc.);
3. Perseverance towards school work;
4. Attitudes towards each of the STEM subjects;

5. Confidence in ability to learn each of the STEM subjects; and
6. Interest in STEM-related careers.

Additional student survey dimensions were designed to measure the quality of classroom instruction and school culture:

1. Frequency of experiencing rigorous instructional strategies in different classrooms;
2. Frequency of experiencing relevant instructional strategies in different classrooms;
3. Perception of teacher expectations and relationships;
4. Participation in STEM-related activities; and
5. Meaningful use of technology.

Finally, surveys collected student demographic information, such as gender, ethnicity, and English proficiency status.

Staff Surveys. Staff surveys collected data about staff and school participation in initiative implementation activities, including the following dimensions:

1. Participation in different types of professional development;
2. Networking and collaboration with other STEM schools;
3. Participation in project-based curriculum development;
4. Collaboration with business/community partners related to STEM;
5. STEM vision in the school;
6. Additional STEM classes;
7. Out-of-school STEM experiences for students;
8. Classroom practices related to rigorous and relevant instruction;
9. Classroom practices related to project-based learning and teaching of 21st century skills;
10. Objectives for student learning;
11. Technology use; and
12. School climate.

Additionally, staff surveys collected information on the roles of those taking the survey and, for those who self-identified as teachers, the subject(s) taught.

Both student and staff survey measures are provided in Appendix B.

Implementation Data

The current report incorporates a variety of data sources collected by both NC New Schools and the RttT STEM Evaluation Team. The STEM Implementation Team (NCDPI, NC New Schools, and NCSSM) 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;
- Leadership and instructional coaches' reports of their activities in the schools;
- Agendas and minutes from Industry Innovation Councils and other partnership development meetings; and
- Curriculum materials for the first four integrated STEM 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 affinity schools;
- Interviews with math and science teachers, administrators, and students in affinity schools;
- An interview with NCSSM curriculum developers; and
- Systematic review of posts and interactions on the online networking site Edmodo and Twitter chats.

To evaluate the general quality of classroom teaching, evaluators used the Classroom Assessment Scoring System (CLASS) observational protocol (Pianta, Hamre, & Mintz, 2011). This protocol organizes classroom interactions into 11 dimensions scored on a 7-point scale. Observers take notes using the protocol for 15-minute blocks; each block is followed by a 10-minute period during which observers review and finalize their ratings. As time permitted, observers conducted two observation cycles during each class period.

The Team complemented the CLASS observation protocol with Team-developed scales for evaluating classroom features of interest to this project: the Common Instructional Framework (CIF), quality of STEM classroom instructional practices and formative assessment, quality of inquiry and project-based learning, 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 also were developed for this evaluation. The interview protocols for teachers and administrators were designed to determine 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 for them, and their observations of changes occurring in their schools due to the STEM initiative. The interview protocols for students gathered views on changes occurring in their schools due to the STEM initiative.

A protocol for monitoring the initiative's online networking sites was designed to evaluate the quantity and quality of online interactions among network participants, as well as the nature and topics of these interactions. To evaluate the quality of the integrated STEM courses, a rubric was created that prompts reviewers to provide feedback on the design features outlined in the contract for this work. These features were evaluated for both the extent and quality of coverage.

All new protocols designed for this evaluation are provided in Appendix B.

Procedures and Analyses

Student and Staff Surveys

Students and staff completed surveys either in the spring or fall of 2012. Although many participating schools officially joined the initiative several months before survey administration, implementation of most initiative activities was in a beginning phase when staff and students at those schools completed the surveys. Therefore, we consider this survey a baseline survey of the status of implementation activities and student short-term outcomes. The survey administration scheduled for the fall of 2013 will provide data that will be compared with the data reported here.

All schools were sent links to the online survey, which included a participant consent form. All surveys were anonymous. Passive parental consent was approved by the Institutional Review Board for the student survey, so two weeks prior to survey administration, the information and withdrawal letter was sent home to parents of all students who were later asked to complete the survey. Schools were offered an option for administering the pencil-and-paper surveys, with six schools selecting this option.

After all data were received, the spring, fall, and paper-and-pencil data for each survey were combined, cleaned, and prepared for analyses. Incomplete cases (those that included only incomplete demographic data, cases without participant consent, or cases that left out the participant's school name) were removed from the data set.

Responses from students and staff at each school were categorized into four groups: all 20 RttT STEM schools, anchor schools (4 schools), small new schools and STEM academies (6 schools), and comprehensive schools (10 schools). For some questions, the responses were also analyzed by the themed network. The numbers of schools in each themed network are as follows:

- Aerospace, Security, and Automation: 3 schools
- Health & Life Sciences: 4 schools
- Energy & Sustainability: 4 schools
- Biotechnology & Agriscience: 9 schools

The questions on the survey were designed to represent the constructs described in the *Data and Measures* section. In order to test that these conceptually constructed groups of questions represent statistically coherent scales, exploratory factor analyses were performed. These analyses will serve as a basis for confirmatory factor analyses to be performed on the set of data collected for the final report. Based on these analyses, scales described in the *Data and Measures* section will be revised, and the data from both administrations will be compared on these scales.

Implementation Data

All implementation data sources were analyzed descriptively, with an emphasis on understanding the nature of the work that has been completed thus far:

- The agendas for meetings and professional development events were examined to describe the content and intended outcomes of specific activities. Registration and sign-in lists were summarized to describe school participation levels in different activities.
- The Evaluation Team conducted two-day site visits to a sample of four of the affinity schools. These four schools are referred to in this report by pseudonyms that reflect their STEM themes: *Energy School*, *Greenbrier Agriscience*, *Laurel Agriscience*, and *Health Academy*. Two of these schools (Greenbrier and Laurel) opted for a whole-school implementation, and the other two (Energy and Health) created a new STEM Academy as a separate school within the larger comprehensive school. Energy School and Health Academy refer to these school-within-a-school academies rather than their host schools. During the visits, Team members interviewed math and science teachers, principals, and on some occasions, other teachers and administrators leading the STEM initiative at the school.
- Interviews and focus groups with staff and students at affinity schools were used to gather perspectives on the schools' participation in the network and on the extent of initiative implementation in the schools. Following transcription, these data were then analyzed for information relevant to research questions.
- Classroom observations during site visits to anchor schools were analyzed both quantitatively (ratings) and qualitatively (observer comments and notes).
- Four STEM teachers from a non-participating STEM school were contracted to provide a review of the four integrated STEM freshman courses developed by NCSSM for the initiative. Reviewers used a rubric designed by the Evaluation Team to provide ratings and descriptive notes. An interview with lead developers of integrated STEM courses at NCSSM was used to provide a context for the teacher reviews of these courses and to inform the development of the review rubric.
- Professional development observations were used to describe the quality of professional development provided to teachers and principals in participating schools, as well as face-to-face networking opportunities. On most occasions, the Evaluation Team observed types of professional development events that had not been observed previously by other members of the Team. These observations were analyzed quantitatively and qualitatively.
- Initiative leadership and instructional coaches submitted brief reports after each visit they made to a participating school. From these reports, the Team was able to determine the number of visits support staff made to each affinity network school.
- Analyses of the interactions among moderators and participants collected from the networking website Edmodo and Twitter chats 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 using the protocol developed for this evaluation.

Findings

The findings[3] are organized in six sections, each corresponding to one or more of the Research Questions (RQ):

I. Structure of the Network of STEM Anchor and Affinity Schools (RQ 1.1)

II. Professional Development (RQ 1.2)

III. Development and Implementation of Project-Based Curricula (RQ 1.3)

IV. Partnerships (RQ 1.4)

V. Student and Staff Responses to Implementation and Outcome Surveys (overall RQs 1 and 2)

VI. Site Visits to Affinity Schools (overall RQs 1 and 2)

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

In this section, we describe the extent of online and face-to-face networking and collaboration among principals, teachers, and students. As NC New Schools believes that a combination of face-to-face and online networking is the best solution for teacher learning and collaboration for innovative work, 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 assistance in overcoming the barrier of distance between network schools.

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

- Overall, one year into the project, teacher surveys indicate that the rates for both face-to-face and online collaboration among schools were not high. Networking among RttT STEM schools lagged behind implementation of other initiative components.
- The extent of face-to-face networking and collaboration was higher than the extent of online networking.
- While teachers and principals found face-to-face networking at various professional development events very valuable, they also found these encounters too brief to provide a basis for the subsequent ongoing collaboration.
- The greatest amount of activity on the online networking platform Edmodo was produced by the two new content networks created by NC New Schools staff in fall 2012 and two school networks composed of teachers and students.
- Twitter chats, a newly-introduced mode of communication among schools, have been successful in attracting participants and fostering discussion of STEM-related topics.
- Staff in two LEAs that adopted the RttT STEM initiative for their high schools LEA-wide saw increased collaborations among those schools.

[3] A response from North Carolina New Schools to these findings and the resultant recommendations is included in Appendix J.

This section is organized in three sub-sections:

1. Report from staff survey on face-to-face and online networking;
2. Face-to-face networking; and
3. Online networking.

Report from Staff Survey on Face-to-face and Online Networking

Surveys collected provide preliminary data on implementation in the schools, as well as useful information about program participation in the first year. Two questions on the staff surveys asked participants about the extent of their participation in face-to-face and online networking. These results are reported in Table 1 below. One year into the project, the rates for both face-to-face and online collaboration with other schools were not high. Overall, 56% of staff have not yet participated in face-to-face meetings, and 71% of staff have not yet participated in online collaboration with other schools. When compared by type of school (see Appendix C for more details), the rates of participation for anchor schools were higher than for other network schools: 56% of anchor schools' staff participated in online and 73% participated in face-to-face collaboration with other schools at least once. The extent of face-to-face networking and collaboration was higher than the extent of online networking.

Table 1. Extent of Staff Participation in Face-to-Face and Online Networking.

			Percentage of Respondents who . . .			
Please rate your level of participation in these activities:	**School Type**	*n*	***Haven't yet Participated***	***Participated Once***	***Participated 2-5 Times***	***Participated More than 5 Times***
Online collaboration with other schools through Edmodo	All schools	332	71%	7%	14%	8%
Face-to-face collaboration with other schools at STEM Network events	All schools	333	56%	12%	22%	10%

Face-to-Face Networking

NC New Schools embeds networking opportunities in all of its professional development events and services. It co-sponsored two large events, a national STEM conference (Scaling STEM: Strategies That Engage Minds, held in Durham on March 11–12, 2013) and the Summer Institute (June 24–27, 2013), and also a number of smaller scale professional development events.[4] Each of the two large events gathered about 700 participants from NC New Schools-supported schools and partners, with the first including 44 participants from 18 RttT-funded schools. Participation data for the 2013 Summer Institute are not yet available.

[4] See Table 10 for professional development event attendance.

Staff in affinity schools found these networking opportunities very valuable. In one teacher's words:

> We've had some conferences where we've actually met with our own affinity networks and we've actually had a lot of roundtable activities, discussions, talking about where we were headed, letting our peers from other areas to come in and say, "That sounds great" or "This is what I see but I wonder if you might think about this. There are some things here." And really, that has been more valuable than a lot of . . . you know, it's easy to get out and find resources and people you can talk to, but for someone who's walking the same path with you maybe a little bit ahead that can tell you there's curves coming or whatever. . . . We actually have been in revision meetings with our affinity network and let them peer review our action plans and make recommendations and point out things that we really did not see or things we needed to be more specific about or things that maybe we were too specific about.

Some staff commented that these networking opportunities are valuable not only for learning about and from experiences of other schools that are working towards the same goals, but also for sustaining this initiative: "I think that the support that is offered through the state has been probably what has allowed us to keep moving it."

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 who have been working with NC New Schools for a number of years and can share their experiences and best practices. They also had an opportunity to interact with STEM experts and colleagues from out-of-state schools and other organizations.

At the same time, some teachers felt that the time spent meeting people at events such as the STEM Conference, CPS, and Summer Institute was too brief to provide a basis for the subsequent ongoing collaboration. Networking among RttT STEM schools is still lagging behind implementation of other initiative components. During the site visit interview, one principal noted that there has not been much networking with other schools with the same theme, and that he does not feel as if he is a part of the network. He did not even know which school was the theme anchor school:

> I think the whole agribusiness, health, biotechnology theme, part of everything that we're doing, probably lags behind everything else that's involved in terms of networking with others and all of that. I mean I've not felt a lot of help with that . . . but New Schools stuff, the CIF [Common Instructional Framework], and rounds and all this, that was the big push and STEM kind of came running along behind it and I wish that it had been done differently because that gave the teachers of this view of everything being separate and two separate compartments.

A staff member in Greenbrier Agriscience's LEA confirmed that there has been little collaboration at this point in time:

> We've not partnered a whole lot or collaborated with other schools in this [LEA] except at this summer institute with New Schools. We had a session, I guess it was probably one afternoon, where the network of schools chose the big idea question for the school year. . . . I know [another] County, the high schools there are in the same network there we are and in an ideal world we would have liked to have collaborated with them at all, but definitely more during last summer.

Both comprehensive schools that we visited (Greenbrier and Laurel) are in the Agriscience & Biotechnology network, and both are in the LEAs in which all high schools are members of the STEM affinity network. The collaboration between schools within these two LEAs increased due to the initiative's activities. In both schools, some teachers had an opportunity during the summer to collaborate with other teachers in their LEA due to the summer employment. This collaboration often continued beyond summer, but it did not extend to other teachers in these schools or to those in the network schools in other LEAs. Laurel Agriscience collaborates very closely with the other two high schools in the county—one of which is also implementing a beekeeping project. The principal states that this level of collaboration did not exist in the past, but has grown since the school began its participation in the STEM network and the LEA started implementing an LEA-wide STEM initiative. In words of one of the principals:

> The [three] high schools here in [X] County are . . . involved in the network, so we get to collaborate; . . . it's an ongoing collaboration. And like Mr. [X] said earlier, that was typically not the case. Until last year, three high schools were very competitive and almost to the point where you were sworn to secrecy because that's just the competitive nature of the three schools. Now, that's not totally been removed but we're definitely collaborative and we share ideas all the time.

A staff member at Health Academy commented that the STEM network could benefit from being more tightly connected. Energy Academy and Health Academy are in rural areas, and there are no other schools in their LEAs that are part of the network, and so it has been challenging for teachers to connect specifically with other STEM school teachers:

> If we had more STEM schools that were closer to us or . . . even if some of the professional development . . . were specific to STEM schools, and then even specific by theme. And we haven't had as much of that.

Teachers who did not participate in NC New Schools professional development events or summer employment often report that they are not aware of the network: "[L]et's say the teachers haven't had that opportunity [to network] to a great extent."

Online Networking

Edmodo community. In previous reports, the Evaluation Team indicated that NC New Schools was using Edmodo as the main vehicle for online communication and networking among schools. During this reporting period (August 15, 2012 to May 30, 2013), the online community (Edmodo) hosted several networks, including an overarching STEM Affinity Network, three theme networks representing three of the four anchor schools (Biotech & Agriscience, Energy & Sustainability, Health & Life Sciences); ten content networks (e.g., Chemistry); and eleven school networks integrated by teachers and students (see Table C2 in Appendix C). The STEM affinity network is the largest network (211 participants), but participants are frequently members of more than one network. Two newly created content networks are composed of 93 participants, which is about half the size of all content networks. These two networks were created in fall 2012 by a NC New Schools staff person leading a multi-session professional development course in two different regions of the state. With the exception of the school networks, which are moderated by a teacher, all networks are moderated by one to three NC New Schools staff members.

Network activity during the current period was very limited across networks. The two new content networks and two school networks composed by teachers and students were the networks with the most activity among all networks. Postings on the two new content networks accounted for 90% of all posts in the ten content networks (92% of all moderators' posts and 82% of all participants' posts). Teachers use these networks to communicate with students and to post class resources and assignments; students use them to respond to teacher and classmates' posts, post questions, share resources, and submit assignments. Aside from those four networks, the remaining networks had little or no activity at all (See Table C3 in Appendix C).

The NC New Schools moderator of the new content networks utilized them mainly to post session resources and announcements. Session resources included pre-reading focus questions for four sessions, one session agenda, two Data As a Tool for Assessing the Mathematics Program assignments, the Levels and Components of a Math-Talk Learning Community rubric, a case study, sample student interview/focus group prompts for Math classes, professional development session reflection, and a short video on Team Leadership for Mathematics in Middle and High School. Postings on the two communities did not show much two-way interaction or content-focused discussions; most participants' questions to the instructor were requests for class resources.

Twitter chats. From October 29, 2012 to April 1, 2013, NC New Schools hosted a series of 12 Twitter chats covering various topics, such as Innovative Schools & Public Relations, Making Adult Collaboration Happen, Inquiry Based Learning in Math and Science, and Technology Supporting "Powerful Teaching and Learning" (see Table C4 in Appendix C). These topics received a median of 44 tweets (ranging between 12 and 63 tweets) and a median of 20 replies (ranging between one and 43 replies) from participants and moderators.

In fall 2013, NCDPI released the NC STEM Recognition Application.[5] The STEM Recognition process, along with the Attribute Implementation Rubrics, defines a common vision in a coordinated blueprint for schools to advance STEM Education. A school can self-assess its STEM-related goals for students by using the NC STEM Attribute Implementation Rubric to determine the school's level of achievement. Schools are to apply and share their STEM-themed distinguished accomplishments by submitting narrative evidences addressing each of the eleven Attributes. Schools exemplifying level-of-achievement evidences at the "prepared" or "model" levels will be recognized as STEM schools of distinction.

[5] http://www.dpi.state.nc.us/stem/

II. Professional Development

Overall Findings

In this section, we examine the nature and quality of the professional development provided through the RttT STEM initiative from August 2012 to May 2013. Similar to previous years, the professional development provided by NC New Schools combined a substantial number of out-of-school workshops and conferences with onsite instructional and leadership coaching.

Analyses of the professional development activities reveal the following findings:

- Schools are continuing to receive the professional development and coaching services outlined in the RttT scope of work. Based on staff surveys, 86% of staff participated in workshops or professional development offered by NC New Schools Project, and 70% of staff participated in instructional coaching provided by STEM network coaches.
- In most cases, both participants and outside observers perceived the professional development to be relevant and of high quality.
- Sessions at the Scaling STEM Conference received the lowest average ratings among all observed professional development events on three of the four indicators for STEM content, quality, as well as on the quality of design, implementation, and culture of professional development.
- Instructional coaching in STEM schools mostly focused on the Design Principles and CIF, with much less attention paid to projects or to developing each school's STEM theme.
- Challenges and barriers related to professional development included:
    - Providing effective professional development to all teachers.
    - Limited high-quality coaching time.
    - Lack of sufficient time for teachers to effectively implement and explore new instructional strategies in the classroom.

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

1. Professional development participation rates;
2. Independent observations of professional development events;
3. School-based coaching;
4. Participant perceptions of professional development events and school-based coaching; and
5. Potential barriers and additional supports needed.

Professional Development Participation Rates

During Year 3 of RttT STEM funding, teachers and administrators from the STEM Affinity Network had the opportunity to participate in a variety of professional development activities, including: a) workshops or professional development offered by NC New Schools; b) instructional coaching from the STEM network coaches; c) site visit(s) to other North Carolina schools; d) site visit(s) to national model schools; and e) peer school reviews. Based on responses from the STEM Affinity Network staff survey (see Methods section for more details regarding this survey), Table 2 describes educators' reported levels of participation in the different types of RttT STEM professional development opportunities provided.

Table 2. Participation in Different Types of Professional Development

	Percentage of Respondents who . . . (*n*=333)			
Please rate your level of participation in these activities:	***Haven't yet Participated***	***Participated Once***	***Participated 2-5 Times***	***Participated More than 5 Times***
Workshops or professional development offered by NC New Schools Project	14%	22%	44%	19%
Instructional coaching from the STEM network coaches	30%	22%	32%	16%
Site visit(s) to other North Carolina schools	70%	15%	14%	2%
Site visit(s) to national model schools	88%	8%	3%	1%
Peer school reviews	72%	18%	8%	1%

Overall, the most frequent professional development activities in which respondents reported participating were: workshops or professional development offered by NC New Schools (86% reported participation) and instructional coaching from the STEM network coaches (70% reported participation).

When compared by school type (see Appendix D for more details), staff at anchor schools reported the highest rate of participation in professional development activities, followed by teachers at small new schools and STEM academies, and then teachers at comprehensive schools. These differences are likely to be explained by both the role and start time in the network, as well as the size of the schools.

Based on electronic sign-up sheet data provided by NC New Schools, there were at least 14 professional development events that had two or more STEM Affinity Network schools in attendance during the 2012-13 school year. Table 3 (following page) presents these outside-of-school professional development events as well as the number of RttT network participants and number of schools that attended each event. Overall, the highest number of RttT participants attended the following events: the NC New Schools Summer Institute (113 participants), the Secondary Lenses on Learning series of events (73 participants), the New Teacher Institute (52 participants), and the Scaling STEM Conference (44 participants).

Table 3. Cross-School Professional Development, August 2012–June 2013

Professional Development Event	Dates	Number of RttT Participants	Number of RttT Schools
Secondary Lenses on Learning	September 2012 through April 2013; 16 sessions	73	18
Common Practices Symposium	October 31, 2012 and November 8, 2012; two regional meetings	33	17
Early College Webinar	August 22-23, September 19, and December 12, 2012	4	4
Counselor/College Liaison Support Session	October 17,19, and 24, 2012 and February 20 and 22, 2013	37	15
Counselor Support Webinar	November 21; December 5-6, 2012	6	3
LIN Meeting	September 2012 through February 2013; 12 meetings	39	20
Scaling STEM Conference	March 11, 2013	44	18
New Teacher Institute	September 27, 2012	52	18
Peer School Review	October and November 2012; 8 sessions	41	17
New Principals Institute	September 12, 2012	9	9
Regional Planning Meeting	November 28 and 30, 2012	35	16
NY Study Visit	January 28, 2013; April 25-27, 2013	16	7
LLI Study Visit	October 25 and November 29, 2012; January 24 2013	19	5
Summer Institute	June 24-27, 2013	113	20

Independent Observations of Professional Development Events

In an effort to document the structure, content, relevance, and quality of the various RttT professional development opportunities, a sample of five events were observed by evaluators. Most of the observed events (four out of the five sample events) selected for this report had not been previously observed by the Evaluation Team (the exception being the Scaling STEM Conference). The five events observed between fall 2012 and spring 2013 included:

1. Common Practices Symposium (CPS) East, fall 2012;
2. Visit to a model school, winter 2012;
3. Secondary Lenses on Learning (SLoL) third meeting, winter 2013;
4. School-level professional development, spring 2013; and
5. Scaling STEM Conference, spring 2013.

Structure and content of sample professional development events. Four of the five events consisted of multiple sessions—The Common Practices Symposium (2), the school-level professional development (2), the Secondary Lenses on Learning event (4), and the Scaling STEM Conference (9)—and thus each session was evaluated separately. The fifth event—a visit to a model school—included a single session. As a result, there were a total of 18 professional sessions observed.

Typically, the length of sessions observed was between 1 and 2.5 hours. With the exception of the two school-level professional development sessions, all events included participants from other schools supported by NC New Schools. The observed sessions had between 11 and 43 participants, with an average of 26 participants per session. Participants were mainly teachers, teacher leaders, and school administrators, with some sessions including LEA-level administrators. (For more details regarding activities and content of these events, see Appendix D.)

Relevancy of sample professional development events. For all events, observers rated the extent to which specific topics relevant to RttT STEM were addressed, using the following scale: 1=not at all; 2=not much; 3=somewhat; 4=to a great extent; 5=not applicable to class or activity being observed. The means and standard deviations for these ratings are reported in Table 4. The table reports average ratings for all 18 sessions combined (Overall column), as well as average ratings by the type of event (other columns). Overall, across the 18 professional development sessions observed, mean scores for each indicator ranged from a low of 2.94 (concerning how high school students learn STEM content) to a high of 3.61 (for attention to various inquiry-based and/or STEM instructional strategies).

Table 4. RttT STEM Content-Specific Activities

Professional Development Event:	**Overall**	**CPS**	**School PD**	**School Visit**	**SLoL**	**STEM**
***Number of Sessions*:**	18	2	2	1	4	9
Indicator	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)*	Mean (SD)	Mean (SD)
Session provided opportunities to consider how high school students learn STEM content (e.g. misconceptions they might have, how they think about the content).	2.94 (1.66)	3.50 (2.12)	4.00 (1.41)	2.00 (--)	3.25 (1.50)	2.56 (1.88)
Session devoted attention to inquiry, project-based, problem-based learning, exploring STEM theme, Engineering Design, or other STEM-specific instructional strategies.	3.61 (1.29)	4.00 and N/A	4.00 and N/A	N/A (--)	3.25 (1.50)	3.22 (1.30)
Session devoted attention to CIF or other non-STEM-specific instructional strategies.	3.22 (1.80)	3.00 (2.83)	N/A (0.00)	N/A (--)	2.50 (1.73)	3.00 (1.80)
Session devoted attention to the North Carolina or Common Core standards and assessments for STEM-specific subjects.	3.19 (1.72)	3.00 (2.83)	N/A (0.00)	2.00 (--)	2.33 (2.31)	3.25 (1.49)

*Note: For *Visit to Model School*, *n*=1, so no Standard Deviation was calculated.

Quality of the professional development events. After observing each professional development session, observers assigned a synthesis rating for the overall quality of the session according to the following 5-point scale:[6]

Level 1: Ineffective Professional Development (passive learning, activity for activity's sake)

Level 2: Elements of Effective Professional Development

Level 3: Beginning Stages of Effective Professional Development

Level 4: Accomplished, Effective Professional Development

Level 5: Exemplary Professional Development

Observers also assigned a summary rating to three distinct dimensions of the professional development (quality of the design, quality of implementation, and quality of the culture) on a 4-point scale ranging from low quality (1) to high quality (4). All three dimensions were rated measuring the extent to which the specific indicators were observed. Table 5 reports the ratings for these three dimensions and the overall quality (see Appendix D for more details regarding the ratings for indicators of quality of design, quality of implementation, and culture of the professional development). The overall quality of 3.39 (out of 5) indicates that, on average, the professional development sessions were assessed as being short of "Accomplished, Effective Professional Development", with ratings ranging from "Elements of Effective Professional Development" to "Exemplary Professional Development."

The ratings under the Overall column on Table 5 show that on average, the quality of the design, quality of the implementation, and quality of the culture of the events were rated in the medium to high range, with culture of the professional development being rated as the highest among all dimensions (3.41).

Table 5. Overall Event Quality and Quality of Event Design, Implementation, and Culture

Professional Development Event:	**Overall**	**CPS**	**School PD**	**School Visit**	**SLoL**	**STEM**
Number of sessions:	18	3	1-2	1	4	9
Dimension	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)**	*Mean (SD)*	*Mean (SD)*
Overall Quality of Professional Development**	3.39 (1.15)	4.00 (1.41)	3.00 (0.0)	4.00 (--)	4.75 (0.5)	2.67 (0.87)
Quality of Design of Professional Development	3.00 (0.79)	3.00 (0.0)	2.50 (0.71)	4.00 (--)	4.00 (0.0)	2.50 (0.54)
Quality of Implementation of Professional Development	3.06 (0.77)	3.5 (0.71)	3.00 (--)	3.00 (--)	4.00 (0.0)	2.50 (0.54)
Quality of Culture of the Professional Development	3.41 (0.71)	4.00 (0.0)	4.00 (--)	4.00 (--)	4.00 (0.0)	2.89 (0.60)

* No Standard Deviation was calculated (--) when *n*=1
**The scale for Overall Quality is a 5-point scale; the scales for the other dimensions are 4-point scales.

[6] A copy of the professional development observation protocol is provided in Appendix B of the Second-Year Report.

Among the events, Secondary Lenses on Learning was rated higher on all dimensions and most indicators than any of the other events. The Scaling STEM Conference event was rated, on average, lower than the other professional development events. In many cases, the Scaling STEM Conference and on-site PD designed by one particular school brought the average observational ratings down.

Open-ended notes recorded by observers about the *design* of the professional development indicate that most Scaling STEM Conference sessions were designed as informational sessions with presentation as a predominant mode. These events contained few small or whole group discussions or opportunities for interaction, and few activities for participants. In contrast, the other events displayed small- and whole-group discussions, immersion activities that modeled classroom instruction, well-modeled CIF strategies, collaborative development of lesson plans, and reflection.

Observers' open-ended notes about *implementation* indicate that, in most sessions, participants were engaged. Relative to facilitators at other events, facilitators at Secondary Lenses on Learning were the strongest in modeling Common Instructional Framework strategies overall and questioning techniques specifically. Often, the events did not allow enough time for a deep discussion or exploration of topics.

Observers' open-ended notes about the *culture* of professional development indicate that all sessions exhibited a climate of respect and openness, largely facilitated by the presenter/moderator. Participants shared ideas and opinions openly and frequently asked each other questions, particularly during small group work.

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 activities focus on the Common Instructional Framework, on developing content expertise, and on implementing key instructional practices in mathematics and science. 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. Table 6 shows the number of total coaching visits for the group and the ranges for individual schools by school type and by type of coaching during the 2012-13 school year.

Table 6. Number of Coaches Visits to RttT Network Schools

Type of School	**Leadership Total (Range)**	**Instructional Total (Range)**
Anchor schools (4 schools)	49 (9–20)	130 (29–35)
Small new schools and STEM academies (6 schools)	52 (7–10)	169 (27–30)
Comprehensive schools (10 schools)	84 (7–9)	397 (26–57)
Total	***185***	***696***

There were a total of 185 leadership coach visits and 696 instructional coach visits to all 20 RttT STEM schools, with an average per school of nine leadership coach and 35 instructional coach visits. Schools on average received one leadership coach visit and three to four instructional coach visits per month. The newest anchor school, Northeast Regional School of Biotechnology and Agriscience (opened in 2012) received the largest number of leadership coach visits (20).

Participant Perceptions of Professional Development Events and School-based Coaching

As part of the RttT Year 3 evaluation, evaluators conducted site visits at four STEM affinity schools. This section of the report describes both principal and teacher perceptions regarding the implementation and quality of the professional development and coaching services.

Participant perceptions of professional development events. During the interviews, staff from all four sample schools indicated that they participated in professional development events and received school-based coaching from NC New Schools. For example, the principal in one of the schools went to 23 one- to three-day professional development sessions, and teams of two to three teachers in that school went to at least 15 sessions over the school year. They also attended professional development events during the summer, including one-week and three-week math and science content workshops. Of the 40 teachers in this school, more than half went to at least one of these professional development events. As the principal noted, information from these events was regularly brought back and shared with the other teachers: "[T]he teachers come back from whatever they go to, share it with our teachers and try to light fires in different departments."

Most participants indicated that the professional development events they attended were of high quality. Math and science teachers in another school praised content-specific workshops held during the summer and commented that they were helpful in motivating them and their colleagues to incorporate what they learned into their classrooms. A staff member in Health Academy reported that NC New Schools has been very supportive with providing professional development events and instructional coaches, and that these events have been of high quality.

> Our training for our teachers is exceptional. The NC New Schools has offered us a huge amount of support, including the coaching for the teachers. I think they are very well planned out. There's not a bit of wasted time. Once in a while you have a speaker who's a little off course, but that would be the exception. The planning that goes into their [professional development] is wonderful, and they give you a lot to work on when you leave, so you're coming back the next time with expectations to fill.

One of the principals indicated that "the best professional development, in my opinion, that I saw the teachers come back and implement what they got was when we went to Worcester, Massachusetts, to a study visit . . . to a school that followed the Common Instructional Framework."

Principals' perspective on coaching. Three of the four principals interviewed praised NC New Schools and thought that their coaches had effectively worked with their teachers to demonstrate high quality instructional practices and then provided teachers sufficient time and support to implement the instructional strategies in the classroom. The principals shared a desire for the budget to allow for more coaching time, and moreover, a belief that for the RttT STEM initiative to move forward, coaching support must continue to be offered to the school once the RttT funds are no longer available. One principal stated, “To become the STEM school that I envision, it’s going to continue to take ongoing help from coaches, so that collaborative partnership piece has definitely got to be sustainable.” However, one school principal did not think that the NC New Schools instructional coaching was beneficial, due to the rigid structure and prescribed nature of the professional development offerings that did not properly align with the specific and emerging needs of her school.

Teachers’ perspectives. Most teachers interviewed indicated that the NC New Schools coaches helped them by modeling effective strategies, observing their instruction, providing useful and timely feedback, supporting implementation of the design principles, providing a good sounding board for ideas, and helping sustain the school’s overall effort to improve instruction. One teacher explained,

> I don’t think we could have done that without the instructional coaching that we’ve had through New Schools. Just as individuals coming back to a school looking at a Design Principle rubric, we would have never understood how to interpret that without having some guidance there.

On the other hand, teachers in the RttT STEM school that did not highly regard the NC New Schools coaching indicated that the coaching was not always based on the school’s needs or individual teacher needs, but rather was based on a structured framework created by NC New Schools. As a result, teachers indicated the instructional coaching was not always STEM relevant, useful, or of high quality. One teacher stated,

> As far as the instructional coaches go, I think they do the best they can based on the guidelines that they are held to and their commitment to the New Schools Project. I don’t think some of the things that they have to do are necessarily what we need from them. . . . And I wish there was a way to have told [the coach] ahead of time that a lot of us don’t need that, because we’re comfortable with it. . . . And so you go in expecting one thing and then you wonder why you’ve spent 90 minutes doing [something else].

Indeed, teachers at the others RttT STEM schools reported that the NC New Schools coaches led some professional development activities related to STEM; however, most of the focus was on the Design Principles and CIF. Teachers reported that the focus this year had yet to touch upon using projects or working on the school’s theme: “I feel like the only part that they help us with is group work—strategies on how to have effective group work. But projects, like an overall project, no.” However, one teacher stated that she expects that more STEM specific professional development will take place in the spring of 2013 and into the 2013-14 school year.

Potential Barriers and Additional Supports Needed

During site visit interviews, principals and teachers also identified various challenges and barriers regarding professional development.

Providing effective professional development to all teachers. In large schools, not all staff can be trained directly by NC New Schools, so some teachers receive professional development from staff who were able to attend NC New Schools training and then must train the other teachers at the school. One principal reported that the administration at the school tries to maximize these opportunities by trying to send each teacher to different events, so they all have a chance to participate. The principal stated, “When we got the whole list of [professional development], we tried to kind of divide it out and make sure everybody was going somewhere, doing something.” Other schools also indicated they used a “train-the-trainer” type approach to professional development—in which individual teachers were responsible for attending a professional development session and then conveying to their colleagues the new knowledge, skills, and/or resources obtained. Some teachers feel that having the training filtered or translated in this way lowers its quality.

Limited high-quality coaching time. Across the four schools, principals were interested in more one-on-one coaching, as long as it was of high quality, relevant, and useful. Both principals and teachers reported benefits of working with coaches, but wanted to have more access to ongoing, sustainable coaching. However, as previously mentioned, there was a desire for more STEM-specific coaching, rather than more general sessions about instructional practices.

> It would be fabulous if we had one person dedicated to STEM here, but we don’t have the funding for that, and I feel like we need some things that are more specific to STEM schools.

Lack of sufficient time for implementation and exploration. An additional challenge mentioned by teachers was the need for more time for actually planning lessons/projects which incorporate new instructional strategies—instead of spending their teacher work days exclusively in meetings listening to presentations.

> I mean, it’s changed our lives in that we have had a lot of staff development days given . . . and what I wish we had was more time to actually develop these things. But we sit in meetings and we’re fed a lot. But this takes time, in my opinion, to change lessons and that kind of thing, and I wish we had that built into the whole process.

Lack of funds for sustainability. One principal stressed the importance of funding for sustaining the initiative. RttT funding has been viewed as the catalyst in the implementation of the initiative and the LEA has been instrumental in promoting STEM LEA-wide. Once RttT ends, the school will need to look elsewhere for funds to sustain the initiative.

III. Development and Implementation of Project-based Curricula

The following section focuses on the work to design a 9th through 12th 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).

Our analyses of the curriculum development activities reveal several findings:

- Curriculum design work was completed in accordance with the contract awarded to the NCSSM by NCDPI.
- Reviews by STEM teachers of newly-developed STEM curricula point to many strengths as

well as areas for improvement of the materials.

- A number of anchor and small new schools are developing integrated STEM courses that parallel those being developed by NCSSM.
- Implementation of the newly-developed curricula presents the following challenges:
  - Finding opportunities to pilot test STEM courses with targeted population of students and teachers, and to fine-tune them to better serve the needs of the users.
  - Finding teachers with the right background knowledge to teach these Career and Technical Education (CTE) courses with the intended levels of rigor and depth of STEM content coverage.
  - Finding ways to provide necessary professional development for prospective teachers of STEM courses to familiarize them with the new themed content and the new teaching strategies these materials call for.
- NC New Schools devoted a number of sessions in professional development events to the four STEM themes, to project design, and to project-based learning (PBL). NC New Schools also conducted a special event to bring together STEM curriculum developers and users.
- One year into the initiative, the majority of teachers have not yet participated in the development of STEM cross-curricular projects. Participation was much higher in the anchor and small new schools.

This section includes four subsections:

1. Development of integrated STEM curriculum by NCSSM;
2. Teacher reviews of the four freshman themed courses;
3. NC New Schools events focused on STEM curriculum; and
4. The extent of implementation of themes and project-based units in affinity schools.

Development of Integrated STEM Curriculum by NCSSM

In the late spring of 2012, NCDPI awarded a new contract to NCSSM to design a total of 16 year-long courses with authentic assessments, with a series of four 9th through 12th grade courses in each of the four STEM areas:

- Agriscience and Biotechnology (A&B);
- Health and Life Sciences (H&LS);
- Aerospace, Security, and Automation (AS&A); and
- Energy and Sustainability (E&S).

These 16 courses should each provide 150 hours of instructional time and be completed by May 1, 2014. All courses are required to satisfy 14 conditions, including online delivery, a variety of digital content, inquiry-based units, and alignment with all state Essential Standards, among others. The details of the scope of work for this contract can be found in Appendix E.

During September 2012–June 2013, approximately 15 faculty members at NCSSM developed and delivered the first eight courses for the 9th and 10th grades in each of the four themes. Developed materials include lesson plans, presentation materials, lab descriptions, handouts for activities, assessments, and suggested additional resources for teachers. All content is delivered in digital format through LearnNC's Moodle web site and has been reviewed for copyright clearance. It is presently available for review by teachers and other interested parties.

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

- *Agriscience and Biotechnology*: agricultural ecology, agricultural genetics, agricultural biotechnology, agricultural solutions, and sustainable agriculture;
- *Health and Life Sciences*: biomedical systems, biomaterials, tissue engineering, neuroscience, medical imaging, and biomechanics;
- *Aerospace, Security, and Automation*: history of flight, aerodynamics, hydraulics, technical communication, motors and engines, rocketry, programming in various languages, electricity, computers, and communication systems; and
- *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.

To set up the context for the curriculum materials review, the Team conducted an interview with the developers of the courses. The information from this interview is summarized below.

The intent for course use. As indicated by NCDPI, the sequences of four courses in each theme will be designated as CTE courses in one of the CTE program areas. As such, these courses are designed to reinforce and integrate the core subjects of math, science, and English Language Arts (ELA) with technology, engineering, and the course theme through the application of this knowledge to authentic theme-related projects.

These courses both apply previously learned knowledge in core subjects to different contexts, and use novel tasks to motivate the need for and introduce the new topics in math and science. They often teach the core content knowledge necessary to solve a problem or complete a project. The curriculum was also designed to include a set of modules, at least three of which could be used as replacement modules in the core subject classes to teach selected core topics.

Alignment with standards. The core content subject knowledge taught in these courses is partially aligned with the North Carolina Essential Standards and Common Core Math and ELA Standards. Partial alignment means that STEM core subject or ELA topics needed for performing a task or completing an assignment are expected to be taught with rigor comparable to that of a core subject class. At the same time, materials taught might not have covered the entire standard that included that specific topic. The developers provided tables to show courses' alignment with North Carolina Essential Standards and Common Core Math and ELA Standards. In each theme, there are four course levels that correspond loosely to grades 9, 10, 11, and 12. The developers considered which of the math and science courses are typically taught to the majority of the North Carolina students in these grades (Table 7, following page). They considered these courses as likely to be taught in the same grade as the themed courses, and aligned the standards as closely as possible, but not exclusively, with the corresponding math and science subjects. The development of the sequence of courses also assumed that the higher level courses in the sequence require some of the knowledge developed in the lower level courses.

Table 7. Mathematics and Science Courses Typically Taught in North Carolina High Schools

Grade	Math Course	Science Course
9	Integrated Math 1 or Algebra 1	Earth and Environmental Science
10	Integrated Math 2 or Geometry	Biology
11	Integrated Math 3 or Algebra 2	Chemistry
12	Integrated Math 4 or Pre-Calculus	Physics or Physical Science

Prerequisite knowledge for students. Freshman courses in each theme assumed the mastery of knowledge at completion of the middle school, with pre-algebra as the 8^{th}-grade math course.

Selection of topics and projects for the courses. The selection of specific topics and projects for the courses was guided by a number of considerations, including coverage of the Grand Challenges of Engineering, relevance to economic development within the state, and topics found to be interesting and motivational for the students. Selected topics complement the study of core subjects by demonstrating the application of these topics in the real world and by covering science, engineering, and technology topics not addressed in the core curriculum. Large and small projects are designed to take up between 50% and 75% of instructional time and to serve multiple goals, such as motivating students to learn STEM subjects, raising awareness of and interest in STEM careers, providing experience in what “doing” STEM-related work looks and feels like, conducting performance-based assessment of their knowledge and skills, developing students’ analytical thinking and authentic problem solving abilities, and fostering teamwork skills.

Issues related to curriculum implementation. Developers described some courses as covering topics similar to other CTE courses (such as health or agriscience), and others presenting novel content (such as energy, sustainability, and aerospace engineering). In contrast to conventional CTE courses, these courses approach STEM subjects at a much more rigorous and deep level. This presents an issue for determining qualifications of teachers who will be teaching these courses. Because these are integrated courses, developers feel that teachers would need to have a certain depth of knowledge in order to teach these courses well; as one developer noted, “Hardly anyone actually knows all these different pieces.” They believe that such depth could come from either a college major or minor in one of the STEM subjects, or a combination of STEM college coursework and experience teaching STEM subjects in high school. Developers also noted that just technology or just mathematics subject knowledge would not be satisfactory; rather a teacher also would need to have knowledge in sciences, mathematics, and/or engineering.

This teacher background assumption presents a challenge for the implementation of these courses, since the CTE teachers for whom the courses are targeted may not have the required background content knowledge. In such cases, their lack of background knowledge could affect the fidelity of implementation as well as the effectiveness of these courses. To address this issue, NCDPI STEM staff began conversations with NC Virtual Public School staff about the possibility of incorporating course content developed by NCSSM into virtual/blended courses developed by NCVPS.[7] A blended/virtual team teaching environment could provide opportunities to reach more teachers with appropriate background knowledge in the STEM focus areas. The virtual teacher would provide the background STEM knowledge needed to complement the traditional teacher.

The second potential mode of use for these courses specified in the contract is to provide replacement units for traditional core science courses. To accomplish that, some of the units or groups of lessons were designed to teach selected science or other STEM subject standards completely. During the interview, some developers indicated that many of the units complemented the topics taught in the standard core science courses rather than duplicated the content. As a result, only a few topics could be used as a true replacement for information expected to be taught in a regular course.

Additionally, developers felt strongly that before teaching these courses, prospective teachers would need to have professional development to familiarize them with the new themed content and with the new teaching strategies these materials require. Technology training also will be needed because developers chose some technology options that are unfamiliar to many teachers due to their novelty and more typical use in workplaces outside of educational settings.

Another issue the developers were struggling with concerned pre-requisites for students taking these courses. NCDPI requested that the sequence of four courses in each theme be named “Theme 1,” “Theme 2,” “Theme 3,” and “Theme 4,” and that each subsequent course not require previous courses in the sequence as pre-requisites. The assumed prior knowledge for the first course in each sequence is the solid knowledge of mathematics and science at the end of the middle school. At the same time, developers find it difficult to not build on what has been taught in the previous courses on the theme. Given that the courses were designed with this assumption, the effectiveness of the instruction would likely improve if there is a recommendation for students to take the courses in each theme sequentially.

Finally, developers felt that before these courses are made widely available for use by North Carolina schools, the courses need to be pilot tested with the targeted population of students and teachers, and fine-tuned to serve the needs of students and teachers who will teach these courses.

There are plans for limited piloting of some of these courses. For example, the freshman-level Aerospace, Security, and Automation course is to be piloted by the developer in a rural school as a video course during the 2013-14 school year. More pilots are needed to receive feedback from target teachers and students to revise the courses in order to improve them and to make them a better fit for the intended audience.

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[7] For evaluations of the RttT-funded NCVPS STEM blended learning initiative, please see http://cerenc.org/wp-content/uploads/2011/10/NCVPS-blended-course-impact_FINAL.pdf and http://cerenc.org/wp-content/uploads/2011/10/NCVPS-blended-course-impact_Spring-2013-follow-up-report_FINAL-10-04-2013.pdf

Teacher Reviews of the Four Freshman Themed Courses

To evaluate this curriculum development work, evaluators received reviews of the four freshman courses by a group of four teachers from one of the STEM high schools supported by NC New Schools, which is not a part of the RttT-supported STEM network. The school has a focus on engineering, is non-selective, and serves a local population of students with demographics often under-represented in STEM areas. This school has been in existence since 2007 as a redesigned STEM school, longer than any school in the RttT-supported STEM network, and thus has better established STEM practices than many of the RttT-supported STEM schools. Driven by rigorous inquiry based instruction, the school has enjoyed much success in producing college-ready high school graduates. The teacher reviewers teach subjects of mathematics, science, technology, and engineering/drafting. Together, this group of teachers represents potential users of the curriculum under development for the use of modules as replacement units. The teachers have background knowledge in all STEM subjects and can evaluate the depth, quality, and rigor of content treatment.

To evaluate the four courses, each teacher took primary responsibility for one course, and then all met and discussed their reviews as a group. Teachers used a rubric developed by the Evaluation Team, one based on the scope of work for the development of these particular curricula. The scope of work can be found in Appendix E, and the rubric can be found in Appendix B. The entire evaluation of the four courses can be found in in Appendix F, and the summary of the reviews is presented here.

These reviews should be taken with caution, as they represent the views of only four teachers, all from one school. Additionally, due to the copyright permission process, some of the multimedia materials for the courses were added after the reviews were conducted, and they were not considered for this review. The Evaluation Team considers these reviews as a part of formative evaluation that will help course developers to fine-tune the development of other courses moving forward. In addition to these reviews conducted by the Evaluation Team, the developers and NCDPI are seeking reviews from other teachers to inform course development.

The reviewers were asked to look at the standards alignment charts to determine the extent of alignment of each course with standards for various subjects. The chart shows that the courses did to some extent cover standards from different core subject areas, including various sciences, technology, ELA, and some other theme-related or middle school standards. The reviewers could not determine alignment with Common Core Math Standards, and in some cases with ELA standards, due to the incomplete information provided by developers on the standard alignment charts. The alignment with the Next Generation Science Standards was incomplete at the time of review because of the very recent release date of those standards. Science and ELA standards (when alignment data were available) were covered to the highest extent, with each of the courses aligned with at least two and up to five science courses, addressing between 3% and 31% of the course standards at least partially (see Table F1 in Appendix F).

The alignment charts also provided data on addressing the Grand Challenges of Engineering, as shown in Table 8 (following page).

Table 8. Grand Challenges of Engineering Addressed in Integrated STEM Courses

Courses	Number of Grand Challenges	Grand Challenge Topics
E&S	3	Make solar energy economical; Develop carbon sequestration methods; Provide access to clean water.
A&B	2	Engineer the tools of scientific discovery; Manage the nitrogen cycle.
H&LS	3	Advance health informatics; Engineer better medicines; Reverse-engineer the brain.
AS&A	0	

Reviewers also noted that, although no Grand Challenge topics were listed for the AS&A course in the alignment charts, based on reviews of the selected units, there is the possibility of integrating the Grand Challenge topics of Secure Cyberspace, Enhance Virtual Reality, and Engineer the Tools of Scientific Discovery.

For the rest of the analyses, reviewers were asked to select a sample from each course consisting of three or more units, covering at least 25-30% of the course. These units were to have been chosen from the beginning, middle and end of the course in such a way that they together cover standards in each of the STEM subjects and ELA. The content of these units was reviewed in depth for the extent and quality on various dimensions. They were judged on a 3-point scale (low, medium, high), the descriptions for which were provided in the rubric (see Appendix B).

The rigor of the content was evaluated according to teachers' professional judgment with respect to whether the content is likely to result in mastery of content knowledge and conceptual understanding aligned with the 9th grade standards in this content area. In addition to mastery of content knowledge and procedures/skills, other criteria included the degree to which the curriculum is likely to develop the following 21st century skills:

- Critical and analytical thinking, reasoning, interpretation, synthesis, decision making, creativity, and problem solving; and
- Conceptual understanding, defined as the ability to make connections between different concepts, between procedures and underlying concepts and structures, and between abstract and concrete; and to explain personal actions and decisions.

Based on these criteria, reviewers provided the following feedback on various features of the curriculum. The majority of the ratings for the extent of authentic assessments and for the extent of coverage of the theme, core STEM subjects, digital content, and ELA were in the medium range, with some ratings for science and engineering coverage in the high range. The ratings for the quality of the same features were about equally distributed between medium and low ranges. Ratings for mathematics stood out because just one of the four courses received a medium rating for extent, with the rest of the ratings for extent and all of the ratings for quality in the low range. Among the four courses, H&LS received the highest number of low ratings. These ratings are reported in Table 9 (second page following).

Reviewers provided descriptive notes to explain their ratings. A summary is provided here with the compete notes provided in Appendix F. Most units provided clearly defined goals and clarifying objectives, although this feature was not consistent across courses. Reviewers felt that the time constraints and the amount of material covered in all courses did not allow the tasks to reach high levels of rigor. According to the Revised Bloom's Taxonomy, many of the tasks did not require a high level of cognitive demand or further application of procedural knowledge. Reviewers also noted a lack of variety in course structures, and usage of digital content more often by teachers rather than by students. They also suggested a few ways to improve the authentic assessments in the units:

- Include diagnostic, formative, and summative assessment;
- Vary assessment formats: presentation, self and peer assessments, feedback exchange and reflection opportunities for students;
- Ask students to design products that could be used in the real world;
- Align activities with the stated purpose of the courses;
- Provide less guidance to students through the process of activities to allow room for student creativity; and
- Add variety to types of products students are asked to create and add digital formats, to allow for deeper student creativity and to improve overall student engagement.

Reviewers also evaluated the quality of the Project-Based Learning in the courses using seven criteria. The ratings for four courses on these criteria (reported in Table 9, following page) were almost equally split between medium and low, with fewer high range ratings. The descriptive comments noted a lack of collaborative class-level communication that helps to develop deeper understanding of the content, and few projects that were truly large in scope that integrated an umbrella of ideas presented in the courses. All four courses provided opportunities to research STEM careers, but they did not emphasize underrepresented populations. Reviewers also noted that activities in the H&LS course included research into careers, but students were not asked to work toward any possible solutions.

For the general strengths and weaknesses of the courses, reviewers commented that some courses were very strong in the area of science, others in engineering, and still others in technology. In general, courses were seen to provide plenty of useful and interesting content. Reviewers noted however, that the courses would benefit from varying the delivery methods for the content, from providing more opportunities for student creativity and guidance of their own learning, from varying the projects they create and the modes of authentic assessment, from including more differentiation, and from enhancing communication among students. Reviewers also felt that in some cases, various subjects could be better integrated within the courses. Reviewers also suggested including alternative activities, not requiring technology, to avoid delaying the lessons due to any potential technology issues. They would like to see the students doing more of the research and hands-on learning, and less reliance on Power Point presentations and worksheets.

In addition to these in-depth reviews with rubric-based ratings, a number of teachers from the network of 20 STEM schools also reviewed the curricula. These reviews were guided by a different set of questions and were completed after this report was written. The summary of these reviews will be included in the final report.

Table 9. STEM Course Ratings

Criteria	Indicators	Low	Medium	High
Unit goals and objectives	Extent	E&S	H&LS, AS&A	A&B
Coverage of the theme	Extent		H&LS, E&S, A&B, AS&A	
	Quality	H&LS	E&S, A&B, AS&A	
Science	Extent		AS&A	H&LS, E&S, A&B
	Quality		H&LS, E&S, A&B, AS&A	
Technology	Extent		H&LS, E&S, A&B, AS&A	
	Quality	H&LS, E&S	A&B, AS&A	
Engineering	Extent		H&LS, E&S, A&B	AS&A
	Quality	H&LS, E&S	A&B, AS&A	
Mathematics	Extent	H&LS, E&S, A&B	AS&A	
	Quality	H&LS, E&S, A&B, AS&A		
English Language Arts	Extent	AS&A	H&LS, E&S, A&B	
	Quality	H&LS, AS&A	E&S	A&B
Digital Content	Extent	H&LS	E&S, A&B, AS&A	
	Variety	H&LS, AS&A	E&S, A&B	
Authentic assessments	Extent	H&LS, E&S	A&B, AS&A	
	The level of task authenticity	H&LS	E&S, A&B, AS&A	
	Appropriateness of the task for assessment	H&LS	E&S, AS&A	A&B
	Rubric	H&LS, AS&A	E&S, A&B	

Project-Based Learning Criteria	Low	Medium	High
Presents a driving problem, task or challenge		H&LS, AS&A, U7*	A&B, U2,U5*
Provides measurable content learning goal(s)	H&LS	AS&A, U2, U5, U7	A&B
Requires students to research background information	U2, U5, U7	H&LS, AS&A, A&B	
Engages students in inquiry and innovation	H&LS,	AS&A, A&B, U5, U7	U2
Engage students in developing and applying 21st-century skills	H&LS, A&B, U7	AS&A, U5, U2	
Provide feedback and encourage project revision	H&LS, AS&A, A&B, U2, U5, U7		
Provide for a “publicly presented product?”	H&LS, AS&A, U5, U2	A&B, U7	

** Note: The E&S course reviewer provided ratings by unit: U2 = Unit 2; U5 = Unit 5; U7 = Unit*

NC New Schools Events Focused on STEM Curriculum

NC New Schools devoted a number of sessions in professional development events to the four STEM themes, to project design, and to project-based learning (PBL). The National Scaling STEM conference in March 2013 included student presentations of their STEM projects. Students from various schools in the network showcased projects that they had completed in their classes. During the Summer Institute in June 2013, there were a number of sessions devoted to addressing innovative use of technology to integrate STEM subjects, collaborative STEM projects, and collaboration with STEM industry experts to design classroom instruction. The Summer Institute also devoted a special session to the integrated STEM curriculum developed by NCSSM. This session provided a general overview of all 16 courses followed by break-out demonstration sessions for specific freshman courses. Additionally, teachers from STEM schools participated in a STEM day, which brought them to leading North Carolina STEM industries in a whole-day field trip.

NC New Schools also hosted a meeting devoted to STEM curricula on April 10, 2013. To address state and national STEM priorities, various educational organizations started to develop new curricula with the following features:

- Integrating STEM content areas within courses;
- Implementing project-based and problem-based learning as main instructional strategies;
- Utilizing engineering design process for all projects;
- Incorporating new technologies and media; and
- Focusing on a STEM career-relevant theme.

In the state of North Carolina, a number of organizations are currently involved in the process of development of STEM curricula that share some or all of the features above. To increase the awareness of each other's efforts and to facilitate collaborations among curriculum developers, NC New Schools organized a four-hour meeting that hosted representatives from:

- NC New Schools;
- NCDPI;
- NCSSM;
- Southern Regional Education Board (SREB);
- Four STEM anchor schools and two STEM network schools;
- North Carolina Farm Bureau; and
- SERVE Center at the University of North Carolina at Greensboro.

At this meeting, representatives from NCSSM, SREB, the North Carolina Farm Bureau, and STEM anchor and network schools presented their STEM curricula under development and discussed the issues relevant to curriculum development and implementation. A few themes surfaced during this discussion:

- It has been very helpful to learn about each other's efforts in designing integrated STEM courses. There is a great deal of overlap in the goals, content, and design of the courses, so it is important for the designers to not duplicate and to enrich each other's efforts. There was a suggestion to conduct curriculum developers' meetings regularly, one to two times a year.
- It is important to emphasize to students that it is acceptable to fail and learn from their mistakes. College professors and businesses complain that the current generation of students are afraid to fail and cannot cope with their failures. Teachers need to convey to students that they value students' ideas and questions even if they are wrong. Using engineering design for project work may help students to develop these beliefs.
- The newly developed courses integrate multiple subjects and employ project-based learning. There is a need for professional development for future teachers of these courses.
- Many of the STEM courses being developed are designated as CTE courses, which raises a number of questions.
    - Compared to traditional CTE courses, the rigor and amount of core STEM content knowledge in these courses have increased. What should be the background knowledge of teachers who will be teaching these courses? Are they to be taught by the CTE or STEM content teachers?
    - How are these courses going to be aligned with the state assessments?
    - Are there state designated Pathways for the courses with themes developed under the RttT funding?
    - What kind of credits do students get for these courses?

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

The staff survey had a question on teacher participation in project curriculum development related to the STEM theme or the Grand Challenges for Engineering. Staff responses from 20 network schools are presented in Table 10.

Table 10. Teacher Participation in Project Curriculum Development

Please rate your level of participation in these activities:	**School Type**	*n*	**Percentage of Respondents who . . .**			
			Haven't Yet Participated	***Participated Once***	***Participated 2-5 Times***	***Participated More than 5 Times***
Project curriculum development related to the STEM theme or the Grand Challenges for Engineering	All schools	333	65%	18%	12%	5%
	Anchor schools	46	37%	28%	17%	17%
	Small new schools and STEM Academies	49	33%	35%	27%	6%
	Comprehensive schools	238	77%	13%	8%	2%

One year into the initiative, the majority of teachers have not yet participated in the development of STEM cross-curricular projects. Due to school sizes and different roles in the networks, about one-third of teachers from anchor and small schools and STEM academies had not yet participated, while in the comprehensive schools, 77% of teachers had not participated in these activities. Anchor schools were leading in the proportion of teachers who participated in curriculum design activities more than five times (17%).

Other sources confirm that anchor and some small schools were involved in STEM curriculum design on their own. A health anchor school was working on the curriculum that blends all 9th grade subjects, including core and health-related subjects. The school plans to implement this curriculum next school year. In the fall of 2012, the health anchor school brought together a team of subject matter teachers from different schools and a nurse for five consecutive Mondays (40 hours total). They designed cross-subject courses, with subject content integrated into a number of different courses for the 9th grade. Together, these courses will cover the complete Social Studies, English, Math, and Science 9th grade curriculum.

A Regional Career Academy is also trying to integrate courses in a similar way. The school is trying to create flexible schedules so that they can be adjusted on a weekly basis to provide more time for specific subjects or for project needs. A School of Engineering designed an introductory STEM Foundations Course. All 9th and 10th graders will take the course before they go to various themed academies. The course was developed in the summer of 2012 as a collaboration among two NC New Schools coaches, a teacher from an Ohio STEM school, and four School of Engineering teachers. The course consists of nine units, with each unit designed as a project using the engineering design process. This course has been piloted as a CTE course in Career Management, and next year will be integrated with the Project Management CTE course.

One STEM early college high school (an energy and sustainability anchor school) is developing an integrated curriculum that is based on the Grand Challenges of Engineering, which are integrated across all subjects. In this curriculum, science courses are blended with engineering design, forming year-long courses that give students an opportunity to earn credits in both science and engineering.

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 NC New Schools and anchor schools are working to build these partnerships and to help other schools in the network to build their partnerships as well.

Our analyses of partnerships resulted in the following findings:

- Industry Innovation Councils (IICs) for each of the four themes met quarterly to plan and provide support for the networks, and various business partners also supported teachers and students in a variety of ways.
- One year into the program, most staff in the 20 affinity schools have not yet participated in a collaborative activity with partners. Staff in anchor schools reported participation in partnerships and collaboration activities at a higher rate (40%) than did staff in small new

schools and STEM academies (30%) and comprehensive schools (13%).

- Three of the affinity schools visited by the Evaluation Team established their own partnerships with local businesses and colleges. The initiative strengthens the focus and breadth of these partnerships.

This section is divided in two subsections:

1. NC New Schools efforts to develop partnerships for the four themed networks; and
2. The extent of implementation of partnerships in affinity schools.

NC New Schools Efforts to Develop Partnerships for the Four Themed Networks

NC New Schools is seeking to develop partnerships that provide different and deeper 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 three primary mechanisms: Industry Innovation Councils (IICs), an on-staff STEM field coordinator, and events focused on both professional development and building partnerships.

Industry Innovation Councils. To ensure that the partners provide consistent and regular support that is geared towards STEM schools' needs, NC New Schools 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 met two or three times during the fall and winter of 2012 and participated in two big events during the spring and summer: the Scaling STEM conference in March and Summer Institute in June 2013.

IIC meetings typically happen at one of the member businesses of the council. They involve NC New Schools staff members, a few staff members from one of the STEM schools (often an anchor school with the council's theme), and between one and two dozen business members. The agenda typically includes an update on the network activities during the previous quarter and a presentation by a teacher or principal. Presentations outline the activities in the school facilitated or supported by the partnerships, and reflect on how effective these activities are in leading to desired outcomes for student learning.

For example, at the Energy and Sustainability IIC in September 2012, a teacher from one of the network schools described himself as a converted skeptic due to his participation in the STEM Day organized by NC New Schools with industry partners in previous June. He now claims a clear understanding of how STEM topics can be integrated into History and English classes. During STEM day at FREEDM Systems, he observed teams analyzing, evaluating, creating and problem solving. His goal is to keep a focus on energy and sustainability and to challenge his students with questions related to these topics such as, "What does the energy of the future look like?"

The update on activities at the Health and Life Sciences activities at the December 2012 meeting included a report on internships for the anchor school students at Duke University and with other institutions they selected, the provision of and transportation for college student-tutors to the anchor school students, and funding for the science lab in the school.

The agenda for the meeting also included a discussion of possible supports from partners and setting goals for the council for the next period. Examples of future goals from different council meetings include:

1. Support the establishment of a business advisory board at each network school and pledge assistance in recruiting local businesses and organizations for engagement;
2. Partner with individual schools within the Energy & Sustainability STEM network to ensure that at least two Tier 1 activities occur at each school this year (the description of Tier 1 and Tier 2 activities can be found in the Appendix H to the Second Year Report);
3. Participate in and craft an effective STEM Day 2013 experience for more teachers;
4. Arrange at least one teacher externship opportunity within member company or organization, or secure an externship with a third-party organization;
5. Establish at least one student internship opportunity at an organization that aligns with the school's economic theme;
6. Identify a point-of-contact within an organization who can connect students and teachers with employees willing to serve as advisors, project coaches, guest speakers, and co-teachers; and
7. Help one or more schools make contact with at least one company/organization in the school's local area that could provide learning opportunities for students and teachers or that might serve on the school's business advisory council.

Other partnership building activities. In addition to regular IIC meetings by theme, business partners participated in a number of meetings devoted to specific support activities, such as a STEM Day or summer teacher externships. Additionally, Health and Life Sciences IIC supported the NC New Schools and the network anchor school in establishing a prototype for the network functioning. The business partners funded 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 Health and Life Sciences network. This employee reported on the process of building partnerships for one of the IICs, and provided recommendations and a model for other anchor and affinity schools. NC New Schools has also organized three visits to NC New Schools innovative partner schools for business and community leaders. These visits included classroom observations, networking with peers and exposure to a school culture where participants saw collaboration, teacher support and extension of student learning.

Building partnerships at professional development events. NC New Schools also involved businesses and other partners in their professional development events. For example, the Scaling Up STEM conference was sponsored by and featured a number of prominent NC and international businesses, including GlaxoSmithKline, Lenovo, Red Hat, Biogen, and Duke Energy, among others. The conference was organized by a partnership among NC New Schools, NC STEM Learning Network, NCDPI, the University of North Carolina system, North Carolina Community Colleges, and North Carolina Independent Colleges and Universities. Businesses and other partners shared their experience in building partnerships and supporting schools and communities with participants from schools.

During the Summer Institutes in 2012 and 2013, a whole day was designated as a “STEM Day.” STEM Day 2013 brought 150 teachers from 26 NC New Schools-supported STEM schools, including 16 of the schools in RttT-supported affinity networks, to visit a dozen businesses in the Research Triangle Park that rely on STEM-educated employees. On this whole-day experience, industry tours related to schools’ themes and teachers gained industry-based experience and learned about real-world applications of what they teach in the classrooms. The event occurred as planned, as reported in STEMwire digital news service and in the NC New Schools blog (Lodaya, 2013; Miller, 2013). Tour agendas (North Carolina New Schools, 2013) included a variety of activities, such as:

- *SAS*: Participants will tour SAS’ solar farms and then, under the guidance of SAS employees, analyze weather, electricity, and efficiency data generated from the farms. Through inquiry-based methods, participants will learn how to identify patterns and anomalies that would guide future business decisions.
- *Caterpillar Inc.*: Participants will rotate through three hands-on engineering stations, investigate “challenge questions” designed to help them think critically about Caterpillar’s work, and then collaborate with one another to craft possible solutions to the given problems.
- *Interfaith Food Shuttle*: With aquaponics as context, participants will explore nutrient cycling on one of Interfaith Food Shuttle’s sustainable farms and then build a functioning aquaponics system that can be easily replicated on school campuses using an aquarium, pumps and gravel trays. Participants will explore the flow of nutrients through a demonstration of composting techniques.

The Extent of Implementation of Partnerships in Affinity Schools

The staff survey asked participants a question about the extent of their collaboration with business or community partners related to STEM. Table 11 reports on the extent of this collaboration one year into program implementation.

Table 11. The Extent of Staff Collaboration with Business or Community Partners

Please rate your level of participation in these activities:	**School Type**	*n*	**Percentage of Respondents who . . .**			
			Haven’t Yet Participated	***Participated Once***	***Participated 2-5 Times***	***Participated More than 5 Times***
Collaboration with business/community partners related to STEM (example: Externships)	All schools	333	81%	10%	7%	2%
	Anchor schools	45	60%	11%	18%	11%
	Small new schools and STEM Academies	50	70%	20%	10%	0%
	Comprehensive schools	238	87%	8%	4%	1%

As can be seen from the table, the majority of the staff have not yet participated in a collaborative activity with partners one year into the program implementation. More staff members in anchor schools report participation than those in other schools, with 40% of staff participating at least once.

The NC New Schools has the expectation for schools to build relations with local businesses and colleges. Three of the four schools we visited (that were not new this school year) had established partnerships with local community colleges and businesses, and in one case, a four-year university, prior to joining the affinity network.[8] In three of the four schools, many students currently take college transfer courses at or through local community colleges. Under this initiative, these partnerships often become more focused on activities that support the school theme. For example, a theme-related beekeeping project at Laurel Agriscience is a central activity for the school's partnership with local businesses and a community college. The school has established and maintains a link to the North Carolina Beekeepers Association through the community college. As a result of this focus, the school is tapping into the expertise of the beekeeping instructors at the college (who are also members of the association) for advice and support throughout the implementation of its beekeeping project. In addition, this project helps to build a new partnership with a four-year university. In the words of one staff member:

> We have also been to [a four-year university] and met with their biotech person there and actually attended a bioagriculture symposium there where they talked about bees and other bioagriculture crop projects. We've made some contacts there as well and some partnerships we hope we're going to be able to use more through our bee project. What we're looking at with biotechnology is partnerships with the community, farmers, and businesses. Also, we're looking at doing some research of our own. We've already started our . . . STEM project. We're looking at the healthful benefits of honey, looking at the actual role that the honeybee plays in our food production and food shortages, and then we're looking at the harmful effects of pesticides, pests like the moth and the beetle, and then we're looking at the radiation from radio towers.

One of the most notable collaborative initiatives at Energy Academy is an ongoing project with a local four-year university focused on installing and maintaining a wind turbine at the high school. One student discussed the benefits of the high school and community college partnership:

> Pretty much, it's like 90% of our graduates and students take some [Community College] classes because we're not having to pay for it because we don't have to pay for our textbooks. . . . I've got like 5 [Community College] credits right now. I won't have to pay for those when I go up to college, which will be nice.

As part of the summer employment experience for teachers, NC New Schools, in collaboration with the Kenan Fellows program and local businesses, provides externships in theme-related businesses. For example, in the summer of 2013, Greenbrier Agriscience sent three teachers to local and California wineries and other agriscience businesses.

While the existing schools have been developing partnerships, Health Academy, a STEM academy in its first year, has not yet established many partnerships. STEM teachers reported that they had not directly received any support from business or colleges/universities, and that they

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[8] For an example of the types of partnerships developed by participating schools, see the text box on the following page.

were not aware of any specific partnerships, though the principal and Professional Development Coordinator both mentioned that local experts have volunteered to talk to students about their STEM careers and what STEM-related skills benefit them in their jobs. According to one staff member, the parents have been very involved and willing to help with getting students exposure to the variety of occupations within the STEM field, either through coming in to talk about their own STEM jobs or by helping the school network. According to another staff member:

> We have a panel of experts that have come in and talked to us about how the skills that underpin STEM would be very beneficial in their careers. We've got a federal bankruptcy court judge and an architect and a civil engineer and a director of nursing for Baptist Hospital.

Establishing Partnerships: A Case Study of Greenbrier Agriscience

Affinity schools often establish partnerships with local businesses and community on their own, and have done so prior to the grant. In many cases, CTE teachers take initiative in building those connections. At Greenbrier Agriscience, the CTE Agriculture teacher is the main driver of building partnerships with local agricultural businesses such as State Farm and Murphy-Brown (the world's largest producer of pork products with headquarters in North Carolina). In the health area of CTE courses, Greenbrier Agriscience students are doing work in the local hospital, in nursing homes, and other local health care organizations. This is how a staff member describes it:

> Now, things that we do in our county that don't necessarily fit directly under the STEM umbrella but are connecting with local businesses – we've done internships for juniors and seniors for years and we basically knock on the door of every business in our [LEA] that will . . . and even outside of our [LEA] too, that will allow students to come job shadow or internship. So we had done those things for years and we continue to do those. But has there been an increase in that? Probably not, at this point.

As a result of RttT STEM initiative, the focus on these kinds of partnership-building activities became school-wide. Here is how a staff member from Greenbrier Agriscience described activities to increase students' interest in STEM careers:

> Some people bring in people from the community with different jobs, depending on what the project is. Like I brought in the chiropractor for one of our projects and he came, listened and helped me grade the projects and gave them feedback and then showed 'em some cool little tricks that chiropractors have and they thought that was awesome, so of course they want to be a chiropractor after they saw the cool tricks. Just things like that, getting the outside community involved.

Guidance counselors also take part in establishing relationships with local businesses in order to expose students to future careers. As one Greenbrier Agriscience student describes:

> [J]ob shadow[ing] happens while you're at school. . . . 11th and 12th grade usually gets to do it, because that's where you're getting ready to decide when you leave where you're going to go to. . . . You can do any type. Like I job shadowed; I went on the air force base

> and looked at the job that I want to do on an air force base. . . . The guidance counselors, basically they say, “Well you can job shadow,” and basically when you told them what you wanted to do, they basically got in contact with local businesses and they said, “This person wants to do this,” and they put you and the business in contact where you guys can plan out a certain time and date.

In addition to CTE classes and job shadowing, students learn about future careers through different clubs related to their school themes, Health Occupation Students of America (HOSA) and Future Farmers of America (FFA). There are partnerships built in Greenbrier Agriscience through the HOSA club:

> There is a mentor program for the medical students there . . . . [W]e’re going to Duke. . . . [I]t’s a whole group of mentors. They’re meeting with our students, doing tours, answering questions about their careers and so forth.

Students commented on their HOSA club experiences:

> Like, we were supposed to go to Duke the other day . . . but we were going to go to the medical centers, like, the new one and then the old one and then we were going to tour the hospital. . . . They also had, like, internships with the local hospital . . . for health classes where . . . if you wanted to be an RN . . . you basically shadowed one of the nurses there to see what they go through on a daily basis.

and FFA club experiences:

> With the FFA, during the summer they collaborate with like Murphy-Brown and all them to have internships for students. . . . Basically, that gives us a chance to work with them and we get paid for it.

With relation to partnerships with colleges, the guidance department has connected with admissions departments at a few North Carolina universities, but most of the activities are to get students ready for college. The school had a few guest speakers from colleges, a couple of field trips, but not much collaboration. The school encourages students to attend college by having all students fill out applications to different colleges, and then sending many of them to visit these campuses.

V. Student and Staff Responses to Implementation and Outcomes Surveys

This section provides a summary of student and staff responses to a preliminary survey designed to measure perceptions of implementation activities and intermediate student outcomes. These surveys were administered in the spring and fall of 2012, approximately one year (plus or minus a few months for different schools) into the program implementation. They are considered preliminary surveys because by that time the implementation activities were only in the initial stages and were expected to have limited effects on students, staff, and schools overall. In the fall of 2013, the same surveys will be administered again, and the results of two administrations will be compared. The summary of selected responses is reported here; the full survey results are presented in Appendices G and H, while student and staff survey measures are provided in Appendix B.

Survey responses from students in 20 STEM network schools suggest that one year into the program implementation:

- Many students placed a very high value on learning in general and on learning mathematics in particular. Students had a moderately high level of confidence in their ability to be successful in their studies of mathematics, science, and technology. Areas with the most room for improvement include: enjoyment of learning (both in general and of STEM subjects in particular), and student engagement in the engineering aspects of STEM (from initial exposure to development of confidence in learning about engineering).
- The quality of classroom instruction and school culture was mixed. Students generally reported high expectations from and positive relationships with their teachers and high levels of meaningful use of technology. At the same time, a number of desired activities were not reported as frequently, such as student engagement in cross-curricular or real-life projects, rigorous instructional practices, or in STEM-related activities supported by the school.
- Students' outcomes, the quality of the classroom instruction, and the school culture differed among the types of schools, with students in comprehensive schools consistently reporting lower levels of the desired features.

Survey responses from staff in 20 STEM network schools suggest that in the beginning of the program implementation:

- Many teachers felt that they were comfortable with many of the target instructional strategies, and implemented them fairly frequently. Additionally, many teachers reported having positive relationships with students.
- There were few extra-curricular STEM activities, additional STEM courses, cross-curricular projects for students, or staff meetings devoted to STEM issues. Staff also reported that not everyone at their school understood what it meant to be a STEM school. At the same time, two-thirds of respondents reported that their schools were focused on a STEM-related goal for students and that their schools emphasized their STEM theme in a number of different ways.
- Staff responses differed among types of schools on many of the dimensions, with staff in comprehensive schools typically giving lower ratings than did their peers on staff-student relationships, meetings about STEM issues, using technology, extra-curricular STEM activities, and STEM vision.

The tables in the Appendices G and H report student and staff responses to all questions for four groups of schools: all 20 RttT STEM schools, anchor schools (4 schools), small new schools and STEM academies (6 schools), and comprehensive schools (10 schools). For some questions, the responses were also analyzed by themed network (Aerospace, Security, and Automation; Health & Life Sciences; Energy & Sustainability; and Biotechnology & Agriscience).

All comparisons described below should be treated with caution, as no statistical testing for differences were performed. All differences may be considered as suggestive, and not as established. After data is collected for the next survey administration, statistical tests for the differences will be performed.

Student surveys. The two largest ethnicities represented in the sample of about 3,000 students were African American and Caucasian (39% and 38% correspondingly). Half of the sample was comprised of female students, and 31% of students were identified as English language learners. These numbers clearly suggest that the sample has a higher proportion of females and minorities than is typical for STEM fields. Almost half of the students were from the 9th grade, a quarter were from the 10th grade, and 13.5% and 11.3% correspondingly from the 11th and 12th grades (see Appendix G for details).

As noted earlier, the Evaluation Team included several constructs in the student survey to serve as indicators of key short-term outcomes for students:

1. Attitudes towards school and learning;
2. Perception of school's impact on growth of the students' 21st century skills (critical thinking, problem solving, technology and work-related skills, communication and collaboration skills, etc.);
3. Perseverance towards school work;
4. Attitudes towards each of the STEM subjects;
5. Confidence in ability to learn each of the STEM subjects; and
6. Interest in STEM-related careers.

Generally, students had positive attitudes towards learning, with 65% to 90% of students agreeing that they enjoy their classes, value learning, and get support for learning in their schools. Students agreed most with the statement that they place a high value on learning (90% agreed or strongly agreed), and agreed least with the statement that they enjoy coming to school most of the time (65% agree or strongly agree). With respect to attitudes toward STEM subjects in particular, students enjoyed learning technology the most (70% to 80% agreed or strongly agreed), and engineering the least (52% agreed or strongly agreed), with mathematics and science in between (56% to 65% agreed or strongly agreed). Many more students reported that they will need a good understanding of math for their future work or career (81% agreed or strongly agreed).

There was also a relatively high agreement with the series of questions on how much the school contributed to a student's growth of the students' 21st century skills (critical thinking, problem solving, technology and work-related skills, communication and collaboration skills, to name a few). For all areas except one, 65% to 79% of students reported that the school helped them to grow either a fair amount or a lot. An exception, "Knowledge about engineering design process," had the highest proportion of students who thought that the school contributed little or not at all (52% of students) to their growth in this area.

Students in general had a relatively high confidence in their ability to be successful in their studies of mathematics, science and technology (74% to 86% agree or strongly agree), and were a little less confident about engineering (66% agree or strongly agree). With regard to students' interest in STEM disciplines as career choices, the most popular subject area is medicine and medical science; 56% of students across schools reported that they are either interested or very interested in this subject area. Various sciences had a lower interest (30% to 35% interested or very interested) with mathematics and engineering in the middle (41% and 45% interested or very interested, respectively). When student interest was analyzed by the themed network, certain subjects were preferred in specific networks (for example, physics and medicine), while others were not (for example, earth science and environmental work).

It is worth noting that when looking at data collected from groups of schools, students in comprehensive schools had consistently lower responses on almost every outcome question (see Appendix G).

There were also several dimensions on the student survey designed to measure the quality of the classroom instruction and the school culture:

1. Frequency of experiencing *rigorous* instructional strategies in different classrooms;
2. Frequency of experiencing *relevant* instructional strategies in different classrooms;
3. Perception of teacher expectations and relationships;
4. Participation in extra-curricular STEM activities; and
5. Meaningful use of technology.

Twenty-nine percent of students reported that they work on projects related to real life at least once a week, and 40% to 55% of students reported that they were asked to engage in other rigorous practices at least once a week. The most infrequent activity reported by students was working on projects across different school subjects. Students from all schools reported being asked to do this activity "never" (24%) or "a few times a year" (29%). Many students reported that the teachers used technology in a number of helpful ways that increased their learning (71% to 77% agreed or strongly agreed).

The percentage of students across all schools who reported that they either never engaged in extra-curricular STEM activities supported by their schools or engaged only once ranged from 66% to 79%. It should be taken into account that some students in the sample were 9^{th} graders who started at the school two to three months prior to the survey's administration, so they did not yet have many chances to engage in such activities. As far as school culture is concerned, a high proportion of students agreed that teachers care about them and their school success, support them, and have high expectations for them (79% to 89% agreed or strongly agreed).

As with students' outcomes, the quality of the classroom instruction and the school culture differed among the groups of schools, with students in comprehensive schools consistently reporting lower agreement with or frequencies of desired features.

Staff Surveys. Of the 334 respondents to staff survey, 85% were teachers, 5% administrators, 6% counselors, and 4% other staff. Table 12 reports on the distribution of subjects taught by teachers.

Table 12. Teacher Respondents' Subject Taught

Subject Taught	Percentage of Respondents
Math	20%
English	19%
Science	17%
Career and Technical Education	17%
Social Sciences	13%
Arts Education	8%
Other Non-STEM Subject	8%
Healthful Living	5%
Information and Technology Skills	3%
Other STEM Subject	3%
World Languages	3%
English as a Second Language	2%

Note: The percentages total over 100% because respondents were able to select more than one subject taught.
n = 286

Staff surveys collected data about teachers' participation in initiative implementation activities, including the following dimensions:

1. Participation in different types of professional development;
2. Networking and collaboration with other STEM schools;
3. Participation in project-based curriculum development;
4. Collaboration with business/community partners related to STEM;
5. STEM vision;
6. Additional STEM classes;
7. Out-of-school STEM experiences for students;
8. Classroom practices related to rigorous and relevant instruction;
9. Classroom practices related to project-based learning and teaching of the 21st century skills;
10. Objectives for student learning;
11. Technology use; and
12. School climate.

The data on the first four dimensions of the staff survey are reported in the corresponding sections above. The rest of the staff survey analyses are reported in this section. All detailed tables reporting staff survey responses can be found in Appendix H.

Staff responded to six questions related to the STEM vision in the school. Teachers most strongly agreed that their schools were focused on a STEM-related goal for students (69% either agreed or strongly agreed). A majority of teachers also reported that they felt their schools emphasized their STEM theme in a number of different ways, be it through work displays, student activities, or some other way (65% agreed or strongly agreed). Teachers were least likely to agree that everyone on staff at their school understands what it means to be a STEM school (43% agreed or strongly agreed) and that students spend extra time learning STEM content or participating in STEM activities (47% agreed or strongly agreed).

Six questions about additional course offerings in technology, engineering design, and four network themes revealed that one year into the program implementation:

1. Additional courses in Technology and Health Sciences were offered by many schools (57% and 59% of respondents said they were offered in their schools).
2. Engineering design was offered more often in Aerospace and Security and Energy and Sustainability networks (79% and 65% of respondents) than in two other networks (23% and 8% of respondents).
3. Energy and Sustainability courses were offered more often in Health & Life Sciences and Energy and Sustainability networks (43% and 44% of respondents) than in two other networks (4% and 8% of respondents).
4. Biotechnology and Agriscience courses were offered more often in Biotechnology and Agriscience and Energy and Sustainability networks (53% and 50% of respondents) than in two other networks (19% and 8% of respondents).
5. Aerospace and Security was offered more often in Aerospace and Security network (23% of respondents) than in three other networks (0%, 1%, and 8% of respondents).
6. Approximately one quarter of staff did not know whether these courses were offered in their schools (19-30% of respondents).

Staff knowledge about extra-curricular STEM activities for their students could also be significantly improved: 35 to 42% of staff members surveyed did not know how many students in their school participated in four specific extra-curricular STEM activities: internships in STEM facilities, field trips to STEM facilities, STEM-related clubs, and STEM-related projects in the community. Only 1% to 9% of respondents reported that more than half of the students participate in these activities, and 35% to 48% of respondents reported that these activities were not offered in their schools.

Self-reports on frequency of teacher use of relevant and rigorous instructional practices reveal that most teachers implemented most of these practices either monthly or weekly. The most frequently implemented practices include asking students to explain their thinking (60% implemented daily), encouraging students to find more than one way to answer a question (40% implemented daily), and asking students to discuss important ideas with each other (40%

implemented daily). The least frequently implemented practices included implementing a project with a teacher in another subject area (2% implemented daily and 42% never implemented), implementing projects in their classrooms (10% implemented daily and 8% never implemented), and asking students to develop and test a theory or hypothesis (7% implemented daily and 19% never implemented).

Ten questions asked teachers about their comfort level with implementing Common Instructional Framework (CIF[9]) strategies and various aspects of implementing projects. Except for integrating literacy groups into instruction (49% of teachers), most teachers were either fairly or extremely comfortable with all CIF strategies (69% to 87% of teachers reported that they could do these strategies fairly well or felt extremely comfortable and could teach others). Likewise, 71% and 75% of teachers were either fairly or extremely comfortable with designing and implementing projects, and managing and assessing students during project work, respectively. Two-thirds of respondents reported that they use technology either weekly or daily. The breakdown of technology use for various instructional goals can be found in Table H10 in Appendix H.

Four questions asked teachers how frequently they met in school to discuss various STEM-related issues, plan STEM activities, or engaged in STEM-related professional development. The results reveal that 18% to 35% of respondents said they never met for such meetings, and 30% to 35% of respondents said they met once per semester. Two-thirds of respondents indicated a very infrequent focus on STEM issues during school meetings, if there was any at all. Five questions asked teachers about relationships between students and staff. Positive relationships were reported by 51% to 84% of staff with the highest agreement received by "Every student in this school is known well by at least one staff member," and the lowest agreement received by "Students respect all the faculty members in this school."

Staff responses differed among types of schools on many of the dimensions, with comprehensive schools being comparatively lower on staff-student relationships, meeting about STEM issues, using technology, extra-curricular STEM activities, and STEM vision.

VI. Site Visits to Affinity Schools

This section presents an analysis of the Evaluation Team visits to the four sample affinity schools in the spring of 2013. During the visits, evaluators interviewed principals, math teachers, science teachers, and students. Members of the Evaluation Team also conducted formal observations of STEM classrooms.

Our analyses of site visits to affinity schools revealed the following findings:

- In all of the affinity schools visited by the Evaluation Team, the STEM initiative is in the beginning stages of implementation.
- In all four of these schools, there is a focus on instructional improvement that includes the following elements:

[9] The detailed description of CIF is provided in Appendix F to the Second-Year Report. All questions for this survey are provided in Appendix B to this report.

  - Incorporation of project-based learning; and
  - A focus on the development of students' critical thinking, understanding, problem solving, and communication skills.
- In two schools, staff exhibited a high degree of initiative buy-in. In the other two schools, buy-in is still an area for improvement.
- The primary focus of implementation is on changing instruction to incorporate CIF across subject areas; a secondary focus is on development of STEM projects and themes.
- Regarding technology use, a common goal among schools is to shift away from use by teachers and to increase technology use by students.
- The single most notable impact of the initiative on students reported across all schools was an increase in student engagement.
- The challenges for implementation fall into five main categories: 1) logistical, time, and resource challenges; 2) student, faculty, and community buy-in; 3) implementation of STEM curriculum and instruction; 4) sustainability; and 5) relationships with the wider community.

This section is divided in four subsections:

1. Overview of the affinity schools;
2. Development of a vision for STEM schools and the STEM Affinity Network by students and staff in affinity schools;
3. Perceived preliminary outcomes of the initiative in:
   a. Staff buy-in,
   b. STEM curriculum,
   c. Use of technology,
   d. Instructional improvement,
   e. Impact on students; and
4. Challenges that affinity schools are facing as they continue implementation.

Overview of the Affinity Schools

In February 2013, the Evaluation Team visited a sample of four affinity schools. As noted above, two of these schools, Greenbrier Agriscience and Laurel Agriscience, are considered comprehensive schools that work to implement the STEM model as a whole-school reform. Greenbrier Agriscience has approximately 600 students and Laurel Agriscience has approximately 750 students. Each school belongs to a different rural LEA that is implementing the STEM initiative in every high school. Both Greenbrier Agriscience and Laurel Agriscience have Agriscience and Biotechnology as their theme. They both joined the STEM network in the late fall of 2011, so we visited them about one year after they started implementation.

Prior to this initiative, Greenbrier Agriscience was a turnaround school in a takeover status and was on the edge of being closed. NCDPI's coaches were in the school almost every day. The main emphasis, before the collaboration with NC New Schools started, was on remediation for the low level students. As one staff member noted, "You're at a school right now that was 38% proficient five years ago, and almost became 80% last year. The tests went up in three years and the Early College/STEM initiative started right after that." Greenbrier Agriscience is a part of an LEA-wide early college/STEM initiative, so the LEA's RttT funds were spent on hiring five achievement coaches for the county, and funding extensive professional development for teachers and principals. The Early College model at the LEA-wide level is defined by the three components:

1. NC New Schools Design Principles;
2. Common Instructional Framework; and
3. Increased college opportunities; starting college readiness awareness and activities at the elementary school level.

Prior to this initiative, Laurel Agriscience was going through training on the Common Core Standards, which caused staff to realize that they would need to emphasize critical thinking and presentation skills much more. When invited by NC New Schools to join the STEM Network, the superintendent and the high school principals realized how well this opportunity seemed to align with the transition to the Common Core Standards, so all high school principals and the superintendent decided to participate.

Energy Academy and Health Academy were created as new STEM Academies within an already-extant comprehensive school. Energy Academy's theme is Energy and Sustainability, and Health Academy's theme is Health and Life Sciences. Energy Academy is in its second year and has approximately 108 10^{th} and 11^{th} grade students, while Health Academy is in its first year and has approximately 100 9^{th} grade students.

Energy Academy is a school of choice and a part of a school-within-a-school model, with all ninth graders attending Freshman Academy and then choosing between STEM and the Leadership and Public Service Academies for their 10^{th} through 12^{th} grade studies.

Both the principal and assistant principal of Health Academy are relatively new to the school, starting in January 2012. Prior to joining the initiative, Health Academy had a focus on technology as the county put substantial emphasis and resources on the development of technology in the schools. In the words of one staff member:

> Every classroom in our county has a SMART Board and a projector, and most schools have five to six sets of the voting mechanisms for their classes. We have IVCs [Internet Video Conferencing devices] in each of the media centers, which are used fairly well. We're technology rich; we've had STEM as an underpinning.

At the same time, there were initial difficulties and confusion at the start of the STEM initiative. It was unclear to the school who was setting up expectations for them and holding the school accountable: NC New Schools, their LEA, or NCDPI. The school staff also felt that their voices were not heard in setting up activities and making decisions, such as selecting the school's theme. Also, the lead STEM teacher advocating for this initiative has left the school right before the start of the school year creating the staffing obstacles. In the words of one staff member:

> [W]e've had several obstacles and just trying to get things off the ground . . . the one teacher who had been employed over the summer who had done a lot of the planning and leadership literally left before school started. . . . We didn't have the staff solidified as far as who is going to be teaching STEM this year, and there were still some last minute changes. So I feel like there's some foundation that was missing in our case when we started in August with the implementation.

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

Building a common vision for the outcomes of the initiative 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 NC New Schools STEM vision combines the NC New Schools Design Principles (implemented both in the early college and redesign reform models) with elements of STEM (such as a school-wide STEM theme and cross-curricular projects addressing authentic STEM problems).

Analyses of interviews indicate that, in all four visited schools, the common understanding of the initiative focuses on instructional improvement and includes the following elements:

- Incorporating project-based learning; and
- Focusing the instruction on the development of students' critical thinking, understanding, problem solving, and communication skills.

In the words of one teacher, "[N]ow we [have] become more project-based learning[-focused] and we're incorporating more of . . . the Ag science and biotechnology." Added another teacher in a different school:

> I think eventually going to a more project-based learning type instruction, I think that the kids are going to have a benefit over traditional schools who are not doing that, just because their ability to be able to talk about what they know, to work on teams, to actually be creative enough to find an issue, to discover that issue, to be able to resolve it in some way.

Energy Academy staff adds that the school provides a more tailored curriculum to students interested in STEM. Greenbrier Agriscience, which is part of an LEA-wide early college/STEM initiative, places an additional emphasis on college readiness as a part of this initiative. The leadership in Health Academy (which just opened in the current school year) reported that the school has not yet developed a common and clear vision for their STEM school, that they have not embraced their theme, and they have concerns that narrowing the theme will alienate students interested in different STEM areas.

It could be concluded from the interviews that instructional improvement definitely receives priority in the STEM vision being developed in the schools. While instructional improvement is a common element of vision among all schools, schools vary on additional components of the vision.

Perceived Outcomes of the Initiative in Affinity Schools

During the interviews, we asked staff in the schools a general question about changes in the school since the start of the initiative and specific questions about perceived changes in STEM curriculum, technology, instructional strategies and students' attitudes and behavior. In all four schools, staff discussed the buy-in into the initiative up to date.

Staff buy-in. Staff in at least two schools noted that one of the main outcomes of the past year's activities was an almost universal teacher buy-in into the STEM initiative and corresponding instructional improvements. As one principal said:

> [T]hat's the first time I've been involved in a school improvement plan that I believed in. . . . I like the way New Schools approaches that because we get buy-in.

As another principal said:

> With the Common Core and NSP [New Schools Project], it's all about critical thinking and problem solving and that's what we're leaning towards more and more and we're trying to move away from the traditional sit and get. . . . I would say that 80 to 85% of the faculty have embraced the [NC New Schools Design Principles]. We have very few naysayers.

In the words of a teacher:

> I feel like the initial conversation was just another . . . something else to put on the plate, think initially that's kind of how I felt. And I'll speak for a couple others that I know of and they said, "It's just something else for us to do." And then as the conversations got into the meaning and reasoning why we're going to do this and you start to believe in it, and I think that's the biggest thing, is believing in it.

This is how one staff member reflected on staff buy-in in four high schools in the LEA that are part of the STEM initiative (the Evaluation Team visited just one of these schools):

> I'd say it's probably in pockets as well. You know. One of the unfortunate things probably with the Race to the Top is people see it as, "I know it's here today and I know it's not gonna be here tomorrow," so a lot of people are programmed to think that when it goes away, we'll go to something else. . . . Well, I know there are some that haven't bought in. But I'd say our numbers are getting bigger that do see the benefit of what we're doing.

STEM curriculum. While STEM theme and cross-curricular work was not often mentioned by staff as the elements of the STEM initiative's vision, this work is beginning in all four schools. Here we will report on how schools are incorporating the theme in their core classes, cross-curricular work and projects, and additional STEM offerings in the schools.

Greenbrier and Laurel Agriscience and the Health Academy have started to incorporate STEM-related topics and practices in non-STEM classes, while mentioning that this effort is just starting and the schools hope to improve and do more of it. Some interdisciplinary projects between math and English classes in Greenbrier Agriscience were related to community needs: students wrote letters to politicians about building additional roads in the area. Cross-curricular projects have been started by a few teachers, but not all teachers in the Greenbrier Agriscience are aware of what's going on in other classrooms with regard to cross-curricular projects:

> But we're still trying to tweak the schedule a little bit so we can do some more cross-curricular PLCs or professional learning communities. So we're working. We're not there yet.

Teachers at the Energy Academy, and Greenbrier and Laurel Agriscience have started to incorporate the school's theme in core STEM and other subjects. For example, a teacher at one of the schools had her students work on projects integrating agriscience and biotechnology:

> In my classes, since I have biology and we do stuff with like photosynthesis and plants, we have one project where . . . they have to sell artificial photosynthesis to the medical industry, the agricultural industry, the food industry, the technology industry, and then we have another project where we do like the cell model and they have to create like a blueprint like for engineering, a blueprint for a cell city and . . . their idea of transportation in and out of the city.

Laurel Agriscience took on a school-wide research project on honey bees in their local area. In the words of one staff member:

> [T]his STEM initiative here at [our school] is not just oriented towards the math and the science department. It is oriented towards all departments and we actually have departments that are collaborating. For example, with our overall theme with the biotechnology and our project with the bees, we've already in our morning sessions worked out what role each department will play in that process.

Students at Greenbrier Agriscience confirm that they do many projects, mainly in CTE classes: agriculture, construction (build a house), health sciences. All of this project work in CTE classes was happening before the start of the STEM initiative. While the theme is definitely present in Greenbrier Agriscience at least through the CTE department, the STEM theme is not yet a focus of attention of the school's or LEA's professional development. A staff member knowledgeable about all four high schools in Greenbrier's LEA commented that they were trying to get some basic aspects of instructional improvement in place first:

> But the things that we're doing, like instructional rounds, lesson plan tuning, using . . . learning about the Common Instructional Framework and then trying to implement those in what we've already done has been our biggest challenge thus far and I think that once teachers are more comfortable with those processes and that way of teaching, then we'll be able to better implement the actual content of agriscience and biotechnology.

Two of the schools added STEM-focused course offerings. Health Academy had offered an additional STEM course "Technology, Engineering, and Design" in fall 2012, which incorporated many design aspects of STEM. Due to increased focus on the school theme, Laurel Agriscience offered a biotechnology class in partnership with a local Community College that granted college credit to students who took it.

> [County] Community College is a college partnership. . . . Last semester we offered a biotechnology class. The reason we offered that biotechnology class to our students, and it was college credit, was because of our partnership with New Schools.

In the future, Laurel Agriscience is also planning to offer an engineering course. They have also changed their curricula in math and science courses to those recommended by the NC New Schools: Integrated Math I and II, and Modeling Instruction in Physics, Chemistry, or Biology. There were no changes in core math and science curriculum in the other three schools that we visited.

Use of technology. Technology is widely used across all four schools, and there are some commonalities among them. All of these schools had a clear emphasis on technology and a focus on using the available technology effectively. All four schools are using technology to support the curriculum, at least to some extent. All four schools also point to functional issues as barriers to effective use of technology, to one degree or another. However, there is a great deal of difference across the schools in how technology is used, the degree to which it is available to students and teachers, and the support available for facilitating its use.

Energy Academy is a one-to-one school and has integrated technology firmly into the fabric of the school. Each student in grades 6-12 has a MacBook Air, purchased with local funds. Computer use is incorporated in some form across most curriculum areas, with students using their computers both for research and to generate products for classroom assignments, as well as to participate in online courses not available at the school. Assignments are submitted electronically, and STEM teachers use the HAIKU learner management system to maintain immediate access to information on each student. More extensive use of technology is planned for next year, possibly with an engineering emphasis; the school may use Race to the Top funding for this push.

Technology is also widely in use at Laurel Agriscience. While this is not a 1:1 school, mobile laptop carts and class sets of tablets, as well as other technology, are available for classroom use. Students use technology to access information over the internet, take tests online, and use social media as a part of their learning experience. Laurel Agriscience places a strong emphasis on providing teachers with support to use the available technology effectively, in the form of professional development and collaborative planning. However, while technology is firmly in place as a part of the learning experience at this school, staff indicated that their goal is to see the technology more in the hands of students, used as a learning tool, rather than only in the hands of teachers.

Greenbrier Agriscience approaches the use of technology from a different perspective. At this school, every classroom was equipped with a SmartBoard this year; some laptop carts also were available, funded by the LEA. Greenbrier Agriscience is focused on “bringing the world into the school.” They have used funds supplied by RttT to purchase a studio that will be used to broadcast content and information to every classroom SmartBoard. They plan to use this equipment to offer STEM content to students, as well as for videoconferencing and online course work.

Health Academy also has every classroom equipped with a SmartBoard and IVCs in each of the media centers, which are used fairly well. Additionally, the school has recently purchased two IPad carts for teacher use through a technology grant. While the attitude toward technology at the school is positive, use of technology varied from classroom to classroom. The school has experienced a great many functional Internet and access difficulties, and currently, teachers are the ones who typically use the available equipment. Staff would like to see greater computer use by students, and there is some discussion at this school of a "bring your own device" system to ameliorate the lack of enough individual computers available to students.

Instructional improvement. Professional development aimed at instructional improvement is a major component of this initiative. The extent of instructional improvement in four visited schools was judged based on the following sources:

- Interviews with teachers, principals, and an LEA-level coach about perceived changes in instruction;
- Focus groups with students; and
- Observations by the Evaluation Team in selected classrooms.

Interviews and focus groups. The major focus on the Common Instructional Framework (CIF) in professional development and coaching is reflected in how teachers and principals describe the impacts of the initiative on teachers. Staff in all visited schools said they have been incorporating the CIF strategies and making instruction more student-centered. In the words of a principal:

> I've seen evidence of CIF. Even if you just walk the halls, you look in a classroom, you see more cooperative work going on and you see more student-driven teaching instead of teacher-driven, and you just . . . can see it happening.

Another principal commented,

> Basically, I think the biggest thing that we have seen, especially through the modeling and integrated math, is the teachers relinquishing the idea that they are the people with the knowledge and they just need to give that knowledge to kids. That's been the biggest thing. We don't see that when we enter a classroom anymore. We see kids who are dealing with content.

Teachers reported doing less lecturing and focusing more on group work and hands-on activities; they also reported incorporating more rigorous instruction with the focus on concepts, more critical thinking skills, more student presentations, and more active student engagement into their learning. Teachers in all visited schools also spoke about trying to incorporate more project-based learning, with varying degrees of success.

At the same time, we heard that instructional improvement has not been consistent across classrooms. In some cases, students have not seen noticeable changes in instruction because they say they were already doing substantial amounts of group work in their classes before the initiative. In other cases, teachers are focusing more on CIF strategies and are not yet comfortable incorporating PBL as well, though they expect this will change over time.

Classroom Observations. During visits to schools, evaluators observed 12 classes spanning the following content areas: math (3), science (5), CTE (2, engineering and agriscience), English, (1), and art (1). The 12 classes were comprised of a total of 192 students (98 males and 94 females). Reported grade distribution included: 9th grade only classes (4), 10th grade only classes (2), and a combination of multiple grade levels (6: 9th, 10th, 11th, and/or 12th).

Two observation instruments were used during the observation of instruction in the 12 classrooms: a) the CLASS instrument to evaluate the general quality of classroom teaching and b) the STEM Classroom Observation instrument to capture program-specific instructional information.

The CLASS instrument organizes classroom interactions into four overarching constructs (emotional support, classroom organization, instructional support, and student engagement), including a total of 12 dimensions which are scored on a 7-point scale (low-range: 1, 2; mid-range: 3, 4, 5; and high-range: 6, 7, with 4 being the middle of the scale). The CLASS observation protocol divides classroom observation time into 25-minute periods which include 15 minute segments for observing instruction and 10 minutes segments for rating. (See Appendix B in Second Year Report for CLASS scoring rubric.)

Analysis of 34 15-minute CLASS observation segments conducted across 12 classes showed that all CLASS dimensions had mean scores in either the mid-range (3.0 to 5.99) or high-range (6.0 to 7.0). Table 13 (following page) provides mean scores and standard deviations for each of the CLASS dimensions.

Keeping in mind that the number of CLASS observations was relatively small (*n*=34), and reported differences were not tested for statistical significance, the summary of the data is as follows:

- All mean scores were above the mid-range cut of 3.0 (including Negative Climate when inversing the mean score).
- Behavior Management and Positive Climate received the highest scores (6.18 and 6.03, respectively).
- Analysis and Problem Solving received the lowest score (3.12), the only score below the middle of the scale (score of 4).
- When the data were disaggregated based on subject (math-related, science-related, or other), math classes appeared to score slightly higher than other subjects on Quality of Feedback (4.40) while science classes appeared to score slightly higher than other subjects in Regard for Adolescent Perspectives (4.42), Behavior Management (6.21), Instructional Learning Formats (4.89), and Instructional Dialogue (4.26). The “other” classes (English and art) scored slightly higher on Positive Climate (6.80), Teacher Sensitivity (5.80), Productivity (6.00), Content Understanding (5.00), Analysis and Problem Solving (4.80), and Student Engagement (6.20)—and lower on the Negative Climate mean (1.00).

Table 13. CLASS Observation Mean Scores for Sample STEM Schools (2013)

Dimension	*Mean (1–7)*	*SD*	**Dimension Description**
Positive Climate	6.03	.72	Positive climate reflects the emotional connections among teachers and students and the warmth, respect, and enjoyment communicated by their shared interactions.
Negative Climate	1.24*	.50	Negative climate reflects the overall level of negativity among teachers and students in the class.
Teacher Sensitivity	5.32	.88	Teachers demonstrate sensitivity by noticing when students need support and actively responding to their needs.
Regard for Adolescent Perspectives	4.32	1.01	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	6.18	.58	Teachers manage the classroom well when they communicate and fairly enforce rules and expectations and when they redirect minor behaviors.
Productivity	5.94	.89	In productive classrooms, teachers manage time and routines effectively so that instructional time is maximized.
Instructional Learning Formats	4.82	.76	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	4.65	1.07	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	3.12	1.67	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	4.15	1.50	High-quality feedback **e**xpands 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	4.21	1.23	Instructional dialogues are content-focused discussions that build in complexity, extend over sustained periods of time, and involve many students.
Student Engagement	5.71	.84	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.

In addition to CLASS ratings, observers used the STEM Classroom Observation instrument (see Appendix B in the Second Year Report), designed specifically for this evaluation. This instrument supplemented CLASS with five additional dimensions scored on a 4-point scale (1=not observed, 2=minimal, 3=to some extent; 4=very descriptive of the observation.). Unlike the CLASS instrument (which was developed to collect data multiple times at specific intervals across a single class), the STEM observation instrument was developed to synthesize across the duration of a single class; producing just one rating for each class observed. Table 14 provides mean scores and standard deviations for each of the dimensions. A more detailed table that includes ratings for the indicators for these dimensions is provided in Appendix I.

Table 14. STEM Project-specific Observation Mean Scores

Dimension	*Mean*	*SD*
Quality of Common Instructional Framework	2.83	0.58
Quality of STEM content	2.83	0.58
Quality of inquiry learning; engineering design process, Project-based learning; and Problem-based instruction	2.58	1.00
Quality of formative assessment	2.42	0.51
Quality of use of technology	2.27	0.79

Across the 12 observed classes, the majority of the classes (75%) spent equal time on: a) practicing algorithms/basic skills and procedures/vocabulary and b) concept development and meaningful learning—while 17% of classes spent most time on just practicing algorithms/basic skills and procedures/vocabulary and 8% on just concept development and meaningful learning.

Keeping in mind that the number of observations was relatively small (*n*=12), and reported differences were not tested for statistical significance, the summary of the data is as follows:

- All five dimensions had average rating between 2 (minimal) and 3 (observed to some extent).
- Quality of Common Instructional Framework and Quality of STEM Content received the highest average ratings (2.83)—while Quality of Use of Technology received the lowest average rating (2.27).
- Among 32 individual indicators (see Appendix I), the item regarding accuracy of content information and teacher's use of appropriate mathematics/science vocabulary received the highest mean score (3.56)—while the item regarding students' use of technology to explore or confirm relationships, ideas, hypotheses, or develop conceptual understanding received the lowest mean score (1.17). This score means that technology was almost never observed being used for this goal.
- When the data were disaggregated based on subject (math-related, science-related, or other), math classes appeared to score slightly higher than other subjects on quality of Use of Technology (2.67) dimension—while science classes appeared to score slightly higher than other subjects in quality of STEM Content (3.00) and Formative Assessment (2.50). The "other" classes (English and art) scored slightly higher on the quality of Common Instructional Framework (3.00) and Inquiry Learning; Engineering Design Process, Project-based learning; and Problem-based Instruction (3.5).

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, principals; and
- Focus groups with students.

The single most notable impact reported across all schools was an increase in student engagement. Staff at all sites said that their students were more motivated and more engaged in the classroom, particularly because of instructional changes coming from use of the CIF. Staff and students mentioned increased use of group work and hands-on projects, more classroom discussion, and an emphasis on different "learning styles." As a result of these changes, students were more excited about learning. Giving students increased responsibility has helped to motivate them. The principal at one school said, "I think through CIF especially, it…kids more expect coming to class to be engaged at a higher level… I see kids on a daily basis more engaged in the classroom than I did when I came here before." At some schools, teachers said that this increase in engagement had helped reduce misbehavior and disruptions – "The kids are behaving because they're engaged."

Students agreed that instruction had changed and that they were being given more responsibility, and that they felt more engaged and involved in the classroom as a result. Below are some quotations from students at different sites:

- As STEM students, we're more like- they give us more responsibility and we have- like they look at us as being very self-motivated. So we have to work on our own, and they trust us. A lot of times a teacher will tell a group of kids, say go to the library and come back in 45 minutes.
- For me it helps me focus more in doing hands-on activities or working in groups rather than just sitting there listening to the teacher, which is kind of boring.
- In STEM since we're all like one on one with the teachers and all the teachers know our learning styles and stuff, we're respected more. And like we all respect our teachers. And the teachers respect us. Whereas in the regular part of the high school, the teachers don't get to build that one on one connection because they've got 80 different students in a school day. So a kid may not have that respect with the teachers that we are able to have. And I like our class size, because they're fairly small. And we have a lot of discussion within our class.
- [Regarding collaboration:] Everybody has a different viewpoint on a problem so you can combine them and make it a lot easier...It helps to get along with people more too, to listen to their opinions.

Schools appear to be making efforts to increase student interest in STEM subjects and careers, but most say that there have not been significant changes at this point. One school's STEM program has only been in place for a semester, so there has not been time to observe many impacts on students yet.

Challenges Faced by Schools

In general, schools are committed to the STEM initiative but still face significant challenges in terms of implementation. Schools are still working on getting necessary levels of buy-in and tailoring the STEM programs to work within their individual structures and limitations. Teachers are sometimes unsure about exactly what is expected of them. It can be difficult to find time to incorporate all the new ideas and strategies in the classroom and still cover the required material. There are some concerns about the sustainability of the programs going forward, and schools emphasized the need for continued coaching and support, but in general they seem positive about the program and are looking forward to continuing implementation.

The challenges for the implementation mentioned by teachers, staff and coaches in the STEM schools visited fall into five main categories: 1) logistical, time, and resource challenges, 2) student, faculty, and community buy-in, 3) implementation of STEM curriculum and instruction, 4) sustainability, and 5) relationships with a bigger community.

1. Logistical, time, and resource challenges:
    - Transportation issues limit schools' ability to offer programs and support outside of official school hours.
    - Teachers lack materials and resources for some projects (such as the hands-on science labs modeled in professional development) as well as technology, such as laptops for students to use.
    - Energy Academy is geographically isolated, which makes active participation in the STEM network more difficult. They must also deal with the fact that many of their students lack internet access at home.
    - Teachers mentioned that it is a challenge to find adequate time to prepare projects and incorporate new instructional strategies while still covering the required curriculum.
2. Student, faculty, and community buy-in:
    - Three of the four schools talked about the difficulty and importance of getting community, faculty, and student buy-in. In a large comprehensive school, it can be difficult to get buy-in across the entire school staff.
3. Implementation of STEM curriculum and instruction:
    - Teachers mentioned the difficulty of grading cross-curricular projects where students do work for several teachers in several subject areas.
    - One school's teachers reported that the biggest challenge for them was adopting the NC New Schools instructional style, which they feel positively about but find very different from their traditional methods.
4. Sustainability:
    - Schools are concerned about the sustainability of funding for program components post-Race to the Top. RttT funds have catalyzed many changes but the schools will have to look elsewhere for funds to keep those changes going after RttT ends.

5. Relationships with a bigger community:
    - STEM programs contained within larger comprehensive schools struggle with keeping STEM students from feeling isolated and with dealing with non-STEM teachers' concerns that things must be much easier for teachers in the STEM program because they have smaller classes and better students.

Conclusions and Recommendations

The Year 2 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 3 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.

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. While all four areas of implementation are receiving great attention from the Implementation Team, some of these areas moved further along than others. In many cases, there are components within the areas that progressed faster or slower relative to other components. Additionally, implementation in different types of schools moves along with a different speed.

In this section, we first summarize the conclusions and recommendations for the whole initiative, and then we provide summaries for each of the four areas of implementation reviewed above and for the intermediate outcomes observed in the affinity schools. Some of the challenges summarized in this section are persisting from the previous years and are described in the previous report. These challenges are marked with an asterisk. The implementation team is advised to continue addressing these challenges.

Initiative as a Whole

Staff and student surveys revealed that one year into implementation, comprehensive schools are lagging behind anchor and small new schools, and STEM Academies in all four areas of implementation, as well as in intended student outcomes. These differences between comprehensive and other schools are demonstrated for students' attitudes, motivation, and interest in STEM subjects and careers, as well as for students' and staff reports on implementation of the program's components. Differences in students' preliminary outcomes between types of schools may be explained by the admission process for many of the small schools and academies, for which students have to apply, suggesting that they are motivated to be there in the first place. The differences in implementation may partially be explained by the schools' sizes and subsequent challenges in engaging all staff and students in the school into implementation.

These initial differences between types of schools present a challenge that has to be addressed as implementation continues. While larger schools do get more days of coaching, research has shown that it is harder for bigger schools to engage in whole school reform and to change the school culture. The Implementation Team may consider devoting some time to meeting with comprehensive schools as a group to discuss their specific challenges in implementation, sharing strategies of those schools which were more successful in getting buy-in from most staff, and providing some guidance to less advanced schools. They also may benefit from online discussions addressing specific challenges of comprehensive schools.

Across the implementation areas, there are reports of greater focus on general instructional strategies, such as group work, communications (speaking and writing), and questioning, and a lesser focus on STEM-specific activities such as student engagement in cross-curricular or real life projects, and in STEM-related activities supported by the school. These differences in emphasis were reported both in staff surveys and in interviews with staff in four visited affinity schools. The Implementation Team may consider increasing the focus on STEM-specific components of the Initiative in the last year of implementation.

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

During the data collection period for this report (August 2012–June 2013), most of the 20 network schools had been involved in the RttT STEM initiative for about a year. While NC New Schools has encouraged and facilitated networking and collaboration by various means, face-to-face meetings have been more successful than online networking in facilitating collaboration. Based on staff surveys, 44% of staff participated in face-to-face meetings, and 29% of staff have already participated in online collaboration with other schools as of fall of 2012.

The networking and collaboration were very successful in two LEAs in which all high schools were part of the network with the same theme, likely due to the physical proximity and the common content interests. Moving some professional development elements into the online space, the new strategy for the online networking, did produce additional online communication among members of the network as did a new strategy of using Twitter for online chats about STEM-related topics.

The STEM network does face some challenges. Challenges identified in this evaluation are listed below, accompanied by recommendations to help address those challenges.[10]

1. *While there are plenty of face-to-face networking opportunities for the schools, online networking continues to lag behind. Given the number of staff in comprehensive schools, it may be challenging to engage all of them in face-to-face meetings organized by NC New Schools through the life of the project. The Implementation Team should continue to explore various online modes of communication. For example, summer content institutes could require additional online follow-up sessions so that participants can share their teaching experiences and/or lesson plans for particular topics or certain instructional strategies. Additionally, instructional and STEM coaches could create online groups for follow-up after face-to-face visits.
2. While teachers and principals find face-to-face networking at various professional development events very valuable, they also find these encounters too brief to provide a basis for the subsequent ongoing collaboration. The Implementation Team should consider facilitating cross-school working groups that have a common goal of creating products for the participants' schools, such as unit plans, common authentic assessments, or planning extra-curricular STEM activities. These working groups may combine face-to-face and online modes of collaboration. Online platforms such as Edmodo or Twitter could be used for finding common goals or products teachers would like to work on together.

[10]Challenges that are similar to those identified in the previous year report are marked with an asterisk.

3. *Geographically isolated rural schools reported little or no collaboration with other STEM schools in their themed network. The Implementation Team should consider facilitating collaboration within themed networks by combining face-to-face and online modes of collaboration. Such collaboration might include business partners from IIC with some connection to the theme. Additionally, site visits to other schools in the same theme network could facilitate such collaborations.

II. Professional Development

The Evaluation Team found that STEM Affinity Network schools had access to extensive professional development opportunities. STEM schools participated in multiple professional development events 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. Professional development included extensive onsite coaching provided by leadership and instructional coaches, with an average of 9 leadership and 35 instructional coach visits per school. These coaches provided services related to improving instruction and strategic planning in STEM schools. Based on staff surveys, 86% of staff participated in workshops or professional development offered by NC New Schools Project, and 70% of staff participated in instructional coaching from the STEM network coaches.

In most cases, both participants and outside observers perceived the professional development to be relevant and of high quality. Participants were observed to be highly engaged in most sessions. Both teachers and principals view coaching as a crucial component of the professional development, essential for the program sustainability. Instructional coaching in STEM schools mostly focused on the Design Principles and CIF, with much less attention paid to projects or working on the school's STEM theme.

Challenges identified in evaluation of professional development are listed below, accompanied by recommendations to help address those challenges moving forward:

1. Sessions at the Scaling STEM Conference received the lowest average ratings among all observed professional development events on three of the four indicators for STEM content quality, as well as on the quality of design, implementation, and culture of professional development. Among a sample of observed sessions, most Scaling STEM Conference sessions were designed as informational sessions with presentation as a predominant mode, little small- or whole-group discussions or opportunities for interaction, and few activities for participants. The Implementation Team should consider strengthening sessions at future STEM Conferences by providing more opportunities for participants to:
   a. practice new skills and/or apply new knowledge;
   b. consider how they would apply what they learned in their school, or to develop a product that they will use in school; and
   c. engage in small- and whole- group interactions.
2. *While instructional coaching in STEM schools mostly focused on the Design Principles and CIF, with much less attention paid to projects or to developing each school's STEM theme, some staff viewed it as not well aligned with their schools' needs. The Implementation Team

should consider increasing the flexibility of the coaching content based on each school's specific needs, as well as either increasing the amount of STEM-specific coaching or combining CIF with STEM-specific coaching.

3. In larger schools, not all staff can be trained directly by NC New Schools, so principals have to figure out how to train other teachers at the school in order to truly support whole-school change. The Implementation Team should consider new ways of bringing the most essential professional development events (such as the New Teacher Institute, Critical Friends Group, or Common Practices Symposium) to all teachers in each school. For example, LEAs in which all high schools are the members of the network could have some local professional development events with increased numbers of participants from each school, or the Team could increase coaching efficiency by coaching teachers in teams in addition to individual coaching.
4. A challenge mentioned by teachers was the need for more time for actually planning lessons/projects that incorporate new instructional strategies. The Implementation Team should consider devoting more coaching time to lesson- and project-planning that incorporates new instructional strategies.

III. Development and Implementation of Project-Based Curricula

The curriculum design work was completed in accordance with the contract awarded to NCSSM by NCDPI. Reviews by STEM teachers of the newly-developed STEM curricula point to many strengths as well as areas for improvement of the materials. A number of anchor and small new schools are developing integrated STEM courses that parallel those being developed by NCSSM.

NC New Schools devoted a number of sessions in professional development events to the four STEM themes, to project design, to project-based learning, and to conducting a special event to bring together STEM curriculum developers and users. One year into the initiative, the majority of teachers have not yet participated in the development of STEM cross-curricular projects. Participation in this work was much higher in the anchor and small new schools.

NCDPI's STEM Recognition Program developed a vision for STEM schools and programs in the state that includes eleven attributes. Six of these attributes belong to a broad area of "Integrated Science, Technology, Engineering and Mathematics (STEM) curriculum, aligned with state, national, international and industry standards." This means that any school or program that aspires to be recognized by the state as a STEM school or program has to implement integrated STEM curriculum. While such curricula are currently being developed, the evaluation team identified multiple challenges that both developers and schools will face during implementation of such integrated STEM curricula.

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

1. The reviewers of the STEM courses developed by NCSSM rated the rigor in most areas at the medium or low levels. At the same time, these same materials may be considered as too rigorous in math and science content by teachers with little STEM background knowledge. The Implementation Team should consider including in the Teacher Guide clear guidance to

schools on the level of rigor in STEM content areas teachers of these courses are expected to provide.

2. *The courses under development by NCSSM have not yet been pilot tested with the target groups of students and teachers. Such pilots are needed in order to (1) learn whether CTE teachers (target users of the curriculum) are able to implement the curriculum as intended or whether adjustment are needed to accommodate their needs; (2) learn whether the curriculum works with the target student population; (3) learn about supports needed for curriculum implementation; and (4) receive information for curriculum revisions and refinement. The Implementation Team should consider finding opportunities to conduct such pilots and curriculum revisions before making the courses available for broader use.
3. Because the courses integrate multiple STEM subjects with ELA and thematic content, they present a challenge for finding teachers with the appropriate qualifications to teach these courses. It will be hard to find teachers with the right background knowledge to teach these CTE courses with the intended levels of rigor and depth of STEM content coverage. The Implementation Team should consider including in the Teacher Guide a clear description of the background teacher knowledge desirable for teaching each of the courses to provide guidance to schools implementing these courses. Additionally, the Implementation Team should consider unconventional ways to implement these unconventional courses. For example, to preserve the rigor of STEM content, these courses might be taught by teams of teachers that include both CTE and core STEM subject teachers.
4. *Some content of the STEM courses may be unfamiliar to prospective teachers. Such content may include material related to the theme, programming, engineering, technical writing, technology, and certain STEM content. The Implementation Team should consider finding ways to provide necessary professional development for prospective teachers of STEM courses to familiarize them with the new themed content and the new teaching strategies these materials require.
5. *A number of organizations and schools in North Carolina are currently developing integrated STEM curricula around different topics, some of which overlap, so it is important to find ways to encourage those designers to enrich rather than duplicate each other’s efforts. The Implementation Team should consider conducting regular meetings of curriculum developers (e.g., once or twice a year) to encourage collaboration.

IV. Partnerships

Industry Innovation Councils (IICs) for each of the four themes met quarterly to plan and provide support for the networks. Business partners supported teachers and students in a variety of ways. Three of the affinity schools visited by the Evaluation Team also had established their own partnerships with local businesses and colleges. The initiative strengthened the focus and breadth of these partnerships.

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

1. One year into the initiative, the majority of the staff (81%) in the 20 affinity schools have not yet participated in a collaborative activity with partners. Anchor schools have participated in

partnerships the most. The Implementation Team should consider helping schools to set up certain goals and foci for such collaborations and to facilitate sharing of successful stories of collaborations with staff in every participating STEM school. Webinars or online chats may be conducive to engaging a wider audience.

V. Student and Staff Responses to Implementation and Outcomes Surveys

Student surveys revealed that, one year into program implementation, students are on the right track for demonstrating positive outcomes of interest. Many students placed a very high value on learning in general and on learning mathematics in particular. Students had a moderately high level of confidence in their ability to be successful in their studies of mathematics, science, and technology. Areas with the most room for improvement include: enjoyment of learning in general and of STEM subjects in particular; and student engagement in the engineering aspects of STEM (from initial exposure to development of confidence in learning about engineering).

Student and staff surveys revealed that, one year into the program implementation, the quality of classroom instruction and school culture was mixed. Students generally reported high expectations and care from their teachers and high levels of meaningful use of technology. Many teachers reported having positive relationships with students, and that they were comfortable with and implemented fairly frequently many of the target instructional strategies. Two-thirds of staff reported that their schools were focused on a STEM-related goal for students and that their schools emphasized their STEM theme in a number of different ways.

Student and staff surveys suggested areas for improvement as the initiative moves forward:

1. Student outcomes, the quality of the classroom instruction, and the school culture differed among the types of schools, with students in comprehensive schools consistently reporting lower levels of desired features than did students in anchor schools, small schools, and academies.
2. Staff responses differed among types of schools on many of the dimensions, with staff in comprehensive schools typically reporting lower levels of staff-student relationships, meetings about STEM issues, using technology, extra-curricular STEM activities, and STEM vision.
3. A number of desired activities were reported by students as not happening frequently, such as student engagement in cross-curricular or real-life projects, and in STEM-related activities supported by the school.
4. Students reported very little exposure to engineering and somewhat negative? attitudes toward engineering.
5. Staff reported that there were few extra-curricular STEM activities, additional STEM courses and cross-curricular projects for students, or staff meetings devoted to STEM issues. Staff also reported that not everyone at their school understood what it meant to be a STEM school.

VI. Site visits to Affinity Schools.

In all four visited affinity schools, the STEM initiative is in the beginning stages of implementation. While in two schools staff exhibited a high degree of initiative buy-in, in the other two schools, buy-in is still an area for improvement. The primary focus of implementation in the schools is on changing instruction to incorporate the Common Instructional Framework across all subject areas, while development of STEM projects and themes is a secondary focus. Some teachers in each of the four schools have started to focus on STEM-related work (such as incorporating themes into core subjects, adding STEM-related classes, and implementing real-life cross-curricular projects). Staff and students reported that the single most notable impact of the initiative was an increase in student engagement.

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

1. *Some schools are facing logistical problems related to transportation, lack of resources for technology and projects, geographical isolation, and lack of time for planning. These schools might benefit from other schools sharing their best practices in solving these problems, either face-to-face or online.
2. *Some schools are still struggling to define what this initiative means for the school and to get community, faculty, and student buy-in. The Implementation Team should consider identifying schools and communities with those issues and providing them with more opportunities for visiting model STEM schools.
3. Schools are concerned about the sustainability of funding for program components post-RttT. The Implementation Team should consider including discussions about sustainability in their professional development events.

Limitations and Next Steps

Limitations

This report is qualitative and descriptive in nature, and it presents data about the development of the STEM school and network model and the implementation of the proposed STEM activities. It should be considered as an evaluation of the *current stage* of project development; the Evaluation Team's conclusions and recommendations are suggestions, though carefully considered and evidence-based ones.

Next Steps

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 outcomes for students in the anchor and affiliated network schools. Next year's report will be the final for this evaluation, and will present a summative evaluation of the initiative's components, intermediate outcomes, and of the sustainability of the initiative. Over the next year, the Consortium for Educational Research and Evaluation – North Carolina will continue to track changes in initiative activities, and use this evidence to determine progress toward expanding the academic opportunities and improved outcomes for students.

The Evaluation Team will collect data from the final administration of the staff and student surveys in all network schools and analyze these data for any changes in the variables of interest. The Team also will continue qualitative data collection and analyses. The next evaluation report of the RttT STEM initiative is scheduled to be finalized in September 2014. By that time, we will be able to analyze data collected through January of the 2013-14 school year. The Team will continue to analyze project documents received from NC New Schools related to all professional development and partner activities, as well as monitor online and face-to-face networking.

In addition, the Team will conduct second site visits to three STEM Anchor schools, and a first visit to the anchor school that was opened in 2012. The site visits will focus on the changes that happened in these schools as a result of the RttT STEM initiative. School and Implementation Team staff will be interviewed about the plans for the initiative's sustainability.

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List of Appendices

Appendix A. STEM Network Schools with Themes and Types, July 2013

School System	School Name	STEM Theme	School Type
Craven County	Early College EAST [a]	Aerospace, Advanced Manufacturing and Security	Anchor
Durham County	City of Medicine Academy[a]	Health and Life Sciences	Anchor
Wake County	Wake NCSU STEM Early College High School[a]	Energy and Sustainability	Anchor
Beaufort, Martin, Pitt, Tyrell, and Washington Counties	Northeast Regional School of Biotechnology and Agriscience[a]	Biotechnology and Agriscience	Anchor
Avery County	Avery County High School	Energy and Sustainability	STEM Academy within existing school
Bertie County	Bertie High School	Health and Life Sciences	Comprehensive school
Columbus County	East Columbus High School	Biotechnology and Agriscience	Comprehensive school
Columbus County	South Columbus High School	Biotechnology and Agriscience	Comprehensive school
Columbus County	West Columbus High School	Biotechnology and Agriscience	Comprehensive school
Davidson County	Yadkin Valley Regional Career and College Academy	Aerospace, Advanced Manufacturing and Security	New small school
Davie County	Davie High School	Health and Life Sciences	STEM Academy within existing school
Duplin County	East Duplin High School	Biotechnology and Agriscience	Comprehensive school
Duplin County	James Kenan High School	Biotechnology and Agriscience	Comprehensive school
Duplin County	North Duplin High School	Biotechnology and Agriscience	Comprehensive school
Duplin County	Wallace Rose Hill High School	Biotechnology and Agriscience	Comprehensive school
Durham County	Southern Durham High School	Energy and Sustainability	Comprehensive school
Guilford County	Guilford STEM Early College High School, A & T	Energy and Sustainability, Biotechnology	New small school
Guilford County	Middle College at UNC–Greensboro	Health and Life Sciences	New small school
Surry County	Surry Central High School	Aerospace, Advanced Manufacturing and Security	Comprehensive school
Wake County	Athens Drive High School	Health and Life Sciences	STEM Academy within existing school

Appendix B. Measures Used for Data Collection

Appendix B contains three protocols developed by the project: (1) Student Survey, (2) Staff Survey, and (3) Rubric for STEM Curriculum Review. Protocols provided in the first and second year reports are not copied here.

Race to the Top STEM Initiative

High School Student Survey

Today's Date: ______________________ Grade: ______________________________

School Name: ____

Gender:
- ❍ Male
- ❍ Female

My race/ethnicity is (please check one):
- ❍ American Indian/Alaska Native
- ❍ Asian
- ❍ Black/African American
- ❍ Native Hawaiian/Other Pacific Islander
- ❍ White/Caucasian
- ❍ Hispanic/Latino
- ❍ Multiracial

Have you been identified as an English Language Learner (Limited English Proficient student) at your school?

- ❍ Yes
- ❍ No

DIRECTIONS:

The goal of this survey is to hear from **you** about your interests, feelings, and experiences in your school. There are no "*right*" or "*wrong*" answers! The only correct responses are those that are true *for you*. This is your chance to provide honest feedback.

Even though some statements may seem similar, please answer each statement. This is not timed; work fast, but carefully.

Your responses are completely confidential: Your responses will be combined with responses from other students in your school before being reported.

Thank you for your participation.

PLEASE FILL IN ONLY ONE ANSWER PER QUESTION.

1. How much do you agree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. In general, I am excited about my classes.	❍	❍	❍	❍
b. I place high value on learning.	❍	❍	❍	❍
c. The support I get at school encourages me to learn more.	❍	❍	❍	❍
d. I look forward to learning new things at school.	❍	❍	❍	❍
e. I enjoy coming to school most of the time.	❍	❍	❍	❍
f. Most students in this school want to do well in class.	❍	❍	❍	❍

2. How much has your experience at this school contributed to your growth in the following areas?

	Very little	Some	Quite a bit	Very much
a. Knowledge about engineering design process	❍	❍	❍	❍
b. Solving real life problems	❍	❍	❍	❍
c. Gathering and analyzing information	❍	❍	❍	❍
d. Thinking creatively to find solutions to problems or projects	❍	❍	❍	❍
e. Making your own decisions about your work on problems or projects	❍	❍	❍	❍
f. Working well in a team of people	❍	❍	❍	❍
g. Communicating effectively with other people	❍	❍	❍	❍
h. Writing effectively	❍	❍	❍	❍
i. Speaking effectively	❍	❍	❍	❍
j. Thinking deeply and critically	❍	❍	❍	❍

	Very little	Some	Quite a bit	Very much
k. Using computing and information technology	❍	❍	❍	❍
l. Learning work-related skills	❍	❍	❍	❍

3. During this school year, how often did the following things happen while you were doing your schoolwork?

	Never	Once in a while	Half the time	Most of the time	All the time
a. I gave up when my schoolwork became too hard.	❍	❍	❍	❍	❍
b. I gave extra effort to challenging assignments or projects.	❍	❍	❍	❍	❍
c. When my schoolwork became too difficult, I found a way to get help.	❍	❍	❍	❍	❍
d. I tried to do my best in school.	❍	❍	❍	❍	❍
e. I kept working on a hard problem or assignment even if it took much longer than I expected.	❍	❍	❍	❍	❍
f. When I failed it made me try that much harder.	❍	❍	❍	❍	❍

4. How much do you agree with the following statements?

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
a. I really like science.	❍	❍	❍	❍	❍
b. I like the challenge of science assignments.	❍	❍	❍	❍	❍
c. I have a real desire to learn science.	❍	❍	❍	❍	❍
d. I will need a good understanding of science for my future work or career.	❍	❍	❍	❍	❍
e. I will need a good understanding of math for my future work or career.	❍	❍	❍	❍	❍
f. I really like math.	❍	❍	❍	❍	❍
g. I like the challenge of math assignments.	❍	❍	❍	❍	❍
h. I have a real desire to learn	❍	❍	❍	❍	❍

i. Working with technology is something which I enjoy very much.	❍	❍	❍	❍	❍
j. I like the challenge of technology assignments.	❍	❍	❍	❍	❍
k. I have a real desire to learn more about technology.	❍	❍	❍	❍	❍
l. I will need a good understanding of technology for my future work or	❍	❍	❍	❍	❍
m. I will need a good understanding of engineering for my future work or	❍	❍	❍	❍	❍
n. I enjoy engineering very much.	❍	❍	❍	❍	❍
o. I like the challenge of engineering	❍	❍	❍	❍	❍
p. I have a real desire to learn more about engineering.	❍	❍	❍	❍	❍
q. I like to imagine creating new products.	❍	❍	❍	❍	❍
r. Knowing science or math or technology or engineering will help me earn a living.	❍	❍	❍	❍	❍
s. If I learn engineering, technology, math, and science, then I can improve things that people use every day or invent new useful things.	❍	❍	❍	❍	❍
t. I would like to use creativity and innovation in my future work or career.	❍	❍	❍	❍	❍

5. How much do you agree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. I'm certain that I can master the skills taught in **math** this year.	❍	❍	❍	❍
b. I can do even the hardest work in my **math** class if I try.	❍	❍	❍	❍
c. If I have enough time, I can do a good job on all my **math** class work.	❍	❍	❍	❍
d. I can do almost all the **math** class work if I don't give up.	❍	❍	❍	❍
e. Even if the **math** is hard, I can learn it.	❍	❍	❍	❍
f. I'm certain I can figure out how to do the most difficult **math** work.	❍	❍	❍	❍
g. I'm certain that I can master the skills taught in **science** this year.	❍	❍	❍	❍
h. I can do even the hardest work in my **science** class if I try.	❍	❍	❍	❍

i. If I have enough time, I can do a good job on all my **science** class work.	❍	❍	❍	❍
j. I can do almost all the **science** class work if I don't give up.	❍	❍	❍	❍
k. Even if the **science** is hard, I can learn it.	❍	❍	❍	❍
l. I'm certain I can figure out how to do the most difficult **science** work.	❍	❍	❍	❍
m. I can do almost all the **technology** class work if I don't give up.	❍	❍	❍	❍
n. Even if **technology** is hard, I can learn it.	❍	❍	❍	❍
o. I am sure I could do advanced work in	❍	❍	❍	❍
p. I'm certain that I can master the skills taught in **technology** this year.	❍	❍	❍	❍
q. I am good at building and fixing things.	❍	❍	❍	❍
r. I believe I can be successful in a career in **engineering**.	❍	❍	❍	❍

6. Think about the **high school teachers** you have had at this school. How often did they do the following things?

This school year, how often have your teachers…	Never	A few times this year	Once or twice a month	Once or twice a week	Almost every day
a. Asked you to work on projects related to real life?	❍	❍	❍	❍	❍
b. Asked you to work on projects across different school subjects?	❍	❍	❍	❍	❍
c. Asked you to research information?	❍	❍	❍	❍	❍
d. Asked you to form and test a theory or hypothesis?	❍	❍	❍	❍	❍
e. Asked you to analyze and interpret documents or data?	❍	❍	❍	❍	❍
f. Had you engage in in-depth discussions about what you have read	❍	❍	❍	❍	❍
g. Asked you to explain your	❍	❍	❍	❍	❍
h. Asked you to apply what you have learned to solve an unfamiliar problem?	❍	❍	❍	❍	❍

7. Think about the **high school teachers** you have had at this school. How often did they do the following things?

This school year, how often have your teachers…	Never	A few times this year	Once or twice a month	Once or twice a week	Almost every day
a. Let students decide on the projects or research topics they will work	❍	❍	❍	❍	❍
b. Let students decide how to work on their assignments or projects (e.g., read on their own, do research in	❍	❍	❍	❍	❍
c. Let students work with other students on projects or assignments.	❍	❍	❍	❍	❍

8. Think about the **high school teachers** you have had at this school. How much do you agree with the following statements about them?

In general, the **teachers** I have had at this school…	Strongly Disagree	Disagree	Agree	Strongly Agree
a. Believe that all students in this school can do well.	❍	❍	❍	❍
b. Have given up on some of their students.	❍	❍	❍	❍
c. Work hard to make sure that all students are learning.	❍	❍	❍	❍
d. Care about me.	❍	❍	❍	❍
e. Respect and appreciate me.	❍	❍	❍	❍
f. Expect and encourage me to do my best.	❍	❍	❍	❍
g. Believe that I can get a good grade if I put enough work.	❍	❍	❍	❍
h. Are available if I need help.	❍	❍	❍	❍

9. During this school year, how many times have any of the following happened to you with the help of your school? Don't count activities that you did on your own or with your family's help.

	Never	Once	2-10 times	More than 10 times
a. I participated in some after school activities related to science, or technology, or engineering, or mathematics (STEM) (such as clubs, competitions, teams, etc.)	❍	❍	❍	❍
b. I visited some businesses or organizations to learn more about STEM – related jobs.	❍	❍	❍	❍
c. I met with or listened to a presentation of a person from some business or organization to learn more about STEM.	❍	❍	❍	❍
d. I met with a mentor or adviser who works in the STEM field to discuss my future learning and/or career opportunities.	❍	❍	❍	❍
e. I interacted online with someone who works in the STEM field about STEM – related topics.	❍	❍	❍	❍
f. I received help from someone who works in the STEM field on any of the STEM subjects or in my project work.	❍	❍	❍	❍
g. I had (or will have) a summer opportunity to participate in some STEM-related activities (summer camp, internship, workshop, team, etc.)	❍	❍	❍	❍
h. I presented my project work to the members of community or business partners.	❍	❍	❍	❍

10. How strongly do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. The way my teachers use technology helped me to more successfully learn the content of these classes.	❍	❍	❍	❍
b. The way my teachers use technology made my classes more interesting for me.	❍	❍	❍	❍
c. The way my teachers use technology helped me to learn more about technology.	❍	❍	❍	❍
d. The way my teachers use technology helped me to become a more independent learner.	❍	❍	❍	❍
e. The way my teachers use technology helped me to collaborate with other students on school work.	❍	❍	❍	❍

11. Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. Fill in the circle that relates to how interested you are.

How much are you interested in jobs related to:	Not at all Interested	Not So Interested	Interested	Very Interested
1. Physics: is the study of basic laws governing the motion, energy, structure, and interactions of matter. *(physicist, lab technician, astronomer, aviation or aerospace engineer, alternative energy technician)*	❍	❍	❍	❍
2. Environmental Work: involves learning about physical and biological processes that govern nature and working to improve the environment. This includes finding and designing solutions to problems like pollution, reusing waste and recycling. *(pollution control analyst, environmental engineer, or scientist, erosion control specialist, energy systems engineer and maintenance technician)*	❍	❍	❍	❍
3. Biology, Zoology, and Biotechnology: involve the study of living organisms (such as plants and animals) and the processes of life. This may include working with farm animals, in areas like nutrition, and working in the lab to modify organisms. (*biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist)*	❍	❍	❍	❍
4. Veterinary Work: involves the science of preventing or treating disease in animals. *(veterinary assistant, veterinarian, animal caretaker, livestock producer)*	❍	❍	❍	❍
5. Mathematics: is the science of numbers and their operations. *(mathematician, statistician, accountant, applied mathematician, economist, financial analyst, market researcher, stock market analyst)*	❍	❍	❍	❍
6. Medicine and Medical Science: involves maintaining health and preventing and treating disease and working to find new solutions to human health problems. *(physician's assistant, nurse, doctor, nutritionist, emergency medical technician physical therapist, dentist; clinical laboratory technologist, medical scientist, biomedical engineer, epidemiologist, pharmacologist)*	❍	❍	❍	❍

How much are you interested in jobs related to:	Not at all Interested	Not So Interested	Interested	Very Interested
7. Earth Science: is the study of earth, including the air, land, and ocean. *(geologist, weather forecaster, archaeologist, geoscientist)*	❍	❍	❍	❍
8. Computer Science: consists of the development and testing of computer systems, designing new programs and helping others to use computers. *(computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist)*	❍	❍	❍	❍
9. Chemistry: uses math and experiments to search for new chemicals, create new materials, and to study the structure of matter and how it behaves. *(chemical technician, chemist, chemical engineer)*	❍	❍	❍	❍
10. Energy: involves the study and generation of power, such as heat or electricity. *(energy researcher, electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician)*	❍	❍	❍	❍
11. Engineering: involves designing, testing, and manufacturing new products (like machines, bridges, buildings, and electronics) through the use of math, science, and computers. *(civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager)*	❍	❍	❍	❍

Thank you for your time!

Race to the Top STEM Initiative

High School Staff Survey

This survey is part of an evaluation of North Carolina's Race to the Top work. The purpose of this survey is to understand whether and how your school is changing as part of its becoming a STEM school.

School Name: ______(Inputted)________________________________

Position:

- Administrator
- Teacher
- Counselor
- Support Staff

Subject Matter taught (teachers only): (Drop down list)

- Math
- Science
- Other STEM Subject:
- English
- Social Sciences
- Career Technical Education (specify):
- Arts Education
- English as a Second Language
- Healthful Living
- Information and Technology Skills
- World Languages
- Other non-STEM Subject:

1. Staff from your school have been participating in a variety of professional development as part of becoming a STEM school. Please rate your level of participation in these activities.

	Haven't yet participated	Participated once	Participated 2 – 5 times	Participated more than 5 times
a. Online collaboration with other schools through Edmodo	❍	❍	❍	❍
b. Face-to-face collaboration with other schools at STEM Network events	❍	❍	❍	❍
c. Workshops or professional development offered by NC New Schools Project.	❍	❍	❍	❍
d. Instructional coaching from the STEM network coaches	❍	❍	❍	❍
e. Site visit(s) to other North Carolina schools	❍	❍	❍	❍
f. Site visit(s) to national model schools	❍	❍	❍	❍
g. Peer school reviews	❍	❍	❍	❍
h. Project curriculum development related to the STEM theme or the Grand Challenges of Engineering	❍	❍	❍	❍
i. Collaboration with business/community partners related to STEM (example: Externships)	❍	❍	❍	❍

2. Please describe any collaborative efforts or partnerships with business or community that are related to your STEM work. (open-ended)

3. The next set of questions concerns the presence or feel of STEM in your school.

How much do you agree or disagree with the following statements about your school?	Strongly Disagree	Disagree	Agree	Strongly Agree
a. Our school emphasizes our STEM theme in a number of different ways (work displayed, student activities, etc.).	❍	❍	❍	❍
b. Our school is focused on a common related to STEM goal for students.	❍	❍	❍	❍
c. Teachers work across subjects to implement STEM projects.	❍	❍	❍	❍
d. Everyone on staff understands what it means to be a STEM school	❍	❍	❍	❍
e. We use our STEM theme to guide decisions about curriculum and instruction.	❍	❍	❍	❍
f. Students are spending more time learning STEM content or participating in STEM activities.	❍	❍	❍	❍

4. Does your school offer classes to students in any of the following STEM areas?

	Yes	No	I don't know
a. Engineering Design	❍	❍	❍
b. Technology or Programming	❍	❍	❍
c. Health Sciences	❍	❍	❍
d. Energy and Sustainability	❍	❍	❍
e. Biotechnology and Agriscience	❍	❍	❍
f. Aerospace, Advanced manufacturing, or Security	❍	❍	❍

5. (If any are selected) What curriculum or resources do you use in this class?
6. What percentage of students participate in the following STEM experiences outside of the classroom?

	Not offered	1-25%	26%-50%	51%-75%	Over 75%	Do not know	Which students is your school targeting? (e.g., whole school, 9th graders, Biology students, etc.)
a. Internships in STEM facilities	❍	❍	❍	❍	❍	❍	(Open-ended)
b. Field trips to STEM facilities	❍	❍	❍	❍	❍	❍	
c. STEM-related clubs	❍	❍	❍	❍	❍	❍	
d. STEM-related projects in the community	❍	❍	❍	❍	❍	❍	
e. Other_____________							

The next set of questions concerns the kind of instruction that occurs in this school. If you are a teacher, please answer these questions relative to your own practice. If you are an administrator or counselor, please answer this question relative to most teachers in your school.

7. What curriculum materials are you using in your class? (Teachers only)

8. How frequently have you done the following things in your classes?

	Never	Once per semester	Monthly	Weekly	Daily
a. Asked students to solve problems based on life outside of school?	❍	❍	❍	❍	❍
b. Asked students to develop and test a theory or hypothesis?	❍	❍	❍	❍	❍
c. Had students develop their own questions and then answer them?	❍	❍	❍	❍	❍
d. Implemented projects in your classroom/school?	❍	❍	❍	❍	❍
e. Encouraged students to find more than one way to answer a question?	❍	❍	❍	❍	❍
f. Had students develop multiple solutions for a problem?	❍	❍	❍	❍	❍
g. Implemented a project with a teacher in another subject area?	❍	❍	❍	❍	❍
h. Asked students to defend their own ideas or point of view in writing or in a discussion?	❍	❍	❍	❍	❍
i. Asked students to explain their thinking?	❍	❍	❍	❍	❍
j. Asked students to apply what they have learned to solve an unfamiliar problem?	❍	❍	❍	❍	❍
k. Asked students to engage in in-depth discussions about what they have read or learned?	❍	❍	❍	❍	❍
l. Had students work together on projects or assignments?	❍	❍	❍	❍	❍
m. Had students discuss important ideas with each other?	❍	❍	❍	❍	❍
n. Engaged students in activities to build their creativity.	❍	❍	❍	❍	❍

9. Please rate your comfort with the following instructional approaches.

	I don't know how to do this	I have tried this out but need to learn more to do it well	I can do this fairly well	I am extremely comfortable and could teach others
a. Collaborative grouping	❍	❍	❍	❍
b. Integrating writing into instruction	❍	❍	❍	❍
c. Integrating literacy groups into instruction.	❍	❍	❍	❍
d. Creating high quality questions or problems to engage students in higher level thinking.	❍	❍	❍	❍
e. Making connections to students' previous learning.	❍	❍	❍	❍
f. Facilitating discussions among students.	❍	❍	❍	❍
g. Designing projects aligned with the North Carolina Standard Course of Study.	❍	❍	❍	❍
h. Managing students as they complete projects.	❍	❍	❍	❍
i. Assessing what students learned in a project.	❍	❍	❍	❍
j. Implementing projects.	❍	❍	❍	❍

10. (For Math Teachers Only): How much emphasis are you placing on the following objectives?

	No Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis
a. Increasing students' interest in mathematics	❍	❍	❍	❍
b. Teaching students mathematical concepts	❍	❍	❍	❍
c. Teaching students mathematical algorithms or procedures	❍	❍	❍	❍
d. Developing students' computational skills	❍	❍	❍	❍
e. Developing students' problem solving skills	❍	❍	❍	❍
f. Teaching students to reason mathematically	❍	❍	❍	❍
g. Teaching students how mathematical ideas connect with one another	❍	❍	❍	❍
h. Preparing students for further study in mathematics	❍	❍	❍	❍
i. Teaching students about the history and nature of mathematics	❍	❍	❍	❍
j. Teaching students to explain ideas in mathematics effectively	❍	❍	❍	❍
k. Teaching students how to apply mathematics in business and industry	❍	❍	❍	❍
l. Teaching students to perform computations with speed and accuracy	❍	❍	❍	❍
m. Preparing students for standardized tests	❍	❍	❍	❍

11. (For Science Teachers only): How much emphasis are you placing on the following objectives?

	No Emphasis	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis
a. Increasing students' interest in science	❍	❍	❍	❍
b. Teaching students basic science concepts	❍	❍	❍	❍
c. Teaching students important terms and facts of science	❍	❍	❍	❍
d. Teaching students science process or inquiry skills	❍	❍	❍	❍
e. Preparing students for further study in science	❍	❍	❍	❍
f. Teaching students to evaluate arguments based on scientific evidence	❍	❍	❍	❍
g. Teaching students how to communicate ideas in science effectively	❍	❍	❍	❍
k. Teaching students about the applications of science in business and industry	❍	❍	❍	❍
l. Teaching students about the relationship between science, technology, and society	❍	❍	❍	❍
m. Teaching students about the history and nature of science	❍	❍	❍	❍
n. Preparing students for standardized tests	❍	❍	❍	❍

12. This set of questions concerns the use of technology. If you are a teacher, please answer these questions relative to your own practice. If you are an administrator or counselor, please answer this question relative to most teachers in your school.

In my classroom/school…	Never	Once per semester	Monthly	Weekly	Daily
a. Students use a variety of technologies, e.g., productivity, visualization, research, and communication tools.	❍	❍	❍	❍	❍
b. Students use technology during the school day to communicate and collaborate with others, beyond the classroom.	❍	❍	❍	❍	❍
c. Students use technology to access online resources and information as a part of classroom or homework activities.	❍	❍	❍	❍	❍
d. Students use the same kinds of tools that professional researchers use, e.g., simulations, databases, satellite imagery.	❍	❍	❍	❍	❍
e. Students work on technology-enhanced projects that approach real-world applications of technology.	❍	❍	❍	❍	❍
f. Students use technology to help solve problems.	❍	❍	❍	❍	❍
g. Students use technology to support higher-order thinking, e.g., analysis, synthesis, and evaluation of ideas and information.	❍	❍	❍	❍	❍
h. Students use technology to create new ideas and representations of information.	❍	❍	❍	❍	❍

13. The last set of questions concerns the environment of the school. Please indicate how often school staff meet in groups (formally or informally) to do the following activities.

School staff meet in groups to …	Never	A few times this year	Once or twice a month	Once or twice a week	Almost every day
a. plan STEM-related activities.	❍	❍	❍	❍	❍
b. discuss STEM-related outcomes for students.	❍	❍	❍	❍	❍
c. examine and evaluate STEM-related school data.	❍	❍	❍	❍	❍
d. take part in STEM-related professional development or learning (such as PLC).	❍	❍	❍	❍	❍

14. How true are the following statements about your school?

	Not true at all	Somewhat true	Mostly true	Entirely true
a. Every student at this school is known well by at least one staff member.	❍	❍	❍	❍
b. The family and home life of each student is known to at least one faculty member in this school.	❍	❍	❍	❍
c. Faculty members follow up when students miss their classes.	❍	❍	❍	❍
d. Faculty members respect all the students in this school.	❍	❍	❍	❍
e. Students respect all the faculty members in this school.	❍	❍	❍	❍

Thank you for your time!

RttT STEM Course Evaluation
Course Content Review Rubric

Overview

These rubrics are designed to evaluate 9th grade integrated, interdisciplinary STEM courses that have been developed to cover four themes:

1. Energy and Sustainability;
2. Agriscience and Biotechnology;
3. Health and Life Sciences; and
4. Aerospace, Advanced Manufacturing, and Security.

Target audience: These courses are intended for all high schools, whether STEM-focused or not.

Background

During September 2012 through June 2013, NCSSM delivered the first 8 courses for the 9th and 10th grades in each of the four themes. The outlines of the courses indicate that they 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.

To set up the context for the curriculum evaluation, we conducted an interview with the developers of the courses. The information from this interview is summarized below.

The intent for course use. As indicated by NCDPI, the sequences of four courses in each theme will be designated as CTE courses in one of the CTE program areas. As such, these courses are designed to integrate and reinforce the core subjects of math, science, and ELA with technology, engineering, and the course theme through the application of this knowledge to solve authentic theme-related projects.

These courses both apply previously learned core subjects' knowledge to different contexts, and use novel tasks to motivate the need for and introduce the new topics in math and science. They often teach the core content knowledge necessary to solve the problem or complete the project. The core content subject knowledge taught in these courses is partially aligned with the North Carolina Essential Standards and Common Core Math and ELA Standards. Partial alignment means that when knowledge of a specific math or science topic was needed to perform a task and it was assumed unfamiliar to students, this topic was taught to result in knowledge comparable to what would be achieved in a core subject class. At the same time, it might not have covered the entire standard which included that specific topic.

The curriculum was also designed to include a set of modules, at least three of which could be used as replacement modules in the core subject classes to teach selected core topics.

Alignment with standards. The core subject knowledge taught in these courses is aligned with North Carolina Essential Standards and Common Core Math and ELA Standards. The alignment with standards was guided by the following considerations. In each theme, there are four course levels: I, II, III, and IV that tentatively correspond to grades 9, 10, 11, and 12. The developers considered which of the math and science courses are typically taught to the majority of the North Carolina students in these grades, as presented in Table 1. They then considered these courses as likely to be taught in the same grade as the themed courses, and aligned the standards as closely as possible with the corresponding math and science subjects. The development of the sequence of courses also assumes that the higher level courses in the sequence require some of the knowledge developed in the lower level courses.

Table 1. Mathematics and Science Courses Typically Taught in North Carolina in Each Grade of High School.

Grade	Math Course	Science Course
9	Integrated Math 1 or Algebra 1	Earth and Environmental Science
10	Integrated Math 2 or Geometry	Biology
11	Integrated Math 3 or Algebra 2	Chemistry
12	Integrated Math 4 or Pre-Calculus	Physics or Physical Science

Prerequisite knowledge for students. Freshman courses in each theme assume the mastery of knowledge at completion of middle school, with pre-algebra as the last math course.

Selection of topics and projects for the courses. The selection of specific topics and projects for the courses was guided by a number of considerations, including the coverage of the Grand Challenges of Engineering, relevance to state economic development, and topics found to be interesting and motivational for students, among others. Selected topics complement the study of core subjects by both taking the same topics and showing their applications in the real world, and by covering science, engineering, and technology topics not addressed in the core curriculum. The big and small projects are designed to take up between 50% and 75% of instructional time, and serve multiple goals such as motivating students to learn STEM subjects, raising students' awareness of and interest in STEM careers, providing experience in what "doing" STEM-related work looks and feels like, conducting performance-based assessment of students' knowledge and skills, and developing students' analytical thinking and authentic problem-solving abilities and team work.

Reviews will address the following topics:

1. The extent of curriculum alignment with the following North Carolina and national standards:
    a. Science Essential Standards/Next Gen Science Standards
    b. Technology Essential Standards
    c. Engineering Standards
    d. Mathematics Common Core
    e. English Language Arts Common Core; and, when possible,
    f. Any Other Essential Standards

    The tables for Standards Alignment for each of four courses are provided. In the document, "R" means that the standard is fully addressed.
2. In each subject area covered, are these standards addressed with rigor and high content quality?
3. Do the courses provide clearly-defined standards and clarifying objectives?
4. Do the topics and projects emphasize finding solutions in a global society and addressing one or more of the Grand Challenges of Engineering?
5. To what extent and with what quality do the courses address their interdisciplinary themes?
6. To what extent and with what quality are the inquiry-based units implemented?
7. What is the extent and variety of the digital content in the course?
8. What is the extent and quality of the authentic assessments?
9. To what extent and with what quality do the courses present postsecondary education and career opportunities in STEM in each unit, with special consideration for assisting populations underrepresented in STEM fields (e.g., females, minorities, economically disadvantaged, etc.)?

Additionally, the developers of the courses posed their own questions they would like to get feedback on from reviewers. These questions include:

1. What is the reviewers' estimate for the pacing of the instruction: does it correspond to the developers' pacing suggestions?
2. Do the digital materials work in real schools and classrooms (internet access, bandwidth, etc.)?
3. What do teachers like to see more of and less of?

4. Are the assumptions about the students' academic, experiential (e.g., planning an air trip) and cultural knowledge accurate?

Proposed Review Process

- ***For the entire course***, answer questions 1 and 4 in the list above.

1. First, evaluate the extent of alignment with the standards. Compare the number of standards for each mentioned core subject addressed in the course (as provided by the authors) with the number of standards in this subject for the 9th grade in the Common Core, Next Gen Science Standards, or North Carolina state standards. Provide an estimation of the proportion of coverage.

- ***For a sample of units***, answer the rest of the questions. The sample from each course should include 3 or more units, which cover at least 25-30% of the course, chosen in such a way that they together cover standards in each of the STEM subjects and English. Select units from the beginning, middle and end of the course, if possible.

2. Questions 2–3 and 5–9 each include an assessment of extent and quality. These can be judged on a 3-point scale (low, medium, high). The descriptions for the high and low ends are provided in Table 2 (second page following). The assessment of the extent of coverage is descriptive, not judgmental—there is no expectation that every unit covers every standard to a high extent.

3. The rigor of the content is evaluated according to your professional judgment with respect to whether the content is likely to result in mastery of content knowledge and conceptual understanding aligned with the 9th grade standards in this content area. In addition to mastery of content knowledge and procedures/skills, a rigorous curriculum develops the following 21st century skills:

   a) Critical and analytical thinking, reasoning, interpretation, synthesis, decision making, creativity, and problem solving; and
   b) Conceptual understanding, defined as: the ability to make connections between different concepts, between procedures and underlying concepts and structures, and between abstract and concrete; and the ability to explain personal actions and decisions.

4. Note whether the materials rely on student mastery of STEM content knowledge that is supposed to be learned in separate core classes, or whether they allow students to learn the target subject topics without additional study in core-subject courses.

5. Provide a supporting narrative about what guided each of your decisions.

Review Criteria

For the Entire Course:

1. For each of the content standards below, note what % of the 9th grade content standards in each area are covered by the course. To determine whether a standard is covered, you need only refer to direct references to standards in the course materials or in Standard Alignment tables. The judgment for the alignment with the Next Gen Science Standards should be deferred as the standards just came out, according to NCDPI.

   Alignment with the following NC/national standards:

   a. Science Essential Standards/Next Gen Science Standards
   b. Technology Essential Standards
   c. Engineering Connections (http://www.ncpublicschools.org/stem/)
   d. Mathematics Common Core
   e. English Language Arts Common Core
   f. Any Other Essential Standards

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2. Please note which Grand Challenges or topics/tasks about finding solutions in a global society are addressed in this course (if any):

***For a Sample of Units** (see explanation of sampling procedure, above):*

3. Complete Table 2 for each unit sampled:

Table 2. Criteria for Low-Medium-High Assessment

Criteria	Indicators	Low End	High End
1. Unit goals and objectives	Extent	Clearly defined standards and clarifying objectives are provided in less than 50% of units/lessons	Clearly defined standards and clarifying objectives are provided in all units/lessons
2. Coverage of the theme	Extent	Theme is covered in less than 30% of lessons/tasks	Theme is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
3. Science	Extent	Content is covered in less than 30% of lessons/tasks	Content is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
4. Technology	Extent	Content is covered in less than 30% of lessons/tasks	Content is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
5. Engineering	Extent	Content is covered in less than 30% of lessons/tasks	Content is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
6. Mathematics	Extent	Content is covered in less than 30% of lessons/tasks	Content is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
7. English Language Arts	Extent	Content is covered in less than 30% of lessons/tasks	Content is covered in more than 70% of lessons/tasks
	Quality	Superficial treatment	Deep exploration
8. Project-based learning	Extent	Less than 30% of material is learned through the project-based instruction	More than 70% of material is learned through the project-based instruction
	a) Presents a driving problem, task or challenge		
	b) Provides measurable content learning goal(s)		
	c) Requires students to research background information (low – high)		
	d) Engages students in inquiry and innovation (low – high)		
	e) Engages students in developing and applying 21st-century skills (low – high)		
	f) Provides feedback and encourage project revision (low – high)		
	g) Provides for a "publicly presented product"		
9. Digital Content	Extent	Uses digital content in less than 30% of lessons/tasks	Uses digital content in more than 70% of lessons/tasks
	Variety	Utilizes a variety of media (e.g., text, audio, video) and online resources	
10. Authentic assessments	Extent	Fewer than 50% of projects/units include an authentic assessment guide	Every project/unit includes an authentic assessment guide
	The level of task authenticity	Low, example: a word problem	High, Example: designing a product that can be actually used by some people
	Appropriateness of the task for assessment	Task does not allow for assessment of much of the target knowledge/skills	Task allows for assessment of much of the target knowledge and skills
	Rubric	There is no rubric, or it is not helpful	The rubric is helpful for students in creating a high quality product

4. Please comment on any strengths or weaknesses noted in the course content:

Resources for Review:

- Common Core State and North Carolina Essential Standards brief overview: http://www.ncpublicschools.org/acre/standards/

- Next Gen Science Standards: http://www.nextgenscience.org/

- Engineering Connections: http://www.ncpublicschools.org/stem/resources/#engineeringconnections

- Information and Technology: http://www.ncpublicschools.org/docs/acre/standards/new-standards/info-technology/grades9-12.pdf

- Grand Challenges of Engineering: http://www.engineeringchallenges.org/

Appendix C. Detailed Tables for Structure of the Network Section

Table C1. Participation in Networking by School Type

Please rate your level of participation in these activities.	School Type	*n*	Percentage of Respondents: *Haven't yet Participated*	*Participated Once*	*Participated 2-5 Times*	*Participated More than 5 Times*
1. Online collaboration with other schools through Edmodo	All schools	332	71%	7%	14%	8%
	Anchor schools	45	44%	20%	31%	4%
	Small new schools and STEM Academies	49	61%	2%	14%	22%
	Comprehensive schools	238	78%	6%	11%	5%
2. Face-to-face collaboration with other schools at STEM Network events	All schools	333	56%	12%	22%	10%
	Anchor schools	45	27%	9%	47%	18%
	Small new schools and STEM Academies	48	33%	15%	42%	10%
	Comprehensive schools	240	65%	13%	13%	9%

Table C2. Total and Average Number of participants per STEM Network as of May 10, 2013.

Edmodo Network Type	Number of Networks	Total Number of Participants	Average Number of (Range) of Participants per Network
STEM Affinity Network	1	211*	211
Theme Networks	3	189	63 (43-79)
Content Networks	10	176	18 (7-17)
School Networks	11	314	29 (9-17)

*Note: These numbers do not include NC New Schools staff and evaluators.

Table C3. Number of Posts per Network

Network Activity	STEM Affinity Network*	Theme Networks	Content Networks	School Networks**
Average Number of members	211	63	18	29
Date of the first post	8/15/12	9/6/12	8/31/12	8/15/12
Date of the last post	5/10/13	2/22/13	5/22/13	5/25/13
Total Posts	13	8	62	**
Total posts by moderator(s)	13	8	51	**
Total posts by participants	0	0	11	**
# of different participants	0	0	10	**
Largest number of replies for a single post	0	0	4	
Post focus				
# of posts related to the network's work/project development; STEM or the network theme	3	8	1	**
# of posts related to Professional Development	2	0	30	**
# of posts related to teaching in general	1	0	1	**
# of all other posts (e.g., announcements)	7	0	30	**

* 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.

Twitter chats. From October 29, 2012 to April 1, 2013, NC New Schools hosted a series of 12 Twitter chats covering various topics (Table C4). In addition to the title of the chat, Table C4 shows the number of original tweets by ncnewschools (NC New Schools' twitter account), ncnewschools retweets (re-posts of other twitters' tweets), and ncnewschools' replies (direct responses to other twitters) during the day of each event[11]. These topics received between 12 and 63 tweets and between one and 43 replies from participants and moderators.

Table C4. NC New School Twitter Chat Topics and Account Activity Statistics

Num -ber	Date	Chat Title	Number of Tweets*	Number of Retweets*	Number of Replies*
1	10/29/12	Reading, Writing, Thinking, Talking, Every Class, Every Day? Really?	44	11	11
2	11/5/12	Technology Supporting "Powerful Teaching and Learning"	57	17	26
3	11/12/12	Inquiry Based Learning in Math and Science	40	20	21
4	11/19/12	Building School Culture (large and small schools)	20	1	1
5	11/26/12	Making Adult Collaboration Happen	60	7	43
6	12/3/12	Looking at Design	21	6	3
7	12/10/12	Teaching Skills	50	7	18
8	12/17/12	Role of Schools in Workforce Development	36	6	15
9	3/11/13	Classroom Technology (hosted by @mjsamberg)	39	1	26
10	3/18/13	Popcorn Night (participants put forth topics)	58	8	38
11	3/25/13	Innovative Schools & Public Relations	63	5	31
12	4/1/13	Ready for College, Careers and Life	12	11	14

**Source*: www.tweetstats.com

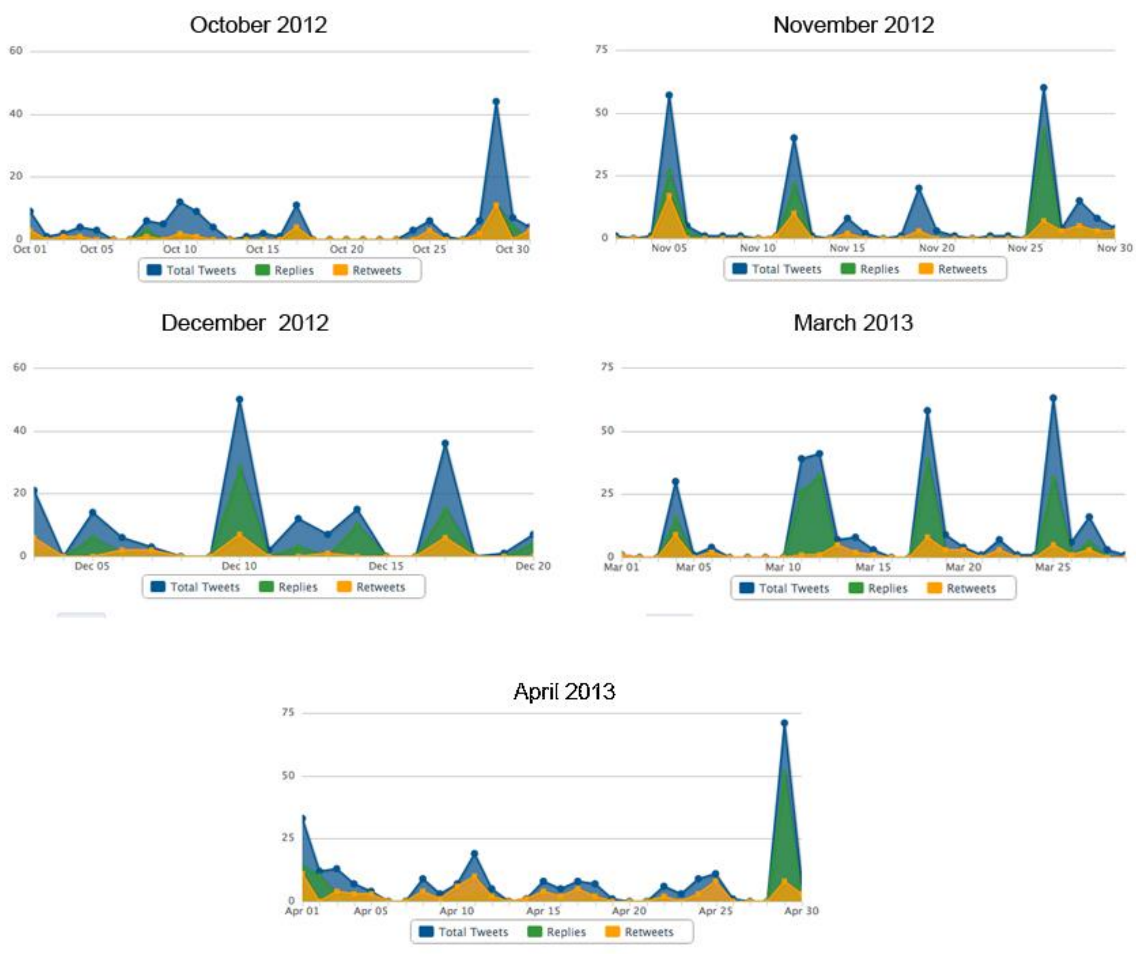
Those data indicate that the topic *Innovative Schools & Public Relations* (# 11) prompted the highest number of total tweets. Other topics with high number of tweets and retweets were *Making Adult Collaboration Happen* (#5), *Popcorn Night (participants put forth topics)* (#10), and *Technology Supporting "Powerful Teaching and Learning*" (#2). The topic with the lowest

[11] Those statistics represent account activity during the day of the event since statistics for the specific time of the event were not available

number of tweets was *Building School Culture (large and small schools). Inquiry Based Learning in Math and Science* (# 3) had the highest number of retweets.

NC New Schools' twitter account activity was higher on the days the chats took place than on the remaining days, suggesting that the increase was due to the chats happening those days. Figure XX shows NC New Schools' activity from October 2012 to April 2013. However, we have to interpret those numbers with caution. Although the number of tweets per chat may be an indicator of the relevance of the topic being discussed, it may also be due to other factors that facilitated or hindered participation in a particular chat.

Figure C1. NC New Schools' Tweet Activity from October 2012 to April 2013.



Note: Higher peaks represent days when chat activity took place.
Source: www.tweetstats.com

Appendix D. Detailed Tables for Professional Development Section

Table D1. Participation in Professional Development by School Type

Please rate your level of participation in these activities.	School Type	*n*	Percentage of Respondents			
			Haven't yet Participated	***Participated Once***	***Participated 2-5 Times***	***Participated More than 5 Times***
1. Workshops or professional development offered by NC New Schools Project	All schools	332	14%	22%	44%	19%
	Anchor schools	46	9%	20%	37%	35%
	Small new schools and STEM Academies	49	2%	20%	63%	14%
	Comprehensive schools	237	18%	23%	41%	17%
2. Instructional coaching from the STEM network coaches	All schools	333	30%	22%	32%	16%
	Anchor schools	46	17%	17%	28%	37%
	Small new schools and STEM Academies	49	24%	16%	33%	27%
	Comprehensive schools	238	34%	24%	33%	10%
3. Site visit(s) to other North Carolina schools	All schools	332	70%	15%	14%	2%
	Anchor schools	46	46%	20%	30%	4%
	Small new schools and STEM Academies	49	57%	22%	20%	0%
	Comprehensive schools	237	77%	12%	9%	2%
4. Site visit(s) to national model schools	All schools	332	88%	8%	3%	1%
	Anchor schools	45	73%	13%	9%	4%
	Small new schools and STEM Academies	50	74%	22%	2%	2%
	Comprehensive schools	237	93%	4%	2%	0%
5. Peer school reviews	All schools	332	72%	18%	8%	1%
	Anchor schools	46	65%	22%	11%	2%
	Small new schools and STEM Academies	50	74%	16%	8%	2%
	Comprehensive schools	236	73%	18%	8%	1%

Detailed Analyses of Observations of Professional Development Events by the Evaluation Team

Primary intended purpose(s) of the professional development sessions

Observers noted the following primary intended purpose(s) of the 18 observed professional development sessions:

- Engineering Design Process as applied to multiple subjects;
- Networking, Reflection on 1.5 days of professional development;
- Fine tuning a lesson plan using a protocol;
- Discuss in groups homework task from the previous session on using data and the reading for today they did prior to session;
- Immersion in problem solving activity, reflection on student learning;
- Considering the written case from the SLOL book, making connections to the Common Core State Standards in Mathematics;
- Learning about math talk by first reading about it, and then watching a video segment and rating it in relation to math talk;
- Deepening understanding of Project Based Learning;
- In-depth review of the STEM-focused partnership between a higher educational institution and the school;
- Learning about Arizona's strategy for evaluating a STEM school;
- Providing information on the whole-school STEM models;
- Building a career and workforce for local economic and business needs;
- Designing a STEM school and what it means at different levels.
- Explore participant’s understanding of NCNS’s design principle “Redefined Professionalism”.
- Familiarize participants with the Problem-Based Learning process and how it can be used in the classroom.
- Discuss logistics of forming partnership networks with IHEs and local business to support student college and career readiness in STEM areas.
- Prepare plan for ecology-themed Grand Challenge capstone project.
- Provide information on a design of a particular school.

During these 18 sessions, participants were engaged in the following major activities:

- Listened to a formal presentation by facilitator (12 sessions);
- Listened to a formal presentation by participants (3 sessions);
- Engaged in whole group discussion led by facilitator (9 sessions);
- Engaged in whole group discussion led by participant(s) (3 sessions);
- Engaged in small group discussion (including pairs, networking) (12 sessions);
- Develop a product/hands-on activity (5 sessions);
- Engaged in whole/small group activity, distinct from discussion (e.g., game, participate as students in an activity designed for the classroom use) (3 sessions);
- Engaged in individual activity (4 sessions);
- Observed classroom instruction (including watching a video) (2 session);
- Engaged in a Q&A session (1 session).
- Modeled processes using “fishbowl” approach (1 session)

Observers identified the core content of the lesson on a 7-option list. Table D2 shows the seven areas, ranked from most to least frequent, along with the number of sessions that addressed each. In the 18 sessions, *STEM-specific instructional strategies (Ex.: Engineering Design")* was the core content addressed most frequently (6 sessions).

Table D2. Core Content of the Sessions

Core Content Area	Number of Sessions
1. Learning STEM-specific instructional strategies (Ex.: Engineering Design)	6
2. Increasing content knowledge of participants	3
3. Designing or scoring student assessments	2
4. Learning non STEM-specific pedagogical/classroom management strategies (Ex.: CIF)	1
5. Considering issues of access, equity, and diversity	1
6. Learning how to use specific instructional materials in the classroom	0
7. Learning how to use technology in the classroom.	0

In addition, observers recorded the following specific core content areas that did not fit in any of the seven options on the list:

1. Networking with other teachers
2. Increasing teacher collaborative working environment
3. How the activity is a professional development
4. Learning about professional development
5. Reflecting on this form of professional development
6. Fine-tuning a lesson plan
7. Leaning about strategies for implementing Project Based Learning
8. Learning about a state-level strategy to guide STEM school change
9. Creating STEM networks with Institutions of Higher Education and business
10. Learning about the whole-school STEM models
11. Importance of incorporating business into the decision process about educating students
12. How to design a STEM school and what it means at different levels
13. STEM school design

Observers' Ratings for Quality of Professional Development Events by Dimension

The quality of professional development events was assessed according to three dimensions including: a) Quality of Design of Professional Development, b) Quality of Implementation of Professional Development, and c) Culture of the Professional Development. These three dimensions were all rated measuring the extent to which the specific indicators were observed on the following scale: 1 = not at all; 2 = not much; 3 = somewhat; 4 = to a great extent.

Quality of design of professional development. The average ratings for the indicators of professional development design ranged from 2 to 3.35 on a 4-point scale. The highest rated indicator was Collaborative approach to learning (Overall Mean = 3.35), and the lowest rated was Opportunities for participants to practice new skills and/or apply new knowledge (Overall Mean = 2.00).

Among the events with more than one session, Secondary Lenses on Learning was rated higher in most indicators than any of the other events. The Scaling STEM Conference event was rated, on average, lower than the other professional development events.

Table D3. Indicators of the Quality of the Design of Professional Development

Professional Development Event:	**Overall**	**CPS**	**School PD**	**School Visit**	**SLoL**	**STEM**
# of Sessions:	17	2	2	1	4	9
Indicator	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)*	Mean (SD)	Mean (SD)
1. The session had clear, explicit, and articulate learning goal(s).	2.94 (0.97)	3.00 (1.41)	1.50 (0.71)	4.00 (--)	4.00 (0.00)	2.63 (0.52)
2. The session provided an opportunity for participants to build their knowledge about the focus content.	3.12 (0.93)	2.00 (1.41)	2.50 (0.71)	4.00 (--)	4.00 (0.00)	3.00 (0.76)
3. The session was of sufficient length to allow for in-depth discussion and exploration of the topics.	3.24 (0.90)	3.00 (1.41)	3.00 (1.41)	3.00 (--)	4.00 (0.00)	3.00 (0.93)
4. The session incorporated tasks, roles, and interactions that modeled aspects of the Design Principles or CIF.	2.88 (1.05)	3.00 (0.00)	2.50 (0.71)	4.00 (--)	4.00 (0.00)	2.25 (1.04)
5. The session provided opportunities for participants to practice new skills and/or apply new knowledge.	2.00 (1.28)	2.50 (2.12)	2.00 (1.41)	4.00 (--)	1.75 (1.50)	1.75 (1.04)
6. Adequate time and structure were provided for participants to share experiences and insights.	3.12 (0.99)	3.50 (0.71)	3.00 (1.41)	4.00 (--)	4.00 (0.00)	2.50 (0.93)
7. The session encouraged a collaborative approach to learning.	3.35 (0.93)	4.00 (0.00)	3.50 (0.71)	4.00 (--)	4.00 (0.00)	2.75 (1.04)

Professional Development Event:	Overall	CPS	School PD	School Visit	SLoL	STEM
# of Sessions:	17	2	2	1	4	9
Indicator	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)*	Mean (SD)	Mean (SD)
8. The session provided opportunities for participants to consider how they would apply what they learned in their school or to develop a product that they will use in school.	2.41 (1.28)	3.00 (1.41)	4.00 (0.00)	4.00 (--)	2.00 (1.41)	1.87 (0.99)
9. Adequate time and structure were provided for "sense-making," including reflection about concepts, strategies, issues, challenges, etc.	2.82 (1.07)	2.00 (0.71)	3.50 (0.71)	3.00 (--)	4.00 (0.00)	2.13 (0.99)

Note: * No Standard Deviation was calculated (--) when *n*=1

Open-ended notes recorded by observers about the design of the professional development indicate that most Scaling STEM Conference sessions were designed as informational sessions with presentation as a predominant mode, little small or whole group discussions or opportunities for interaction, and few activities for participants. In contrast, the other events displayed many more features of quality professional development, such as small- and whole-group discussions, immersion activities that modeled classroom instruction, well-modeled CIF strategies, collaborative development of lesson plans, and reflection.

Observers also noted that many sessions included some type of presentation, which lasted from a few minutes to the entire session. Several were more varied and included strategies such as the presenter modeling a strategy, small or large discussion, hands on activities, and reflecting on the professional development. In some of the sessions, the facilitator stimulated small and whole group discussion through high level questioning, but in others, there was little or only occasional opportunities for participants to ask questions or interact with each other. Observers also indicated that in various sessions participants did not explicitly talk about how they would bring what they were learning to their classroom but they may have addressed it on a reflection they wrote a the end of the day.

Quality of implementation of professional development. The average ratings of the indicators of Quality of Implementation of Professional Development ranged between 2.25 to 3.25 on a 4-point scale (Table X). The highest rated indicator was "The facilitator(s)' formal presentation(s) were carried out effectively" (Overall Mean = 3.25), and the lowest rated was "The facilitator monitored participants' learning and adjusted the session based on how participants were responding" (Overall Mean = 2.25).

Among the events with more than one session, Secondary Lenses on Learning was rated higher in most indicators than any of the other events. Commons Practices Symposium was scored, on average, lower than the other professional development events.

Table D4. Indicators of the Quality of the Implementation of Professional Development.

PD Event:	**Overall**	**CPS**	**School PD**	**School Visit**	**SLoL**	**STEM**
# of Sessions:	16-17	2	1-2	1	4	8
Indicator	Mean (SD)	Mean (SD)	Mean (SD)*	Mean (SD)*	Mean (SD)	Mean (SD)
1. The facilitator(s) effectively modeled CIF strategies and other focus strategies of the session.	2.56 (1.15)	2.00 (1.41)	2.00 (--)	3.00 (--)	4.00 (0.00)	2.00 (0.93)
2. The facilitator(s)' formal presentation(s) were carried out effectively.	3.25 (0.86)	2.00 (1.41)	2.00 (--)	4.00 (--)	4.00 (0.00)	3.25 (0.46)
3. The facilitator(s) effectively used/modeled questioning strategies that are likely to enhance the development of conceptual understanding (e.g., emphasis on higher-order questions, appropriate use of "wait time," identifying prior conceptions and misconceptions).	2.38 (1.15)	2.00 (0.71)	1.00 (--)	4.00 (--)	3.75 (0.50)	1.88 (0.64)
4. Activities were well structured and organized for achieving learning goals.	3.12 (0.70)	2.00 (0.71)	3.00 (0.00)	3.00 (--)	4.00 (0.00)	2.63 (0.52)
5. The pace of the session was appropriate for the purposes of the professional development.	3.24 (0.66)	2.00 (0.00)	3.50 (0.71)	3.00 (--)	4.00 (0.00)	2.88 (0.64)
6. The facilitator monitored participants' learning and adjusted the session based on how participants were responding.	2.25 (0.68)	2.00 (0.71)	2.00 (--)	3.00 (--)	2.50 (0.58)	2.25 (0.71)
7. Participants were engaged with the session.	3.18 (0.64)	2.00 (0.71)	4.00 (0.00)	3.00 (--)	3.00 (0.82)	3.00 (0.54)

Note: * No Standard Deviation was calculated (--) when *n*=1

Observers' open-ended notes about *Implementation* indicate that, in most sessions, participants were engaged. Relative to facilitators at other events, facilitators at Secondary Lenses on Learning were the strongest in terms of modeling Common Instructional Framework strategies overall and questioning techniques specifically. Often, the events did not allow enough time for a deep discussion or exploration of topics.

Culture of the professional development. The average ratings for most indicators of Culture ranged between 3.28 and 3.78 on a 4-point scale (Table X). The highest rated indicator was There was a climate of respect for participants' experiences, ideas, and contributions (Overall Mean = 3.78), and the lowest rated was Participants provided constructive criticism and/or challenged ideas (Overall Mean = 2.19).

Among the events with more than one session, ratings were generally lower for the Scaling STEM Conference due to fewer opportunities for participants to be actively involved in the sessions. Generally, facilitators dominated the sessions much more during the Scaling STEM Conference. The lowest scored dimension was that of participants providing constructive criticism and/or challenging ideas.

Table D5. Indicators of the Quality of the Culture of Professional Development.

PD Event:	***Overall***	***CPS***	***School PD***	***School Visit***	***SLoL***	***STEM***
# of Sessions:	16-18	1-2	2	1	4	8-9
Indicator	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)*	Mean (SD)	Mean (SD)
1. There was a climate of respect for participants' experiences, ideas, and contributions.	3.78 (0.55)	4.00 (0.00)	4.00 (0.00)	4.00 (--)	4.00 (0.00)	3.56 (0.73)
2. Interactions reflected collaborative working relationships between facilitator(s) and participants.	3.28 (0.83)	3.50 (0.71)	4.00 (0.00)	4.00 (--)	4.00 (0.00)	2.67 (0.71)
3. Participants were encouraged to generate ideas, questions, conjectures, and propositions.	3.61 (0.61)	4.00 (0.00)	4.00 (0.00)	4.00 (--)	4.00 (0.00)	3.22 (0.67)
4. Participants were willing to generate ideas and take intellectual risks	3.56 (0.63)	4.00 (0.00)	4.00 (0.00)	4.00 (--)	4.00 (0.00)	3.13 (0.64)
5. Participants provided constructive criticism and/or challenged ideas.	2.19 (0.98)	1.00 (--)*	4.00 (0.00)	2.00 (--)	2.25 (0.50)	1.88 (0.84)

*Note: No Standard Deviation was calculated (--) when *n*=1

Observers' open-ended notes about *Culture of the Professional Development* indicate that all sessions exhibited a climate of respect and openness, largely facilitated by the presenter/moderator. Participants shared ideas and opinions openly and frequently asked each other questions, particularly during small group work. Some participants offered mild constructive criticism, but overall, there was no much challenging of ideas.

Appendix E. 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. <u>S</u>cience Essential Standards
    b. <u>T</u>echnology Essential Standards
    c. <u>E</u>ngineering Standards
    d. <u>M</u>athematics Common Core
    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 F. RttT STEM Freshman Course Reviews

Alignment with Standards

Table F1. Alignment with Standards.

	A&B		AS&A		E&S		H&LS	
Standards/Courses	**Number (proportion) of grade standards covered**	**Number of grade standards covered completely**	**Number (proportion) of grade standards covered**	**Number of grade standards covered completely**	**Number (proportion) of grade standards covered**	**Number of grade standards covered completely**	**Number (proportion) of grade standards covered**	**Number of grade standards covered completely**
Science Essential Standards	E/En 5/30-20% Bio 5/30-20%	1 1	Physics: 9/29 Phys. Sci.: 5/30	Physics: 8/29 Phys. Sci.: 1/30	Phy Sci:1(3%) Bio: 3 (10%) Chem: 2 (6%) Phys: 1 (3%) Earth: 4 (13%)	Phy Sci: 0 Bio: 0 Chem: 0 Phys: 1 (3%) Earth: 1 (3%)	7th: 3 8th: 2 Bio: 6/30 PSc: 4/30 Phy: 2/29 Chem: 3/32	PSc: 3 Phy: 1
Next Gen Science Standards	N/A		N/A	N/A	N/A	N/A	N/A	
Technology Essential Standards	2/10-20%	0	4/4	0	4 (44%)	None	N/A	
Mathematics Common Core	N/A		N/A	N/A	N/A	N/A	N/A	N/A
ELA Common Core	6/10		8/10	0	ELA 10 (100%) WHST: N/A	ELA 0 WHST: N/A	N/A	N/A
Other Essential Standards	6.L.1.1-2 * 7.L.1.4 8.L.3.2	2 1	N/A	N/A	Energy Literacy 5 (71%)	Energy Literacy 0	EG: 3 OA: 2	

* *Note:* Middle school goals

Comments about alignment with standards:

H&LS, A&B, AS&A: Standards for Mathematics Common Core and ELA Common Core could not be included in the count because specific standard strands were not provided at the time of review.

E&S: Based on our observations, the Next Generation Standards and the Common Core Mathematics Standards were not specific enough to collect data for coverage. We assumed the Energy Literacy standards were adopted from the U.S. Department of Energy.

Grand Challenges of Engineering

Table F2. Grand Challenges of Engineering Addressed in Integrated STEM Courses.

Courses	***Number of Grand Challenges covered:***	***Topics of Grand Challenges covered:***
E&S*	3	Make solar energy economical; Develop carbon sequestration methods; Provide access to clean water.
A&B	2	Engineer the tools of scientific discovery; Manage the nitrogen cycle.
H&LS	3	Advance health informatics; Engineer better medicines; Reverse-engineer the brain.
AS&A	0	

Comments about addressing Grand Challenges of Engineering:

H&LS: Activities include research into careers, but students are not asked to work toward any possible solutions.

AS&A: According to the standards spreadsheet that was provided for the review team there are not any Grand Challenge topics addressed in the curriculum. Based on the units observed there is the possibility of integrating the topics of Cyberspace, Virtual and Discovery.

A&B: There is a good introduction to applying design process (DEAL) in the projects. The projects integrate well with the content.

Other Review Criteria

The following units in each of the four courses were selected for the in-depth analyses:

- **Agriscience & Biotechnology:** 1, 5, & 8 as of 6/10/13*
- **Aerospace, Security, & Automation:** 1, 5, 7, & 15 as of 6/10/13
- **Energy & Sustainability:** 2, 5, & 7 as of 6/10/2013
- **Health & Life Sciences:** 1, 2, & 6 as of 6/10/13

*Note: Some course materials were added after the specified review date; these materials were not considered for this review.

Table F3. STEM Course Ratings on Other Criteria.

Criteria	Indicators	Low	Medium	High
1) Unit goals and objectives	Extent	E&S	H&LS, AS&A	A&B
2) Coverage of the theme	Extent		H&LS, E&S, A&B, AS&A	
	Quality	H&LS	E&S, A&B, AS&A	
3) Science	Extent		AS&A	H&LS, E&S, A&B
	Quality		H&LS, E&S, A&B, AS&A	
4) Technology	Extent		H&LS, E&S, A&B, AS&A	
	Quality	H&LS, E&S	A&B, AS&A,	
5) Engineering	Extent		H&LS, E&S, A&B	AS&A
	Quality	H&LS, E&S	A&B, AS&A	
6) Mathematics	Extent	H&LS, E&S, A&B	AS&A	
	Quality	H&LS, E&S, A&B, AS&A		
7) English Language Arts	Extent	AS&A	H&LS, E&S, A&B	
	Quality	H&LS, AS&A	E&S	A&B
8) Digital Content	Extent	H&LS	E&S, A&B, AS&A	
	Variety	H&LS, AS&A	E&S, A&B	
9) Authentic assessments	Extent	H&LS, E&S	A&B, AS&A	
	The level of task authenticity	H&LS	E&S, A&B, AS&A	
	Appropriateness of the task for assessment	H&LS	E&S, AS&A	A&B
	Rubric	H&LS, AS&A	E&S, A&B	

Comments about additional criteria:

a. **In each subject area covered, are the standards addressed with rigor and high content quality?**

H&LS: Based on our observations, we feel that the time constraints and the amount of material covered during this course do not allow the workload to reach high levels of rigor. According to the Revised Bloom's Taxonomy, many of the tasks do not require a high level of cognitive demand or further application of procedural knowledge.

AS&A: Based on our observations, we feel that the time constraints and the amount of material covered during this course do not allow the workload to reach high levels of rigor. According to the Revised Bloom's Taxonomy, many of the tasks do not require a high level of cognitive demand or further application of procedural knowledge. Also, the course materials reveal that many of the tasks are written for grades 11-12, well above the Basic Algebra 1 level. The review team believes the standard level ninth grade student will find it difficult to succeed in the course.

A&B: The course is presented in 5E format which helps to create a clear flow of cognitive tasks. Students make larger connections within the units.

E&S: Based on our observations, we feel that the time constraints and the amount of material covered during this course does not allow the work load to reach the level of rigor nor has evidence of the work being of high quality content.

b. **Do the courses provide clearly-defined standards and clarifying objectives?**

H&LS: There are clearly defined goals and clarifying objectives provided for the sciences. However, the clarifying objectives have not been provided for Common Core Math and ELA because the specific strands have not been identified.

AS&A: The review team did not see the inclusion of learning targets and outcomes or see a clearly defined listing of standards in this course.

A&B: Each unit contains a clearly defined list of standards, objectives and learning targets for students.

E&S: Based on our observations, the course provides clarifying objectives, however, without having the excel document explaining which standards should be covered, there would be no clearly-defined standards to address.

c. To what extent and with what quality do the courses address their interdisciplinary themes?

H&LS: This course does not take advantage of the potential to connect health and life science to the purpose of solving the problems from the Grand Challenges. This course focuses more on physiology and anatomy (health) and fails to integrate modern science and technology applications in the life sciences.

AS&A: Although this course is strong in Engineering, Science, and Math, there are Physics standards included before the students have mastered the Physical Science standards. The Technology piece for the course should have more variety.

A&B: There is a strong emphasis on the Agri-science portion of the course with much less mention of topics related to biotechnology. In the units sampled, there were no clear presentations of biotechnology or biotechnological fields. Basic foundations in simple animal husbandry could be what was considered foundational biotechnology. One reviewer commented that there is enough history content that these sorts of standards should be included. The general flow of content over the four course sequence might have added some light to how the two themes would merge more completely later on.

E&S: Based on our observations, Energy and Sustainability are addressed individually very well, however, there is a lack of cohesiveness between the two themes.

d. What is the extent and variety of the digital content in the course?

H&LS: There is a lack of variety in course structure, and digital content is teacher-delivered rather than student-utilized.

AS&A: There is a lack of variety in course structure, and digital content is teacher-delivered rather than student-utilized. For example, the students are being limited to creating a power point presentation for the Capstone Project.

A&B: There is regular use of teacher delivered technology. Video clips and animations are used to support content. Scratch programming introduces programming and social media use. Unit project labs tend to be more traditional in nature but could utilize technology. Student project products could offer more variety that would expand student utilization of technology and push student creativity.

E&S: Based on our observations, majority of the digital content is in the form of power point. There are some lessons requiring the students to use some online applications and resources, however, there is a lack of web 2.0 tools present in the majority of the course.

e. What is the extent and quality of the authentic assessments?

H&LS: There is very limited use of authentic assessments. Also, it is not clear how students will be assessed in general (lack of diagnostic, formative, and summative assessment). Students are not required to design any final products that could be used in the real world. The activities are not aligned with the stated purpose of this course. According to the Course Content Review Rubric, the selection of topics and projects for the course should "provide experience in what doing STEM-related work looks like and feels like, performance-based assessment of their knowledge and skills, develop their analytical thinking and authentic problem solving abilities and team work."

AS&A: There are authentic assessments in each unit sampled for this course; however, the students are being guided through the process of many activities, which allows little room for student creativity.

A&B: There is a high quality authentic assessment in each of the units reviewed. However, looking across units, the products start to be very similar. The assessments could be enhanced by addition of digital formats, which would allow for deeper creativity and improve overall student engagement. Grouping strategies are unclear. There would seem to be a need for more: presentation, self and peer assessments, feedback exchange and reflection opportunities for students.

E&S: Based on our observations, this course lacks in the variety of assessments that could be used. We recommend that students should be allowed to present and reflect on their practice. Throughout the whole course, there is evidence of one Pre-Assessment, which did not reflect all of the course work. Also there is no clearly defined Post Assessments throughout the course.

Table F4. Project-Based Learning Ratings

Criteria	Low	Medium	High
Presents a driving problem, task or challenge		H&LS, AS&A, U7*	A&B, U2,U5*
Provides measurable content learning goal(s)	H&LS	AS&A, U2, U5, U7	A&B
Requires students to research background information	U2, U5, U7	H&LS, AS&A, A&B	
Engages students in inquiry and innovation	H&LS,	AS&A, A&B, U5, U7	U2
Engage students in developing and applying 21st-century skills	H&LS, A&B, U7	AS&A, U5, U2	
Provide feedback and encourage project revision	H&LS, AS&A, A&B, U2, U5, U7		
Provide for a "publicly presented product?"	H&LS, AS&A, U5, U2	A&B, U7	

** Note: The E&S course reviewer provided ratings by unit: U2 = Unit 2; U5 = Unit 5; U7 = Unit 7*

Comments about project-based learning:

H&LS, AS&A: In the units reviewed, there is a lack of collaborative class-level communication that helps develop deeper understanding of the content. There are no projects outlined that would be defined as "project-based." Presentation, self/peer-assessment, peer-feedback, and reflective work are limited. Project-based learning is defined as

> a systematic teaching method that engages students in learning essential knowledge and life-enhancing skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products and tasks. (Taken from *http://pbl-online.org/About/whatisPBL.htm*)

A&B: There are problems presented in the units that were reviewed that students work on more "topically" but none that are truly large in scope that integrate an umbrella of ideas presented in the course. The 5E format may work against larger project based learning formats in a course like this.

E&S: <No Comments>

To what extent and with what quality do the courses present postsecondary education and career opportunities in STEM in each unit, with special consideration for assisting populations underrepresented in STEM fields (e.g., females, minorities, economically disadvantaged, etc.)?

H&LS: This course provides opportunities to research STEM careers, but it does not emphasize underrepresented populations.

AS&A: Based on the sampled units, this course provides opportunities to research STEM careers, but it does not emphasize underrepresented populations.

A&B: There was an exploration into being a large animal vet which was nicely done. But in the units reviewed very little other exposure was given to vocations tied to this content area. There was not really any attention paid to underrepresented populations. There would seem to be many places in the framework of this course to bring in various community speakers (agricultural extension office for example) to enhance this side of the content including special populations. This could be suggested in the teacher materials for the course.

E&S: Based on our observation, this requirement was not present in the course.

1. **Please comment on any strengths or weaknesses noted in the course content:**

H&LS: This course is very strong in the area of science, but it does not reflect the true purpose of a STEM curriculum. There is a lack of integration with technology, engineering, and mathematics that would allow for a higher level of student engagement. This course provides a lot of useful information, but it will be beneficial to modify the delivery methods of certain units—there is a lack of variety. Also, there is one activity in particular that could be potentially seen as offensive. The activity on chemical composition of the human body can have a negative impact on certain students who are sensitive about their weight.

AS&A: This course is strong in the areas of Science, Engineering and Math. The students will learn the Engineering Design Process in the first unit and apply throughout the remainder of the course. Through the content covered in this course the students will see the real world application for Engineering careers. This course provides a lot of useful information, but it will be beneficial to modify the delivery methods of certain units—there is a lack of variety, which limits the students. All optional activities should be included in the coursework, as well as the pre-assessment due to the degree of difficulty of the content. Also, there is not any indication of differentiation for low, medium and high level students in each class.

A&B: Unit 6 (related to animals/ from its placement?) was missing from the uploaded version of the course. It would seem that a type of project is needed that pulls together numerous course elements is needed at the end (or is a flowing project over the second half of the course) of the course that would be group based and allow for a high level of peer contact and exchange of ideas so needed to add depth of thinking to a STEM style curriculum. Ideally, the project would be student driven by interest with a strong, personally chosen digital component which could be presented in a jigsaw type format (ideally one group project would depend on another/ perhaps development of an agrarian colony with multiple criteria and constraints/ similar to something like Biosphere II, this might also have a list of the types of jobs, educations etc. needed to make a colony like this successful) and would allow for a full peer review and redesign based on peer to peer learning as a source of knowledge. A post-product reflection could allow for an individual redesign and second presentation to further peer-to-peer interaction. It would be interesting to include local professionals in on developing a project like this or a trip to a local specialized or research farm. Of the four courses reviewed, the review team felt this course was the most realistic/teachable in terms of its pace and the work being on “grade” level for an average freshman. Grouping size, strategies and suggestions for differentiation within the course and activities would be helpful. Math just does not seem to be well integrated into the course where there are places where it could be done rather effectively. Without a stronger math component, it is hard to consider the course to be rigorous and STEM in its thinking focus. At one place this course is labeled 6-12, which is a little inconsistent with the description of the course for development. The reviewers were given criteria that established that students would have full mastery of middle school objectives before engaging in this course. It does not seem consistent then that goals from the middle school were chosen for a high school science course even though there are few high school goals available to cover these specific content areas (especially anatomy).

E&S: Based on our observations, we feel that this course is strong in the advancement of technology used, and the use of multiple problem based learning projects throughout the course. We also feel that the course lacks reflection among the groups, and creativity among students.

2. **Comments to course developers:**

   What is the reviewers' estimate for the pacing of the instruction: does it correspond to the developers' pacing suggestions?

   H&LS: There is a lot of material presented in this course. There will be an issue of depth versus breadth depending on the length of the course (semester vs. year-long).

   AS&A: Due to the difficulty of the material, the timeline seems adequate. We don't believe the coursework could be covered in a shorter period of time.

   E&S: The majority of the unit lesson plans could be combined into one big lesson spread over several days. This can allow the Capstone Projects to be completed over the course while teaching the lesson concurrently.

   Do the digital materials work in real schools and classrooms (internet access, band width, etc.)?

   H&LS: There will always be unforeseen circumstances when it comes to technology. There should be alternative activities built in to avoid delaying the lessons because of any potential technology issues. Also, if these courses will be implemented on a large scale, some schools may not have adequate access to technology.

   AS&A: The digital materials that have been presented in the sample units should work in most schools and classroom based on the lack of variety.

   E&S: The digital media can work in the schools, however we highly recommend providing an alternative assignment if the technology cannot be used and informing teachers to download the videos as MP4 files if bandwidth could be a problem for their particular school.

3. **What do teachers like to see more of and less of?**

   H&LS: The reviewers would like to see more differentiation in the curriculum/tasks, as well as variety in presentation of lesson materials. There should be more opportunities for students to collaborate, share their work, and to have more creative freedom with the final products of an assignment. Also, there should be more authentic assessments incorporated, as well as more opportunities to work to find a solution for various Grand Challenges. The reviewers would like to see less PowerPoint presentations and worksheets.

   AS&A: From the perspective of the reviewers the teachers would like to see more reflective activities for formative assessments as well as more structured collaborative activities (homogeneous vs. heterogeneous groupings).
   It was not presented in any of the sampled units as to how the instructor arrived at his/her groupings. We would like to see less of the PowerPoint presentations in the coursework.

Where presentations are concerned, the students are very technologically driven and would benefit from being assigned a "media-based" presentation without limitations.

E&S: We would like to see the students doing more of the research and hands on learning and less of students given notes and then completing a worksheet.

Are the assumptions about the students' academic, experiential (planning an air trip) and cultural knowledge accurate?

H&LS: Students may have taken certain pre-requisite courses, but that does not guarantee retention of information. There are also many advanced science concepts, which average students may find challenging.

AS&A: This will really depend on each student individually.

Appendix G. Student Responses to the Baseline Survey

Table G1. Students' Ethnicity

Ethnicity	Percentage of Respondents
American Indian/Native Alaskan	2%
Asian	1%
Black/African American	39%
Native Hawaiian/Other Pacific Islander [a]	0%
White/Caucasian	38%
Hispanic/Latino	12%
Multiracial	6%
Other	1%

[a] Representation for Native Hawaiian/Other Pacific Islander is 0.2%.
n = 3,014

Table G2. Students' Gender

Gender	Percentage of Respondents
Male	50%
Female	50%

n = 2,997

Table G3. Students' English Language Learner Status

Have you been identified as an English Language Learner?	Percentage of Respondents
Yes	31%
No	69%

n = 2,941

Table G4. Students' Grade Level

Grade	Total Number of Respondents	Percentage of Respondents
9th	1475	48.8
10th	770	25.5
11th	408	13.5
12th	341	11.3
13th	2	.1
Missing	29	1.0
Total	3025	100

Table G5. Students' Attitudes Towards School and Learning

Item	School Type	*n*	Response: *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
In general, I am excited about my classes.	All schools	3,008	7%	24%	61%	8%	69%
	Anchor schools*	240	3%	21%	65%	11%	76%
	Small new schools and STEM Academies	387	5%	15%	67%	14%	81%
	Comprehensive schools	2,381	8%	26%	60%	6%	66%
I place high value on learning.	All schools	3,006	3%	7%	56%	34%	90%
	Anchor schools	240	0%	5%	47%	48%	95%
	Small new schools and STEM Academies	386	1%	3%	43%	53%	96%
	Comprehensive schools	2,380	3%	9%	59%	30%	89%
The support I get at school encourages me to learn more.	All schools	2,999	6%	20%	58%	17%	74%
	Anchor schools	239	3%	14%	51%	31%	82%
	Small new schools and STEM Academies	387	3%	16%	59%	23%	82%
	Comprehensive schools	2,373	6%	22%	58%	14%	72%
I look forward to learning new things at school.	All schools	2,982	4%	10%	60%	27%	87%
	Anchor schools	239	1%	9%	47%	42%	90%
	Small new schools and STEM Academies	383	2%	4%	63%	30%	93%
	Comprehensive schools	2,360	4%	11%	61%	25%	85%
I enjoy coming to school most of the time.	All schools	2,990	11%	24%	53%	13%	65%
	Anchor schools	240	5%	16%	57%	22%	79%
	Small new schools and STEM Academies	384	6%	14%	57%	23%	80%
	Comprehensive schools	2,366	13%	26%	51%	10%	61%
Most students in this school want to do well in class.	All schools	2,991	12%	27%	50%	12%	61%
	Anchor schools	239	1%	9%	64%	25%	90%
	Small new schools and STEM Academies	385	5%	22%	55%	18%	74%
	Comprehensive schools	2,367	14%	30%	47%	9%	56%

*Note: The groups had the following numbers of schools:
Anchor schools - 4 schools
Small new schools and STEM Academies - 6 schools
Comprehensive schools - 10 schools

- In general, responses are consistent across school type. One exception is the final item "Most students in this school want to do well in class"; anchor school students have a higher proportion of agreement than do small new schools and STEM academies or comprehensive schools. There were three items for which approximately one-third of students disagreed or strongly disagreed: "In general, I am excited about my classes" (31%); "I enjoy coming to school most of the time" (35%); and "Most students in this school want do well in class" (39%)

Table G6. Students' Reports on School's Effects on Their Growth in Various Areas

How much has your experience at this school contributed to your growth in the following areas?	School Type	*n*	Response			
			Not at all	***A little***	***A fair amount***	***A lot***
Knowledge about engineering design process	All schools	2,975	33%	34%	25%	9%
	Anchor schools	240	25%	27%	30%	18%
	Small new schools and STEM Academies	387	15%	31%	33%	21%
	Comprehensive schools	2,348	37%	35%	23%	6%
Solving real life problems	All schools	2,987	7%	28%	43%	22%
	Anchor schools	240	4%	23%	41%	33%
	Small new schools and STEM Academies	386	4%	21%	47%	28%
	Comprehensive schools	2,361	8%	30%	42%	20%
Gathering and analyzing information	All schools	2,965	6%	21%	46%	28%
	Anchor schools	234	3%	11%	38%	48%
	Small new schools and STEM Academies	383	4%	9%	48%	39%
	Comprehensive schools	2,348	6%	24%	46%	24%
Thinking creatively to find solutions to problems or projects	All schools	2,978	5%	20%	45%	30%
	Anchor schools	238	3%	13%	36%	48%
	Small new schools and STEM Academies	385	3%	12%	40%	46%
	Comprehensive schools	2,355	6%	22%	47%	26%
Making your own decisions about your work on problems or projects	All schools	2,976	4%	19%	44%	33%
	Anchor schools	239	2%	10%	38%	50%
	Small new schools and STEM Academies	385	2%	9%	45%	44%
	Comprehensive schools	2,352	5%	21%	44%	29%

How much has your experience at this school contributed to your growth in the following areas?	School Type	*n*	Response			
			Not at all	***A little***	***A fair amount***	***A lot***
Working well in a team of people	All schools	2,985	5%	17%	38%	41%
	Anchor schools	240	2%	10%	32%	56%
	Small new schools and STEM Academies	387	1%	11%	33%	55%
	Comprehensive schools	2,358	6%	18%	39%	37%
Communicating effectively with other people	All schools	2,975	5%	19%	40%	36%
	Anchor schools	238	3%	11%	35%	52%
	Small new schools and STEM Academies	386	3%	10%	37%	50%
	Comprehensive schools	2,351	6%	21%	41%	33%
Writing effectively	All schools	2,976	7%	24%	42%	26%
	Anchor schools	240	5%	15%	47%	33%
	Small new schools and STEM Academies	386	5%	19%	43%	33%
	Comprehensive schools	2,350	8%	25%	42%	25%
Speaking effectively	All schools	2,976	8%	21%	43%	28%
	Anchor schools	240	6%	15%	37%	42%
	Small new schools and STEM Academies	387	5%	17%	42%	36%
	Comprehensive schools	2,349	8%	22%	44%	25%
Thinking deeply and critically	All schools	2,977	5%	22%	43%	31%
	Anchor schools	237	3%	17%	34%	46%
	Small new schools and STEM Academies	387	2%	11%	41%	47%
	Comprehensive schools	2,353	6%	24%	44%	27%
Using computing and information technology	All schools	2,980	7%	22%	40%	32%
	Anchor schools	239	7%	18%	25%	51%
	Small new schools and STEM Academies	387	4%	15%	35%	46%
	Comprehensive schools	2,354	7%	23%	42%	28%
Learning work-related skills	All schools	2,981	7%	22%	47%	25%
	Anchor schools	240	4%	14%	47%	35%
	Small new schools and STEM Academies	386	5%	17%	43%	35%
	Comprehensive schools	2,355	7%	24%	47%	22%

For all items except one, 65% - 79% of students agree or strongly agree that they have grown in several areas related to STEM. One item in particular, "Knowledge about engineering design process," has the highest proportion of students who disagree or strongly disagree (67%). Across items, anchor schools and small new schools and STEM academies have higher proportions of agreement (agree/strongly agree) than do comprehensive schools.

Table G7. Students' Reports of Persistence with School Work

Item	School Type	*n*	Response: *Never*	*Once in a while*	*Half the time*	*Most of the time*	*All of the time*
I did not give up when my schoolwork became too hard.[a]	All schools	2,975	2%	6%	12%	42%	37%
	Anchor schools	240	0%	2%	12%	47%	40%
	Small new schools and STEM Academies	381	0%	3%	7%	45%	44%
	Comprehensive schools	2,354	3%	7%	13%	41%	36%
I gave extra effort to challenging assignments or projects.	All schools	2,975	5%	19%	23%	36%	17%
	Anchor schools	240	2%	11%	17%	50%	20%
	Small new schools and STEM Academies	382	4%	11%	19%	45%	21%
	Comprehensive schools	2,353	5%	21%	24%	33%	16%
When my schoolwork became too difficult, I found a way to get help.	All schools	2,971	4%	16%	20%	37%	24%
	Anchor schools	235	2%	12%	14%	45%	27%
	Small new schools and STEM Academies	380	3%	15%	17%	41%	25%
	Comprehensive schools	2,356	4%	16%	21%	35%	23%
I tried to do my best in school.	All schools	2,956	2%	5%	10%	29%	55%
	Anchor schools	238	0%	2%	7%	27%	64%
	Small new schools and STEM Academies	380	1%	2%	3%	33%	61%
	Comprehensive schools	2,338	2%	5%	12%	28%	53%
I kept working on a hard problem or assignment even if it took much longer than I expected.	All schools	2,973	5%	13%	20%	37%	25%
	Anchor schools	239	1%	10%	18%	41%	30%
	Small new schools and STEM Academies	381	2%	7%	15%	43%	33%
	Comprehensive schools	2,353	5%	14%	21%	36%	23%
When I failed it made me try that much harder.	All schools	2,960	5%	11%	18%	29%	37%
	Anchor schools	240	4%	8%	15%	23%	50%
	Small new schools and STEM Academies	380	5%	10%	17%	30%	38%
	Comprehensive schools	2,340	5%	11%	19%	29%	36%

[a] Item was originally negatively worded; it was reverse-coded for analysis.

- For all items, 50% or more students from all school types reported that they are persistent with their school work most or all of the time. It is interesting to note that when responding to the item "When I failed it made me try that much harder," 4% - 5% of students reported "never" (across school types). For the item "I kept working on a hard problem or assignment even if it took much longer than I expected" students from comprehensive schools seem the least persistent; 5% of students reported "never." In general, students in anchor schools reported slightly higher levels of persistence with school work than students from either small new schools and STEM academies or comprehensive schools.

Table G8. Students' Reports of Their Attitudes Towards STEM Subjects

			Response				
Item	**School Type**	*n*	***Strongly Disagree***	***Disagree***	***Agree***	***Strongly Agree***	***Agree + Strongly Agree***
I really like science.	All schools	3,000	15%	25%	41%	19%	60%
	Anchor schools	241	4%	13%	47%	37%	83%
	Small new schools and STEM Academies	387	4%	11%	47%	38%	85%
	Comprehensive schools	2,372	18%	29%	39%	15%	54%
I like the challenge of science assignments.	All schools	2,985	14%	31%	41%	14%	55%
	Anchor schools	237	5%	20%	44%	31%	75%
	Small new schools and STEM Academies	382	5%	20%	51%	25%	76%
	Comprehensive schools	2,366	17%	34%	39%	11%	50%
I have a real desire to learn science.	All schools	2,985	15%	29%	39%	17%	56%
	Anchor schools	237	5%	16%	48%	31%	79%
	Small new schools and STEM Academies	385	5%	16%	44%	35%	79%
	Comprehensive schools	2,363	17%	33%	38%	13%	50%
I will need a good understanding of science for my future work or career.	All schools	2,981	12%	25%	36%	27%	63%
	Anchor schools	240	3%	13%	35%	48%	84%
	Small new schools and STEM Academies	384	4%	13%	34%	49%	83%
	Comprehensive schools	2,357	15%	28%	36%	22%	58%
I will need a good understanding of math for my future work or career.	All schools	2,993	5%	14%	47%	35%	81%
	Anchor schools	239	3%	11%	38%	49%	87%
	Small new schools and STEM Academies	386	2%	7%	40%	51%	91%
	Comprehensive schools	2,368	6%	15%	48%	31%	79%

Item	School Type	*n*	Response: *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
I really like math.	All schools	2,980	13%	22%	39%	26%	65%
	Anchor schools	240	9%	15%	38%	38%	76%
	Small new schools and STEM Academies	387	10%	17%	37%	36%	74%
	Comprehensive schools	2,353	14%	23%	40%	23%	63%
I like the challenge of math assignments.	All schools	2,975	14%	25%	39%	21%	60%
	Anchor schools	240	11%	19%	40%	30%	70%
	Small new schools and STEM Academies	387	12%	20%	38%	31%	68%
	Comprehensive schools	2,348	15%	27%	39%	19%	58%
I have a real desire to learn mathematics.	All schools	2,975	12%	25%	41%	22%	63%
	Anchor schools	239	7%	18%	44%	31%	75%
	Small new schools and STEM Academies	387	8%	18%	44%	30%	75%
	Comprehensive schools	2,349	13%	27%	41%	19%	60%
Working with technology is something which I enjoy very much.	All schools	2,976	5%	15%	46%	34%	80%
	Anchor schools	240	5%	8%	35%	53%	87%
	Small new schools and STEM Academies	384	2%	12%	42%	45%	87%
	Comprehensive schools	2,352	6%	16%	48%	30%	78%
I like the challenge of technology assignments.	All schools	2,980	7%	24%	46%	24%	70%
	Anchor schools	240	7%	18%	41%	34%	75%
	Small new schools and STEM Academies	383	3%	19%	41%	36%	77%
	Comprehensive schools	2,357	7%	25%	47%	21%	68%
I have a real desire to learn about technology.	All schools	2,984	6%	20%	47%	27%	74%
	Anchor schools	241	5%	17%	37%	41%	77%
	Small new schools and STEM Academies	386	4%	15%	43%	39%	81%
	Comprehensive schools	2,357	7%	21%	48%	24%	72%
I will need a good understanding of technology for my future work or career.	All schools	2,985	5%	16%	47%	32%	80%
	Anchor schools	240	3%	10%	41%	46%	87%
	Small new schools and STEM Academies	385	2%	9%	43%	46%	89%
	Comprehensive schools	2,360	5%	18%	49%	29%	77%

Item	School Type	*n*	Response: *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
I will need a good understanding of engineering for my future work or career.	All schools	2,976	11%	31%	39%	20%	59%
	Anchor schools	241	10%	30%	33%	28%	61%
	Small new schools and STEM Academies	387	7%	26%	37%	31%	68%
	Comprehensive schools	2,348	11%	32%	40%	17%	57%
I enjoy engineering very much.	All schools	2,972	13%	34%	37%	16%	53%
	Anchor schools	239	10%	31%	36%	23%	59%
	Small new schools and STEM Academies	385	8%	24%	40%	29%	68%
	Comprehensive schools	2,348	15%	36%	37%	13%	50%
I like the challenge of engineering work.	All schools	2,967	14%	35%	37%	13%	51%
	Anchor schools	241	9%	31%	41%	19%	60%
	Small new schools and STEM Academies	386	8%	26%	44%	22%	66%
	Comprehensive schools	2,340	16%	37%	36%	11%	47%
I have a real desire to learn more about engineering.	All schools	2,976	13%	33%	37%	16%	53%
	Anchor schools	241	10%	34%	34%	22%	56%
	Small new schools and STEM Academies	386	8%	25%	38%	30%	67%
	Comprehensive schools	2,349	14%	35%	37%	14%	51%
I like to imagine creating new products.	All schools	2,958	7%	21%	47%	25%	72%
	Anchor schools	239	3%	15%	41%	41%	82%
	Small new schools and STEM Academies	387	5%	14%	42%	39%	81%
	Comprehensive schools	2,332	8%	23%	48%	21%	69%
Knowing science or math or technology or engineering will help me earn a living.	All schools	2,962	5%	12%	47%	37%	84%
	Anchor schools	240	1%	3%	38%	58%	96%
	Small new schools and STEM Academies	383	2%	5%	37%	57%	94%
	Comprehensive schools	2,339	6%	14%	49%	32%	81%

Item	School Type	*n*	Response: *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
If I learn engineering, technology, math, and science, then I can improve things that people use every day or invent new useful things.	All schools	2,980	6%	13%	50%	32%	82%
	Anchor schools	239	2%	5%	42%	51%	93%
	Small new schools and STEM Academies	387	2%	3%	45%	50%	95%
	Comprehensive schools	2,354	7%	15%	51%	27%	78%
I would like to use creativity and innovation in my future work or career.	All schools	2,957	5%	14%	48%	33%	81%
	Anchor schools	240	1%	7%	37%	55%	92%
	Small new schools and STEM Academies	384	2%	8%	39%	51%	90%
	Comprehensive schools	2,333	6%	16%	50%	28%	78%

- For students from all schools, the four technology-focused items ("Working with technology is something which I enjoy very much"; "I like the challenge of technology assignments"; "I have a real desire to learn about technology"; "I will need a good understanding of technology for my future work or career.") has the highest proportions of students who agreed or strongly agreed (70% - 80%). Students from comprehensive schools have higher proportions of students who disagree or strongly disagree with the items (19% - 53%) than students from anchor schools (4% - 44%) or small new schools and STEM academies (5% - 34%).

Table G9. Students' Confidence in Ability to Learn STEM Subjects

Item	School Type	*n*	Response				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree + Strongly Agree***
I'm certain that I can master the skills taught in math this year.	All schools	2,978	7%	15%	54%	25%	79%
	Anchor schools	241	1%	8%	54%	38%	91%
	Small new schools and STEM Academies	385	5%	11%	54%	31%	84%
	Comprehensive schools	2,352	8%	16%	54%	22%	76%
I can do even the hardest work in my math class if I try.	All schools	2,967	5%	14%	50%	30%	81%
	Anchor schools	240	1%	10%	46%	44%	90%
	Small new schools and STEM Academies	385	4%	11%	46%	40%	86%
	Comprehensive schools	2,342	6%	15%	52%	28%	79%
If I have enough time, I can do a good job on all my math class work.	All schools	2,969	4%	10%	53%	33%	86%
	Anchor schools	240	2%	5%	43%	51%	93%
	Small new schools and STEM Academies	383	1%	6%	45%	47%	92%
	Comprehensive schools	2,346	5%	11%	56%	29%	85%
I can do almost all the math class work if I don't give up.	All schools	2,973	4%	10%	53%	33%	86%
	Anchor schools	240	0%	4%	44%	52%	96%
	Small new schools and STEM Academies	385	2%	8%	43%	47%	90%
	Comprehensive schools	2,348	5%	11%	55%	29%	84%
Even if the math is hard, I can learn it.	All schools	2,967	3%	11%	53%	33%	86%
	Anchor schools	240	0%	6%	43%	50%	94%
	Small new schools and STEM Academies	379	2%	5%	48%	46%	93%
	Comprehensive schools	2,348	4%	12%	55%	29%	84%
I am certain I can figure out how to do the most difficult math work.	All schools	2,963	5%	17%	52%	26%	78%
	Anchor schools	239	3%	8%	50%	39%	89%
	Small new schools and STEM Academies	382	3%	13%	49%	35%	84%
	Comprehensive schools	2,342	6%	19%	53%	23%	75%

Item	**School Type**	*n*	**Response** *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
I am certain I can master the skills taught in science this year.	All schools	2,961	7%	19%	52%	22%	74%
	Anchor schools	240	2%	8%	54%	37%	91%
	Small new schools and STEM Academies	384	1%	6%	51%	42%	93%
	Comprehensive schools	2,337	9%	22%	52%	17%	70%
I can do even the hardest work in my science class if I try.	All schools	2,975	6%	17%	52%	25%	77%
	Anchor schools	240	0%	8%	51%	40%	91%
	Small new schools and STEM Academies	385	1%	7%	46%	46%	92%
	Comprehensive schools	2,350	7%	19%	53%	20%	73%
If I have enough time, I can do a good job on all my science class work.	All schools	2,968	5%	13%	55%	27%	82%
	Anchor schools	239	0%	3%	48%	49%	96%
	Small new schools and STEM Academies	385	1%	3%	44%	52%	96%
	Comprehensive schools	2,344	7%	16%	57%	20%	78%
I can do almost all the science class work if I don't give up.	All schools	2,967	5%	12%	56%	27%	83%
	Anchor schools	239	0%	4%	50%	45%	95%
	Small new schools and STEM Academies	382	0%	3%	49%	48%	97%
	Comprehensive schools	2,346	6%	15%	58%	21%	79%
Even if the science is hard, I can learn it.	All schools	2,960	5%	14%	55%	26%	81%
	Anchor schools	238	1%	7%	48%	44%	92%
	Small new schools and STEM Academies	385	1%	4%	47%	48%	95%
	Comprehensive schools	2,337	6%	16%	57%	21%	78%
I am certain I can figure out how to do the most difficult science work.	All schools	2,964	7%	20%	51%	23%	74%
	Anchor schools	239	3%	11%	50%	37%	87%
	Small new schools and STEM Academies	382	1%	10%	47%	42%	89%
	Comprehensive schools	2,343	8%	22%	52%	18%	70%

Item	School Type	*n*	Response: *Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Agree + Strongly Agree*
I can do almost all the technology class work if I don't give up.	All schools	2,963	5%	12%	57%	26%	83%
	Anchor schools	240	1%	5%	58%	36%	95%
	Small new schools and STEM Academies	385	1%	7%	52%	40%	92%
	Comprehensive schools	2,338	6%	14%	58%	22%	80%
Even if technology is hard, I can learn it.	All schools	2,964	4%	12%	57%	27%	84%
	Anchor schools	240	1%	6%	55%	38%	93%
	Small new schools and STEM Academies	383	1%	7%	49%	43%	92%
	Comprehensive schools	2,341	5%	14%	59%	23%	82%
I am sure I could do advanced work in technology.	All schools	2,973	5%	18%	54%	24%	77%
	Anchor schools	240	3%	14%	50%	34%	83%
	Small new schools and STEM Academies	384	2%	11%	48%	39%	87%
	Comprehensive schools	2,349	6%	19%	55%	20%	75%
I am certain that I can master the skills taught in technology this year.	All schools	2,976	5%	15%	55%	25%	80%
	Anchor schools	239	3%	6%	59%	32%	91%
	Small new schools and STEM Academies	384	2%	7%	52%	39%	92%
	Comprehensive schools	2,353	6%	18%	55%	22%	77%
I am good at building and fixing things.	All schools	2,964	9%	23%	45%	24%	68%
	Anchor schools	239	6%	19%	41%	34%	75%
	Small new schools and STEM Academies	383	4%	16%	41%	39%	80%
	Comprehensive schools	2,342	10%	24%	45%	20%	66%
I believe I can be successful in a career in engineering.	All schools	2,957	10%	26%	41%	23%	64%
	Anchor schools	239	9%	21%	38%	32%	70%
	Small new schools and STEM Academies	384	5%	14%	42%	39%	81%
	Comprehensive schools	2,334	11%	28%	41%	19%	60%

- Most students (64% - 86%) agree or strongly agree with items related to their confidence in STEM. Three items, “If I have enough time, I can do a good job on all my math class work,” “I can do almost all the math class work if I don’t give up,” and “Even if the math is hard, I can learn it” all have the highest proportion of agreement (86%). “I believe I can be successful in a career in engineering” has the lowest proportion of agreement (64%). These findings slightly echo students’ responses to the items about interest in STEM; the math interest items are among the highest rated, whereas the engineering interest items are among the lowest (Table X).

Table G10. Students’ Reports on Classroom Practices

Think about the high school teachers you have had at this school. How often have your teachers:	**School Type**	*n*	**Response**				
			Never	***A few times this year***	***Once or twice a month***	***Once or twice a week***	***Almost every day***
Asked you to work on projects related to real life?	All schools	2,861	16%	32%	24%	20%	9%
	Anchor schools	229	5%	19%	29%	30%	17%
	Small new schools and STEM Academies	363	5%	26%	23%	30%	16%
	Comprehensive schools	2,269	19%	34%	23%	17%	8%
Asked you to work on projects across different school subjects?	All schools	2,852	24%	29%	22%	18%	7%
	Anchor schools	228	9%	28%	23%	26%	14%
	Small new schools and STEM Academies	361	9%	24%	26%	27%	15%
	Comprehensive schools	2,263	28%	30%	22%	16%	5%
Asked you to research information?	All schools	2,842	5%	19%	25%	30%	21%
	Anchor schools	228	0%	4%	10%	33%	53%
	Small new schools and STEM Academies	360	1%	8%	19%	37%	36%
	Comprehensive schools	2,254	6%	23%	28%	29%	15%
Asked you to form and test a theory or hypothesis?	All schools	2,830	15%	23%	24%	26%	13%
	Anchor schools	228	2%	12%	25%	34%	26%
	Small new schools and STEM Academies	363	3%	16%	25%	33%	24%
	Comprehensive schools	2,239	18%	25%	24%	24%	10%

Think about the high school teachers you have had at this school. How often have your teachers:	School Type	*n*	Response: *Never*	*A few times this year*	*Once or twice a month*	*Once or twice a week*	*Almost every day*
Asked you to analyze and interpret documents or data?	All schools	2,850	11%	20%	23%	26%	20%
	Anchor schools	229	4%	10%	13%	35%	39%
	Small new schools and STEM Academies	362	1%	10%	19%	33%	38%
	Comprehensive schools	2,259	13%	23%	25%	24%	15%
Had you engage in in-depth discussions about what you have read or learned?	All schools	2,845	9%	18%	21%	26%	27%
	Anchor schools	229	2%	5%	13%	31%	49%
	Small new schools and STEM Academies	363	2%	10%	15%	28%	45%
	Comprehensive schools	2,253	10%	20%	22%	26%	22%
Asked you to explain your thinking?	All schools	2,841	6%	15%	16%	23%	40%
	Anchor schools	228	0%	5%	6%	17%	72%
	Small new schools and STEM Academies	360	1%	5%	9%	23%	62%
	Comprehensive schools	2,253	8%	17%	18%	24%	34%
Asked you to apply what you have learned to solve an unfamiliar problem?	All schools	2,849	9%	16%	19%	27%	29%
	Anchor schools	229	2%	7%	12%	25%	53%
	Small new schools and STEM Academies	360	3%	7%	13%	33%	44%
	Comprehensive schools	2,260	10%	19%	20%	26%	25%

- Of all the class activity and teaching strategy items, the most frequent activity according to all students is explaining one's thinking; 40% of students reported doing this activity almost every day. It is interesting to note that for comprehensive schools, a lower proportion of students reported being asked to explain their thinking "almost every day" (34%), compared to anchor school students (72%) and small new schools and STEM academy students (62%). In general, students from both anchor schools and from small new schools and STEM academies reported higher frequency of the class activities and teaching strategies listed in Table X, compared to students from comprehensive schools. The most infrequent activity reported by students is working on projects across different school subjects. Students from all schools reported being asked to do this activity "never" (24%) or "a few times a year" (29%).

Table G11. Students' Perceptions of Self-Directed Learning

Think about the high school teachers you have had at this school. How often have your teachers:	**School Type**	*n*	**Response**				
			Never	***A few times this year***	***Once or twice a month***	***Once or twice a week***	***Almost every day***
Let students decide on the projects or research topics they will work on.	All schools	2,833	23%	31%	25%	15%	6%
	Anchor schools	227	15%	29%	33%	16%	7%
	Small new schools and STEM Academies	357	16%	31%	30%	17%	6%
	Comprehensive schools	2,249	25%	31%	24%	14%	6%
Let students decide how to work on their assignments or projects (e.g. read on their own, do research in the library).	All schools	2,830	15%	28%	26%	21%	11%
	Anchor schools	227	8%	18%	32%	22%	20%
	Small new schools and STEM Academies	355	10%	23%	25%	25%	18%
	Comprehensive schools	2,248	16%	29%	25%	20%	9%
Let students work with other students on projects or assignments.	All schools	2,829	8%	21%	22%	27%	22%
	Anchor schools	228	2%	9%	18%	28%	43%
	Small new schools and STEM Academies	354	1%	14%	19%	29%	38%
	Comprehensive schools	2,247	9%	23%	23%	27%	18%

- In general, students reported that they are frequently allowed to work with other students on projects or assignments. Across all schools, 77% of students reported that their teachers let students work with other students on projects or assignments anywhere from once or twice a month to almost every day. According to students, they are not often allowed the opportunity to decide on the projects or research topics they work on. Across all schools, 23% of students reported that students never get to decide and 31% reported that they get to decide "a few times this year."

Table G12. Students' Perceptions of Teachers' Expectations and Relationships

How much do you agree with the following statements about your teachers?	School Type	*n*	Response				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree + Strongly Agree***
Believe that all students in this school can do well.	All schools	2,850	8%	13%	47%	32%	79%
	Anchor schools	227	1%	7%	29%	63%	92%
	Small new schools and STEM Academies	360	3%	8%	41%	49%	89%
	Comprehensive schools	2,263	9%	14%	50%	26%	77%
Have not given up on some of their students.[a]	All schools	2,822	10%	35%	32%	24%	56%
	Anchor schools	227	5%	13%	31%	51%	82%
	Small new schools and STEM Academies	358	7%	21%	40%	32%	72%
	Comprehensive schools	2,237	11%	39%	31%	20%	50%
Work hard to make sure that all students are learning.	All schools	2,832	6%	14%	51%	28%	80%
	Anchor schools	226	1%	6%	40%	52%	93%
	Small new schools and STEM Academies	359	3%	10%	48%	38%	87%
	Comprehensive schools	2,247	7%	16%	53%	24%	77%
Care about me.	All schools	2,834	7%	13%	52%	28%	80%
	Anchor schools	224	3%	6%	43%	48%	91%
	Small new schools and STEM Academies	359	3%	8%	52%	38%	90%
	Comprehensive schools	2,251	8%	15%	53%	24%	77%
Respect and appreciate me.	All schools	2,832	7%	14%	53%	26%	80%
	Anchor schools	225	2%	10%	44%	44%	88%
	Small new schools and STEM Academies	358	3%	8%	51%	38%	89%
	Comprehensive schools	2,249	8%	15%	55%	23%	78%
Expect and encourage me to do my best.	All schools	2,842	5%	11%	50%	35%	84%
	Anchor schools	225	1%	4%	34%	62%	96%
	Small new schools and STEM Academies	358	1%	6%	46%	47%	93%
	Comprehensive schools	2,259	6%	12%	52%	30%	82%

How much do you agree with the following statements about your teachers?	School Type	*n*	Response				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree + Strongly Agree***
Believe that I can get a good grade if I put in enough work.	All schools	2,839	4%	7%	49%	40%	89%
	Anchor schools	226	0%	3%	27%	70%	97%
	Small new schools and STEM Academies	357	2%	4%	40%	54%	94%
	Comprehensive schools	2,256	5%	7%	52%	35%	87%
Are available if I need help.	All schools	2,832	5%	11%	53%	31%	84%
	Anchor schools	226	0%	5%	46%	49%	95%
	Small new schools and STEM Academies	359	3%	7%	46%	44%	90%
	Comprehensive schools	2,247	6%	12%	55%	27%	82%

[a]Item was originally negatively worded; it was reverse-coded for analysis.

- For all but one item, 79% or more students agree or strongly agree that their teachers are supportive of both them and other students. The one exception is the item "Have not given up on some of their students" (56% agreement); this item was originally negatively-worded and thus was reverse-coded. Across all items, anchor school students have the lowest proportions of disagreement, followed by students from small new schools and STEM academies, then by students from comprehensive schools.

Table G13. Students' Participation in Extra-curricular STEM Activities

During this school year, how many times any of the following happened to you with the help of your school?	School Type	*n*	Response			
			Never	***Once***	***2-10 times***	***More than 10 times***
I participated in some after school activities related to science, or technology, or engineering, or mathematics (STEM) (such as clubs, competitions, teams, etc.).	All schools	2,823	46%	20%	26%	9%
	Anchor schools	225	36%	24%	31%	10%
	Small new schools and STEM Academies	362	50%	16%	25%	10%
	Comprehensive schools	2,236	46%	20%	26%	8%
I visited some businesses or organizations to learn more about STEM – related jobs.	All schools	2,819	54%	20%	21%	5%
	Anchor schools	224	50%	19%	26%	5%
	Small new schools and STEM Academies	360	46%	17%	28%	9%
	Comprehensive schools	2,235	56%	21%	19%	4%

During this school year, how many times any of the following happened to you with the help of your school?	School Type	*n*	Response: *Never*	*Once*	*2-10 times*	*More than 10 times*
I met with or listened to a presentation of a person from some business or organization to learn more about STEM.	All schools	2,811	43%	24%	27%	7%
	Anchor schools	224	30%	21%	36%	14%
	Small new schools and STEM Academies	360	26%	27%	33%	14%
	Comprehensive schools	2,227	47%	24%	25%	5%
I met with a mentor or adviser who works in the STEM field to discuss my future learning and/or career opportunities.	All schools	2,822	53%	20%	21%	6%
	Anchor schools	224	56%	17%	22%	5%
	Small new schools and STEM Academies	362	50%	19%	24%	7%
	Comprehensive schools	2,236	53%	21%	21%	6%
I interacted online with someone who works in the STEM field about STEM – related topics.	All schools	2,812	63%	16%	17%	5%
	Anchor schools	224	75%	10%	10%	5%
	Small new schools and STEM Academies	362	68%	13%	14%	5%
	Comprehensive schools	2,226	61%	17%	18%	4%
I received help from someone who works in the STEM field on any of the STEM subjects or in my project work.	All schools	2,820	55%	19%	21%	6%
	Anchor schools	223	54%	15%	23%	8%
	Small new schools and STEM Academies	362	50%	17%	25%	8%
	Comprehensive schools	2,235	56%	19%	20%	5%
I had (or will have) a summer opportunity to participate in some STEM-related activities (summer camp, internship, workshop, team, etc.).	All schools	2,816	53%	19%	22%	5%
	Anchor schools	225	48%	25%	21%	6%
	Small new schools and STEM Academies	361	50%	22%	21%	6%
	Comprehensive schools	2,230	54%	18%	22%	5%
I presented my project work to the members of community or business partners.	All schools	2,811	57%	17%	20%	5%
	Anchor schools	224	56%	16%	25%	4%
	Small new schools and STEM Academies	360	54%	19%	21%	6%
	Comprehensive schools	2,227	58%	17%	20%	6%

- For the items in Table X, 43% - 63% of students across all schools reported that they never engage in STEM-related activities supported by the school. The two most frequently occurring activities are “I met with or listened to a presentation of a person from some business or organization to learn more about STEM” and “I participated in some after school activities related to science, or technology, or engineering, or mathematics (STEM) (such as clubs, competitions, teams, etc.)"; students reported that these two activities happen 2-10 times this school year (27% and 26%, respectively) or more than 10 times this school year (7% and 9%, respectively).

Table G14. Students' Perceptions of Technology Use

Item	School Type	*n*	Response				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree + Strongly Agree***
The way my teachers use technology helped me to more successfully learn the content of these classes.	All schools	2,813	9%	17%	59%	15%	74%
	Anchor schools	226	5%	8%	61%	26%	87%
	Small new schools and STEM Academies	357	3%	10%	62%	25%	87%
	Comprehensive schools	2,230	11%	18%	59%	12%	71%
The way my teachers use technology made my classes more interesting for me.	All schools	2,812	7%	16%	57%	21%	77%
	Anchor schools	224	4%	5%	55%	35%	91%
	Small new schools and STEM Academies	355	2%	12%	49%	37%	86%
	Comprehensive schools	2,233	8%	17%	58%	16%	75%
The way my teachers use technology helped me to learn more about technology.	All schools	2,804	8%	20%	55%	17%	72%
	Anchor schools	225	5%	16%	52%	27%	79%
	Small new schools and STEM Academies	357	3%	13%	53%	31%	84%
	Comprehensive schools	2,222	9%	22%	56%	14%	70%
The way my teachers use technology helped me to become a more independent learner.	All schools	2,801	8%	21%	55%	16%	71%
	Anchor schools	226	6%	15%	54%	24%	79%
	Small new schools and STEM Academies	353	3%	20%	51%	26%	77%
	Comprehensive schools	2,222	9%	21%	56%	14%	70%
The way my teachers use technology helped me to collaborate with other students on school work.	All schools	2,804	8%	18%	55%	19%	74%
	Anchor schools	226	4%	10%	51%	35%	85%
	Small new schools and STEM Academies	353	3%	13%	53%	31%	85%
	Comprehensive schools	2,225	9%	20%	56%	16%	71%

- The majority of students (72%-74%) agree or strongly agree that their teachers' use of technology has a positive impact (as outlined by the items in Table X). Students from anchor schools and from small new schools and STEM academies have higher proportions of agreement/strong agreement than do students from comprehensive schools

Table G15. Students' Levels of Interest in STEM Careers by School Type

Indicate how interested you are in the following careers:	**School Type**	***n***	**Response**			
			Not at all interested	***Slightly interested***	***Interested***	***Very interested***
Physics	All schools	2,821	36%	30%	25%	9%
	Anchor schools	224	34%	32%	20%	15%
	Small new schools and STEM Academies	359	30%	28%	27%	15%
	Comprehensive schools	2,238	37%	31%	26%	7%
Environmental Work	All schools	2,829	35%	31%	25%	9%
	Anchor schools	225	38%	31%	20%	11%
	Small new schools and STEM Academies	361	36%	34%	23%	8%
	Comprehensive schools	2,243	35%	31%	26%	9%
Biology, Zoology, and Biotechnology	All schools	2,820	34%	27%	25%	14%
	Anchor schools	224	32%	25%	24%	19%
	Small new schools and STEM Academies	361	27%	25%	27%	20%
	Comprehensive schools	2,235	35%	27%	25%	12%
Veterinary Work	All schools	2,816	38%	27%	23%	12%
	Anchor schools	224	38%	24%	18%	20%
	Small new schools and STEM Academies	361	43%	26%	22%	9%
	Comprehensive schools	2,231	37%	27%	24%	12%
Mathematics	All schools	2,811	34%	25%	28%	13%
	Anchor schools	223	33%	27%	25%	15%
	Small new schools and STEM Academies	360	28%	28%	28%	18%
	Comprehensive schools	2,228	35%	25%	28%	12%
Medicine and Medical Science	All schools	2,820	24%	21%	25%	31%
	Anchor schools	225	21%	17%	19%	42%
	Small new schools and STEM Academies	361	18%	16%	24%	42%
	Comprehensive schools	2,234	25%	22%	26%	28%

Indicate how interested you are in the following careers:	School Type	*n*	Response			
			Not at all interested	***Slightly interested***	***Interested***	***Very interested***
Earth Science	All schools	2,814	42%	28%	22%	9%
	Anchor schools	224	34%	34%	20%	13%
	Small new schools and STEM Academies	359	40%	29%	23%	9%
	Comprehensive schools	2,231	43%	27%	22%	8%
Computer Science	All schools	2,818	37%	26%	24%	14%
	Anchor schools	224	34%	27%	19%	21%
	Small new schools and STEM Academies	362	33%	22%	24%	22%
	Comprehensive schools	2,232	38%	27%	24%	12%
Chemistry	All schools	2,815	40%	25%	24%	12%
	Anchor schools	225	33%	23%	24%	20%
	Small new schools and STEM Academies	360	28%	24%	24%	23%
	Comprehensive schools	2,230	42%	25%	24%	9%
Energy	All schools	2,825	40%	27%	24%	10%
	Anchor schools	224	36%	32%	20%	12%
	Small new schools and STEM Academies	362	38%	24%	23%	15%
	Comprehensive schools	2,239	40%	27%	24%	9%
Engineering	All schools	2,826	33%	22%	24%	21%
	Anchor schools	224	32%	20%	23%	25%
	Small new schools and STEM Academies	362	28%	20%	21%	32%
	Comprehensive schools	2,240	34%	23%	24%	19%

Note: Each subject area included a brief description.

- The most popular subject area among students is medicine and medical science; 56% of students across schools reported that they are interested or very interested in this subject area. The least popular area is earth science, with 42% of students reporting that they are not at all interested in the subject area (only 30% reported being interested or very interested). Students from anchor schools and small new schools and STEM academies have similar responses with regard to interest in STEM-related subject areas. For students from both school types, the top three subject areas with the highest proportion of students being interested or very interested are (in order) medicine and medical science, engineering, and chemistry. Similarly, students from comprehensive schools also reported that medicine and medical science and engineering are of interest to them;

however, the third most popular subject area for students from comprehensive schools is mathematics.

Table G16. Students' Levels of Interest in STEM Careers by School Theme

Indicate how interested you are in the following careers:	**School Type**	*n*	**Response**			
			Not at all Interested	***Slightly Interested***	***Interested***	***Very Interested***
Physics	All schools	2,821	36%	30%	25%	9%
	Aerospace, Advanced Manufacturing, and Security*	120	31%	31%	20%	18%
	Health and Life Sciences	275	30%	28%	28%	14%
	Energy and Sustainability	331	33%	32%	24%	12%
	Biotechnology and Agriscience	2,095	37%	30%	26%	7%
Environmental Work	All schools	2,829	35%	31%	25%	9%
	Aerospace, Advanced Manufacturing, and Security	121	41%	23%	30%	7%
	Health and Life Sciences	277	35%	31%	25%	9%
	Energy and Sustainability	334	33%	37%	22%	9%
	Biotechnology and Agriscience	2,097	35%	31%	25%	9%
Biology, Zoology, and Biotechnology	All schools	2,820	34%	27%	25%	14%
	Aerospace, Advanced Manufacturing, and Security	120	33%	25%	26%	17%
	Health and Life Sciences	277	25%	26%	26%	23%
	Energy and Sustainability	334	31%	27%	26%	17%
	Biotechnology and Agriscience	2,089	36%	27%	25%	12%
Veterinary Work	All schools	2,816	38%	27%	23%	12%
	Aerospace, Advanced Manufacturing, and Security	121	47%	22%	22%	8%
	Health and Life Sciences	277	31%	28%	26%	15%
	Energy and Sustainability	332	41%	27%	21%	10%
	Biotechnology and Agriscience	2,086	38%	27%	23%	12%

Indicate how interested you are in the following careers:	School Type	*n*	Response: *Not at all Interested*	*Slightly Interested*	*Interested*	*Very Interested*
Mathematics	All schools	2,811	34%	25%	28%	13%
	Aerospace, Advanced Manufacturing, and Security	121	36%	27%	23%	14%
	Health and Life Sciences	275	28%	27%	27%	18%
	Energy and Sustainability	334	27%	27%	30%	16%
	Biotechnology and Agriscience	2,081	35%	25%	28%	12%
Medicine and Medical Science	All schools	2,820	24%	21%	25%	31%
	Aerospace, Advanced Manufacturing, and Security	121	30%	20%	25%	26%
	Health and Life Sciences	277	11%	13%	21%	55%
	Energy and Sustainability	334	24%	24%	25%	27%
	Biotechnology and Agriscience	2,088	25%	21%	26%	28%
Earth Science	All schools	2,814	42%	28%	22%	9%
	Aerospace, Advanced Manufacturing, and Security	120	34%	33%	23%	10%
	Health and Life Sciences	276	36%	28%	24%	12%
	Energy and Sustainability	333	36%	29%	23%	12%
	Biotechnology and Agriscience	2,085	44%	27%	21%	8%
Computer Science	All schools	2,818	37%	26%	24%	14%
	Aerospace, Advanced Manufacturing, and Security	121	30%	24%	26%	20%
	Health and Life Sciences	277	36%	25%	21%	18%
	Energy and Sustainability	335	28%	28%	24%	21%
	Biotechnology and Agriscience	2,085	38%	26%	24%	12%
Chemistry	All schools	2,815	40%	25%	24%	12%
	Aerospace, Advanced Manufacturing, and Security	121	27%	30%	26%	17%
	Health and Life Sciences	277	29%	20%	28%	23%
	Energy and Sustainability	332	31%	27%	24%	18%
	Biotechnology and Agriscience	2,085	43%	25%	23%	9%

Indicate how interested you are in the following careers:	School Type	*n*	Response			
			Not at all Interested	***Slightly Interested***	***Interested***	***Very Interested***
Energy	All schools	2,825	40%	27%	24%	10%
	Aerospace, Advanced Manufacturing, and Security	121	39%	32%	18%	11%
	Health and Life Sciences	277	37%	27%	24%	12%
	Energy and Sustainability	334	32%	30%	23%	15%
	Biotechnology and Agriscience	2,093	41%	26%	24%	9%
Engineering	All schools	2,826	33%	22%	24%	21%
	Aerospace, Security, and Automation (AS&A)	120	25%	19%	28%	28%
	Health and Life Sciences	278	31%	23%	21%	25%
	Energy and Sustainability	334	29%	20%	25%	27%
	Biotechnology and Agriscience	2,094	35%	22%	24%	19%

*Note: The schools' themes are listed in Appendix A. The numbers of schools in each group are as follows:
Aerospace, Security, and Automation - 3 schools
Health & Life Sciences - 4 schools
Energy & Sustainability - 4 schools
Biotechnology & Agriscience - 9 schools

- The most popular subject area among students was medicine and medical science; 56% of students across schools reported that they are interested or very interested in this subject area. The least popular area was earth science, with 42% of students reporting that they are not at all interested in the subject area (only 30% reported being interested or very interested). Students' level of interest in various STEM subject areas generally aligned with their school's STEM theme. As would be expected, students from Health and Life Sciences-themed schools had the highest proportions of interest in relevant subjects areas, compared to students from other themed schools. When asked their level of interest in medicine and medical science, 55% of students from Health and Life Sciences-themed schools reported they were very interested, compared with the 26%-28% of students from the three other themes who reported being very interested. Health and Life Sciences students also had slightly higher proportions of interest in veterinary work, with 15% that reported they were very interested in this subject area. Though it was only marginally higher, students from the Energy and Sustainability-themed schools had the highest proportions of interest in the subject area energy (15% very interested, compared with 9%-12% from the three other themes). Similarly, students from the Aerospace, Security, and Automation-themed schools were marginally more interested in engineering (28% very interested), compared to Energy and Sustainability (27% very interested), Health and Life Sciences (25% very interested), or Biotechnology and

Agriscience (19% very interested). One STEM theme did not follow this pattern. Students from the Biotechnology and Agriscience-themed schools did not have very high proportions of interest in related subject areas. For example, when asked their level of interest in biology, zoology, and biotechnology, only 12% of Biotechnology and Agriscience students reported being very interested. This was the lowest of the four STEM themes, as 17% of both Aerospace, Advanced Manufacturing, and Security and Energy and Sustainability students reported being very interested and 23% of Health and Life Sciences students.

Appendix H. Staff Responses to the Baseline Survey

Table H1. Respondents' Current Roles in School

Role in School	Percentage of Respondents
Administrator	5%
Teacher	85%
Counselor	6%
Support Staff	1%
Other	3%

n = 334

Table H2. Teacher Respondents' Subject Taught

Subject Taught	Percentage of Respondents
Math	20%
English	19%
Science	17%
Career and Technical Education	17%
Social Sciences	13%
Arts Education	8%
Other Non-STEM Subject	8%
Healthful Living	5%
Information and Technology Skills	3%
Other STEM Subject	3%
World Languages	3%
English as a Second Language	2%

Note: The percentages total over 100% because respondents were able to select more than one "subject taught."
n = 286

Table H3. The Presence or Feel of STEM in the Schools

"The next set of questions concerns the presence or feel of STEM in your school."

How much do you agree or disagree with the following statements about your school.	School Type	*n*	Percentage of Respondents				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree/ Strongly Agree***
1. Our school emphasizes our STEM theme in a number of different ways (work displayed, student activities, etc.).	All schools	327	9%	26%	53%	12%	65%
	Anchor schools	44	0%	14%	57%	30%	86%
	Small new schools and STEM Academies	50	2%	12%	72%	14%	86%
	Comprehensive schools	233	13%	31%	48%	8%	56%
2. Our school is focused on a common STEM-related goal for students.	All schools	327	9%	23%	55%	13%	69%
	Anchor schools	45	4%	7%	56%	33%	89%
	Small new schools and STEM Academies	50	4%	4%	70%	22%	92%
	Comprehensive schools	232	10%	30%	52%	8%	59%
3. Teachers work across subjects to implement STEM projects.	All schools	325	10%	35%	47%	8%	55%
	Anchor schools	45	2%	18%	62%	18%	80%
	Small new schools and STEM Academies	49	0%	14%	73%	12%	86%
	Comprehensive schools	231	13%	43%	39%	5%	44%
4. Everyone on staff understands what it means to be a STEM school.	All schools	328	16%	41%	34%	10%	43%
	Anchor schools	45	4%	29%	40%	27%	67%
	Small new schools and STEM Academies	48	2%	40%	46%	13%	58%
	Comprehensive schools	235	21%	43%	30%	6%	36%

How much do you agree or disagree with the following statements about your school.	School Type	*n*	Percentage of Respondents				
			Strongly Disagree	***Disagree***	***Agree***	***Strongly Agree***	***Agree/ Strongly Agree***
5. We use our STEM theme to guide decisions about curriculum and instruction.	All schools	328	12%	32%	48%	9%	56%
	Anchor schools	45	4%	13%	64%	18%	82%
	Small new schools and STEM Academies	50	0%	12%	70%	18%	88%
	Comprehensive schools	233	15%	40%	40%	5%	45%
6. Students are spending extra time learning STEM content or participating in STEM activities.	All schools	328	13%	40%	41%	6%	47%
	Anchor schools	45	2%	22%	51%	24%	76%
	Small new schools and STEM Academies	50	0%	16%	74%	10%	84%
	Comprehensive schools	233	18%	48%	32%	2%	33%

Regarding the presence or feel of STEM at the school, findings indicate that teachers most strongly agree that their schools were focused on a STEM-related goal for students (69% "agreed" or "strongly agreed"). A majority of teachers also reported that they felt their schools emphasized their STEM theme in a number of different ways, through work displays, student activities, etc. (65% "agreed" or "strongly agreed"). Teachers were least likely to agree that everyone on the staff at their school understands what it means to be a STEM school (43% "agreed" or "strongly agreed") and that students spend extra time learning STEM content or participating in STEM activities (47% "agreed" or "strongly agreed"). When compared by school type, teachers at comprehensive schools were much less likely to agree that there was a presence or feel of STEM at their school (an average of 45% of teachers "agreed" or "strongly agreed" across all survey items) than teachers at small new schools or STEM academies (an average of 82%) or anchor schools (an average of 80%).

Table H4. STEM Course Offerings

Does your school offer classes to students in any of the following STEM areas?	School Type	*n*	Percentage of Respondents		
			Yes	***No***	***I Don't Know***
1. Engineering Design	All schools	321	18%	53%	29%
	Anchor schools	41	37%	46%	17%
	Small new schools and STEM Academies	48	42%	42%	17%
	Comprehensive schools	232	9%	57%	34%
2. Technology or Programming	All schools	321	57%	21%	22%
	Anchor schools	41	54%	37%	10%
	Small new schools and STEM Academies	47	60%	28%	13%
	Comprehensive schools	233	57%	17%	26%
3. Health Sciences	All schools	324	59%	21%	19%
	Anchor schools	42	52%	45%	2%
	Small new schools and STEM Academies	49	65%	29%	6%
	Comprehensive schools	233	59%	15%	25%
4. Energy and Sustainability	All schools	314	13%	57%	30%
	Anchor schools	39	18%	62%	21%
	Small new schools and STEM Academies	47	45%	43%	13%
	Comprehensive schools	228	6%	59%	36%
5. Biotechnology and Agriscience	All schools	318	46%	29%	25%
	Anchor schools	40	28%	63%	10%
	Small new schools and STEM Academies	44	34%	57%	9%
	Comprehensive schools	234	52%	18%	31%

Does your school offer classes to students in any of the following STEM areas?	School Type	*n*	Percentage of Respondents		
			Yes	***No***	***I Don't Know***
6. Aerospace, Advanced Manufacturing, or Security	All schools	312	2%	70%	28%
	Anchor schools	40	5%	73%	23%
	Small new schools and STEM Academies	43	5%	81%	14%
	Comprehensive schools	229	1%	67%	32%

When asked about whether or not their school offers classes in several STEM areas, an average of 26% of teachers reported that they "didn't know." Of the remaining teachers who reported a definitive answer, however, the most commonly reported classes were health sciences (the average percentage of teachers reporting "yes" across the three school types was 59%) and technology or programming (the average across the three school types was 57%). These numbers should be interpreted with slight caution, however, since the numbers of teachers responding for each individual school were not weighted.

Table H5. Student Participation in Extra-curricular STEM Activities

What percentage of students participate in the following STEM experiences outside of the classroom?	School Type	*n*	Percentage of Respondents					
			Not Offered	***1-25%***	***26-50%***	***51-75%***	***Over 75%***	***Do Not Know***
1. Internships in STEM facilities	All schools	327	48%	10%	1%	1%	0%	40%
	Anchor schools	44	43%	14%	5%	2%	2%	34%
	Small new schools and STEM Academies	48	58%	8%	2%	0%	0%	31%
	Comprehensive schools	235	46%	9%	0%	0%	0%	43%
2. Field trips to STEM facilities	All schools	326	38%	13%	3%	3%	6%	37%
	Anchor schools	44	16%	16%	14%	11%	18%	25%
	Small new schools and STEM Academies	48	19%	29%	4%	6%	25%	17%
	Comprehensive schools	234	47%	9%	1%	0%	0%	43%

What percentage of students participate in the following STEM experiences outside of the classroom?	School Type	*n*	Percentage of Respondents					
			Not Offered	***1-25%***	***26-50%***	***51-75%***	***Over 75%***	***Do Not Know***
3. STEM-related clubs	All schools	329	35%	20%	7%	2%	2%	35%
	Anchor schools	45	13%	24%	24%	4%	9%	24%
	Small new schools and STEM Academies	49	35%	27%	10%	6%	4%	18%
	Comprehensive schools	235	40%	18%	3%	0%	0%	40%
4. STEM-related projects in the community	All schools	331	39%	15%	3%	1%	2%	39%
	Anchor schools	45	31%	11%	11%	7%	9%	31%
	Small new schools and STEM Academies	50	38%	24%	2%	0%	8%	28%
	Comprehensive schools	236	41%	14%	2%	0%	0%	42%
5. Other	All schools	102	21%	2%	0%	1%	1%	75%
	Anchor schools	7	0%	0%	0%	0%	14%	86%
	Small new schools and STEM Academies	12	33%	0%	0%	8%	0%	58%
	Comprehensive schools	83	20%	2%	0%	0%	0%	77%

Note: For the fifth survey item, "5. Other," the *n* sizes for "Anchor schools" and "Small new schools and STEM academies" are sufficiently small that findings from any comparisons between these results and results for the "Comprehensive schools" should be treated with caution.

When asked about the proportion of students who participated in STEM experiences outside of the classroom, teachers rarely reported that over 25% of students participated in any activity. The most commonly reported STEM experiences outside of the classroom were: STEM-related clubs (20% of educators indicated that 1-25% of students at their school participated) and STEM-related projects in the community (15% of educators indicated that 1-25% of students participated). When compared by school type, teachers at anchor schools and small new schools and STEM academies were more likely to report that students participated in STEM activities outside of school than teachers at comprehensive schools. Teachers from different school types reported the largest differential in student participation regarding field trips to STEM facilities. Twenty-nine percent of teachers at small new school and STEM academies reported that 1-25% of students experienced such a trip, while 9% of teachers at comprehensive schools did.

Table H6. Frequency of Rigorous Instructional Activities

How frequently have you done the following things in your classes?	School Type	*n*	Percentage of Responses				
			Never	***Once per Semester***	***Monthly***	***Weekly***	***Daily***
1. Asked students to solve problems based on life outside of school	All schools	306	7%	11%	28%	39%	16%
	Anchor schools	42	0%	2%	33%	40%	24%
	Small new schools and STEM Academies	45	7%	9%	33%	40%	11%
	Comprehensive schools	219	8%	13%	26%	38%	16%
2. Asked students to develop and test a theory or hypothesis	All schools	303	19%	21%	24%	29%	7%
	Anchor schools	42	2%	10%	38%	38%	12%
	Small new schools and STEM Academies	44	14%	2%	34%	45%	5%
	Comprehensive schools	217	24%	27%	19%	24%	7%
3. Had students develop their own questions and then answer them?	All schools	304	13%	12%	32%	32%	11%
	Anchor schools	42	5%	10%	33%	36%	17%
	Small new schools and STEM Academies	44	16%	11%	25%	34%	14%
	Comprehensive schools	218	14%	13%	33%	31%	9%
4. Implemented projects in your classroom/ school?	All schools	300	8%	18%	35%	29%	10%
	Anchor schools	42	0%	0%	38%	43%	19%
	Small new schools and STEM Academies	44	5%	16%	34%	39%	7%
	Comprehensive schools	214	10%	22%	35%	24%	9%
5. Encouraged students to find more than one way to answer a question?	All schools	299	5%	4%	14%	36%	40%
	Anchor schools	41	0%	0%	7%	46%	46%
	Small new schools and STEM Academies	43	5%	0%	7%	30%	58%
	Comprehensive schools	215	7%	5%	17%	36%	36%

How frequently have you done the following things in your classes?	School Type	*n*	Percentage of Responses				
			Never	***Once per Semester***	***Monthly***	***Weekly***	***Daily***
6. Had students develop multiple solutions for a problem?	All schools	303	11%	9%	22%	37%	21%
	Anchor schools	42	2%	0%	19%	50%	29%
	Small new schools and STEM Academies	44	9%	9%	27%	32%	23%
	Comprehensive schools	217	12%	11%	21%	36%	19%
7. Implemented a project with a teacher in another subject area?	All schools	302	42%	37%	12%	6%	2%
	Anchor schools	42	31%	38%	17%	5%	10%
	Small new schools and STEM Academies	44	34%	34%	27%	5%	0%
	Comprehensive schools	216	46%	38%	8%	6%	1%
8. Asked students to defend their own ideas or point of view in writing or in a discussion?	All schools	300	7%	10%	21%	38%	24%
	Anchor schools	42	0%	2%	24%	52%	21%
	Small new schools and STEM Academies	43	9%	2%	14%	40%	35%
	Comprehensive schools	215	8%	13%	22%	35%	22%
9. Asked students to explain their thinking?	All schools	298	3%	2%	9%	26%	60%
	Anchor schools	41	0%	2%	0%	24%	73%
	Small new schools and STEM Academies	43	5%	2%	5%	23%	65%
	Comprehensive schools	214	3%	2%	11%	27%	57%
10. Asked students to apply what they have learned to solve an unfamiliar problem?	All schools	301	6%	7%	19%	40%	29%
	Anchor schools	41	5%	5%	10%	59%	22%
	Small new schools and STEM Academies	43	5%	7%	23%	33%	33%
	Comprehensive schools	217	6%	7%	19%	38%	29%

How frequently have you done the following things in your classes?	School Type	*n*	Percentage of Responses				
			Never	*Once per Semester*	*Monthly*	*Weekly*	*Daily*
11. Asked students to engage in in-depth discussions about what they have read or learned?	All schools	301	7%	6%	18%	44%	27%
	Anchor schools	42	0%	0%	19%	38%	43%
	Small new schools and STEM Academies	44	5%	7%	16%	48%	25%
	Comprehensive schools	215	8%	7%	18%	44%	24%
12. Had students work together on projects or assignments?	All schools	300	4%	4%	15%	43%	35%
	Anchor schools	42	0%	0%	2%	38%	60%
	Small new schools and STEM Academies	44	5%	9%	9%	39%	39%
	Comprehensive schools	214	5%	3%	19%	44%	29%
13. Had students discuss important ideas with each other?	All schools	300	4%	2%	14%	39%	40%
	Anchor schools	42	0%	0%	5%	29%	67%
	Small new schools and STEM Academies	45	7%	0%	11%	33%	49%
	Comprehensive schools	213	5%	3%	16%	43%	33%
14. Engaged students in activities to build their creativity?	All schools	297	5%	7%	17%	42%	29%
	Anchor schools	41	0%	2%	10%	46%	41%
	Small new schools and STEM Academies	43	2%	5%	16%	58%	19%
	Comprehensive schools	213	7%	8%	19%	38%	29%

When asked to report on the frequency with which they implement STEM instructional activities, teachers reported that they were most likely to:

- Ask students to explain their thinking (5% reported that they do this "never" or "once per semester");
- Have students discuss important ideas with each other (7%);
- Have students work together on projects or assignments (8%); and
- Encourage students to find more than one way to answer a question (9%).

Educators reported that they were least likely to:

- Implement a project with a teacher in another subject area (79% reported that they had either "never" done this" or had done this "once per semester");

- Ask students to develop and test a theory or hypothesis (40%);
- Implement projects in their classroom or school (26%); and
- Have students develop their own questions and then answer them (25%).

Overall, teachers at comprehensive schools were slightly less likely to implement these STEM instructional activities than teachers at small new schools and STEM academies and anchor schools.

Table H7. Teacher Comfort with Instructional Strategies

Please rate your comfort with the following instructional approaches.	School Type	*n*	Percentage of Respondents: *I Don't Know How to Do This*	*I Have Tried This Out but Need to Learn More to Do It Well*	*I Can Do This Fairly Well*	*I am Extremely Comfortable and Could Teach Others*
1. Collaborative grouping	All schools	300	3%	24%	51%	22%
	Anchor schools	41	0%	5%	78%	17%
	Small new schools and STEM Academies	46	7%	17%	37%	39%
	Comprehensive schools	213	3%	29%	49%	19%
2. Integrating writing into instruction	All schools	296	5%	22%	52%	21%
	Anchor schools	42	0%	21%	50%	29%
	Small new schools and STEM Academies	45	9%	20%	51%	20%
	Comprehensive schools	209	5%	22%	52%	20%
3. Integrating literacy groups into instruction	All schools	302	16%	34%	37%	12%
	Anchor schools	41	7%	49%	34%	10%
	Small new schools and STEM Academies	46	20%	24%	37%	20%
	Comprehensive schools	215	17%	33%	38%	11%

Please rate your comfort with the following instructional approaches.	School Type	*n*	Percentage of Respondents			
			I Don't Know How to Do This	***I Have Tried This Out but Need to Learn More to Do It Well***	***I Can Do This Fairly Well***	***I am Extremely Comfortable and Could Teach Others***
4. Creating high-quality questions or problems to engage students in higher-level thinking	All schools	303	3%	28%	51%	17%
	Anchor schools	42	2%	19%	57%	21%
	Small new schools and STEM Academies	46	7%	22%	52%	20%
	Comprehensive schools	215	3%	32%	49%	16%
5. Making connections to students' previous learning	All schools	304	3%	11%	55%	32%
	Anchor schools	42	0%	0%	60%	40%
	Small new schools and STEM Academies	46	9%	9%	46%	37%
	Comprehensive schools	216	2%	13%	56%	30%
6. Facilitating discussions among students	All schools	305	3%	18%	52%	27%
	Anchor schools	41	0%	7%	49%	44%
	Small new schools and STEM Academies	46	4%	20%	41%	35%
	Comprehensive schools	218	3%	20%	55%	22%
7. Designing projects aligned with the North Carolina Standard Course of Study	All schools	303	7%	21%	48%	23%
	Anchor schools	41	2%	2%	63%	32%
	Small new schools and STEM Academies	46	7%	17%	41%	35%
	Comprehensive schools	216	8%	26%	47%	19%

Please rate your comfort with the following instructional approaches.	School Type	*n*	Percentage of Respondents: *I Don't Know How to Do This*	*I Have Tried This Out but Need to Learn More to Do It Well*	*I Can Do This Fairly Well*	*I am Extremely Comfortable and Could Teach Others*
8. Managing students as they complete projects	All schools	303	6%	20%	51%	23%
	Anchor schools	42	0%	5%	60%	36%
	Small new schools and STEM Academies	45	7%	18%	49%	27%
	Comprehensive schools	216	6%	24%	50%	20%
9. Assessing what students learned in a project	All schools	302	5%	20%	53%	22%
	Anchor schools	42	2%	12%	55%	31%
	Small new schools and STEM Academies	44	11%	20%	39%	30%
	Comprehensive schools	216	4%	21%	56%	19%
10. Implementing projects	All schools	302	5%	21%	52%	23%
	Anchor schools	42	0%	14%	52%	33%
	Small new schools and STEM Academies	46	9%	15%	39%	37%
	Comprehensive schools	214	5%	24%	54%	17%

Regarding comfort with various instructional approaches, survey results indicate that, on average, and with a fair amount of consistency (the proportions by survey item did not vary much around the average): 22% of teachers indicated that they had tried the instructional strategies but needed to learn more to do them well; 50% of teachers felt they could do the strategies fairly well; and 22% felt extremely comfortable with the instructional approaches and that they could teach others. For one item, "integrating literacy groups into instruction," a noticeably smaller proportion of teachers reported that they felt extremely comfortable with it (12%) or that they felt they could do it extremely well (37%), while a larger proportion reported that they felt they needed to learn more to do it well (34%).

Table H8. Math Teachers' Emphasis on Instructional Objectives

How much emphasis are you placing on the following objectives?	School Type	*n*	Percentage of Respondents			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
1. Increasing students' interest in mathematics	All schools	51	0%	6%	49%	45%
	Anchor schools	8	0%	0%	63%	38%
	Small new schools and STEM Academies	9	0%	0%	56%	44%
	Comprehensive schools	34	0%	9%	44%	47%
2. Teaching students mathematical concepts	All schools	1	0%	2%	12%	86%
	Anchor schools	8	0%	0%	13%	88%
	Small new schools and STEM Academies	8	0%	0%	13%	88%
	Comprehensive schools	35	0%	3%	11%	86%
3. Teaching students mathematical algorithms or procedures	All schools	26	0%	0%	38%	63%
	Anchor schools	5	11%	22%	33%	33%
	Small new schools and STEM Academies	3	3%	24%	21%	53%
	Comprehensive schools	18	4%	20%	25%	51%
4. Developing students' computational skills	All schools	52	0%	10%	37%	54%
	Anchor schools	8	0%	0%	50%	50%
	Small new schools and STEM Academies	9	0%	11%	56%	33%
	Comprehensive schools	35	0%	11%	29%	60%
5. Developing students' problem-solving skills	All schools	52	0%	4%	13%	83%
	Anchor schools	8	0%	0%	0%	100%
	Small new schools and STEM Academies	9	0%	0%	11%	89%
	Comprehensive schools	35	0%	6%	17%	77%

How much emphasis are you placing on the following objectives?	School Type	*n*	Percentage of Respondents			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
6. Teaching students to reason mathematically	All schools	42	0%	6%	12%	81%
	Anchor schools	8	0%	0%	0%	100%
	Small new schools and STEM Academies	8	0%	0%	0%	89%
	Comprehensive schools	26	0%	9%	17%	74%
7. Teaching students how mathematical ideas connect with one another	All schools	51	0%	4%	31%	65%
	Anchor schools	8	0%	0%	38%	63%
	Small new schools and STEM Academies	8	0%	0%	13%	88%
	Comprehensive schools	35	0%	6%	34%	60%
8. Preparing students for further study in mathematics	All schools	51	0%	6%	22%	73%
	Anchor schools	8	0%	0%	38%	63%
	Small new schools and STEM Academies	8	0%	0%	13%	88%
	Comprehensive schools	35	0%	9%	20%	71%
9. Teaching students about the history and nature of mathematics	All schools	51	24%	45%	24%	8%
	Anchor schools	8	0%	50%	38%	13%
	Small new schools and STEM Academies	8	25%	38%	25%	13%
	Comprehensive schools	35	29%	46%	20%	6%
10. Teaching students to explain ideas in mathematics effectively	All schools	50	0%	16%	34%	50%
	Anchor schools	7	0%	0%	14%	86%
	Small new schools and STEM Academies	8	0%	13%	0%	88%
	Comprehensive schools	35	0%	20%	46%	34%
11. Teaching students how to apply mathematics in business and industry	All schools	51	6%	35%	37%	22%
	Anchor schools	8	0%	13%	75%	13%
	Small new schools and STEM Academies	8	0%	25%	50%	25%
	Comprehensive schools	35	9%	43%	26%	23%

How much emphasis are you placing on the following objectives?	School Type	*n*	Percentage of Respondents			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
12. Teaching students to perform computations with speed and accuracy	All schools	50	0%	40%	32%	28%
	Anchor schools	8	0%	13%	63%	25%
	Small new schools and STEM Academies	8	0%	50%	13%	38%
	Comprehensive schools	34	0%	44%	29%	26%
13. Preparing students for standardized tests	All schools	51	0%	13%	50%	38%
	Anchor schools	8	13%	25%	25%	38%
	Small new schools and STEM Academies	8	3%	23%	26%	49%
	Comprehensive schools	35	4%	22%	29%	45%

Note: Due to small *n* sizes in this survey section, any comparisons made between results for different school types should be treated with caution.

Overall, survey findings suggest that the vast majority of participating math teachers place moderate or heavy emphasis on 13 different objectives. Teachers report putting the heaviest emphasis on teaching students mathematical concepts (86% reported "heavy emphasis"), developing students' problem-solving skills (83%), and preparing students for further study in mathematics (73%). Educators report placing the least emphasis on teaching students about the history and nature of mathematics (a combined 32% reported "heavy emphasis" or "moderate emphasis" and 45% reported "minimal emphasis"), teaching students to perform computations with speed and accuracy (a combined 60% reported "heavy emphasis" or "moderate emphasis" and 40% reported "minimal emphasis"), and teaching students how to apply mathematics in business and industry (a combined 59% reported "heavy emphasis" or "moderate emphasis" and 41% reported "minimal emphasis" or "no emphasis").

Table H9. Science Teachers' Emphasis on Instructional Objectives

How much emphasis are you placing on the following objectives?	School Type	*n*	Percentage of Respondents			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
1. Increasing students' interest in science	All schools	41	0%	7%	41%	51%
	Anchor schools	7	0%	0%	57%	43%
	Small new schools and STEM Academies	8	0%	0%	25%	75%
	Comprehensive schools	26	0%	12%	42%	46%
2. Teaching students basic science concepts	All schools	26	0%	5%	32%	63%
	Anchor schools	5	0%	0%	29%	71%
	Small new schools and STEM Academies	6	0%	0%	25%	75%
	Comprehensive schools	15	0%	8%	35%	58%
3. Teaching students important terms and facts of science	All schools	41	0%	10%	29%	61%
	Anchor schools	7	0%	14%	14%	71%
	Small new schools and STEM Academies	8	0%	0%	50%	50%
	Comprehensive schools	26	0%	12%	27%	62%
4. Teaching students science process or inquiry skills	All schools	41	0%	15%	34%	51%
	Anchor schools	7	0%	14%	43%	43%
	Small new schools and STEM Academies	8	0%	0%	25%	75%
	Comprehensive schools	26	0%	19%	35%	46%
5. Preparing students for further study in science	All schools	23	2%	5%	37%	56%
	Anchor schools	4	0%	0%	43%	57%
	Small new schools and STEM Academies	7	0%	0%	13%	88%
	Comprehensive schools	12	4%	8%	42%	46%

How much emphasis are you placing on the following objectives?	School Type	*n*	Percentage of Respondents			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
6. Teaching students to evaluate arguments based on scientific evidence	All schools	14	7%	15%	44%	34%
	Anchor schools	1	0%	29%	57%	14%
	Small new schools and STEM Academies	5	0%	0%	38%	63%
	Comprehensive schools	8	12%	15%	42%	31%
7. Teaching students how to communicate ideas in science effectively	All schools	41	0%	17%	51%	32%
	Anchor schools	7	0%	43%	14%	43%
	Small new schools and STEM Academies	8	0%	0%	75%	25%
	Comprehensive schools	26	0%	15%	54%	31%
8. Teaching students about the applications of science in business and industry	All schools	41	0%	27%	41%	32%
	Anchor schools	7	0%	29%	14%	57%
	Small new schools and STEM Academies	8	0%	0%	63%	38%
	Comprehensive schools	26	0%	35%	42%	23%
9. Teaching students about the relationship between science, technology, and society	All schools	41	0%	15%	51%	34%
	Anchor schools	7	0%	0%	57%	43%
	Small new schools and STEM Academies	8	0%	0%	50%	50%
	Comprehensive schools	26	0%	23%	50%	27%
10. Teaching students about the history and nature of science	All schools	41	2%	27%	39%	32%
	Anchor schools	7	0%	29%	43%	29%
	Small new schools and STEM Academies	8	0%	13%	50%	38%
	Comprehensive schools	26	4%	31%	35%	31%

How much emphasis are you placing on the following objectives?	**School Type**	*n*	**Percentage of Respondents**			
			No Emphasis	***Minimal Emphasis***	***Moderate Emphasis***	***Heavy Emphasis***
11. Preparing students for standardized tests	All schools	41	7%	22%	34%	37%
	Anchor schools	7	0%	43%	57%	0%
	Small new schools and STEM Academies	8	25%	0%	50%	25%
	Comprehensive schools	26	4%	23%	23%	50%

Note: Due to small *n* sizes in this survey section, any comparisons made between results for different school types should be treated with caution.

Overall, survey findings suggest that the vast majority of participating science teachers place moderate or heavy emphasis on 11 different objectives. Teachers report putting the most emphasis on teaching students basic science concepts (95% reported "moderate emphasis" or "heavy emphasis"), increasing students' interest in science (93%), preparing students for further study in science (93%), and teaching students important terms and facts of science (90%). Educators report placing the least emphasis on teaching students about the history and nature of science (a combined 71% reported "moderate emphasis" or "heavy emphasis" and 29% reported "minimal emphasis" or "no emphasis"), teaching students about the applications of science in business and industry (a combined 73% reported "moderate emphasis" or "heavy emphasis" and 27% reported "minimal emphasis"), and teaching students to evaluation arguments based on scientific evidence (a combined 78% reported "moderate emphasis" or "heavy emphasis" and 22% reported "minimal emphasis" or "no emphasis").

Table H10. Frequency of Use of Instructional Technology

This set of questions concerns the use of technology. If you are a teacher, please answer these questions relative to your own practice. If you are an administrator or counselor, please answer this question relative to most teachers in your school.

In my classroom/ school …	School Type	*n*	Percentage of Responses				
			Never	***Once per Semester***	***Monthly***	***Weekly***	***Daily***
1. Students use a variety of technologies, e.g., productivity, visualization, research, and communication tools	All schools	306	4%	6%	21%	41%	28%
	Anchor schools	42	5%	2%	10%	26%	57%
	Small new schools and STEM Academies	44	0%	2%	18%	50%	30%
	Comprehensive schools	220	4%	8%	24%	41%	23%
2. Students use technology during the school day to communicate and collaborate with others, beyond the classroom	All schools	306	24%	11%	14%	22%	30%
	Anchor schools	43	14%	7%	2%	23%	53%
	Small new schools and STEM Academies	44	16%	9%	11%	36%	27%
	Comprehensive schools	219	27%	12%	16%	19%	26%
3. Students use technology to access online resources and information as a part of classroom or homework activities	All schools	303	6%	8%	21%	30%	34%
	Anchor schools	43	5%	5%	9%	16%	65%
	Small new schools and STEM Academies	44	0%	7%	14%	34%	45%
	Comprehensive schools	216	8%	8%	25%	32%	26%
4. Students use the same kinds of tools that professional researchers use, e.g., simulations, databases, satellite imagery	All schools	305	35%	19%	19%	18%	9%
	Anchor schools	43	21%	12%	19%	26%	23%
	Small new schools and STEM Academies	44	23%	18%	32%	20%	7%
	Comprehensive schools	218	41%	20%	17%	16%	6%
5. Students work on technology-enhanced projects that approach real-world applications of technology	All schools	303	24%	20%	24%	21%	11%
	Anchor schools	42	14%	2%	26%	29%	29%
	Small new schools and STEM Academies	42	12%	26%	31%	21%	10%
	Comprehensive schools	219	28%	23%	22%	19%	8%

In my classroom/ school …	School Type	*n*	Percentage of Responses				
			Never	***Once per Semester***	***Monthly***	***Weekly***	***Daily***
6. Students use technology to help solve problems	All schools	302	7%	11%	21%	31%	30%
	Anchor schools	43	5%	5%	5%	30%	56%
	Small new schools and STEM Academies	42	2%	10%	19%	38%	31%
	Comprehensive schools	217	8%	12%	24%	29%	25%
7. Students use technology to support higher-order thinking, e.g., analysis, synthesis, and evaluation of ideas and information	All schools	303	12%	12%	23%	32%	20%
	Anchor schools	42	7%	7%	7%	29%	50%
	Small new schools and STEM Academies	44	5%	11%	25%	48%	11%
	Comprehensive schools	217	14%	13%	26%	30%	16%
8. Students use technology to create new ideas and representations of information	All schools	304	12%	13%	27%	29%	18%
	Anchor schools	43	9%	5%	14%	26%	47%
	Small new schools and STEM Academies	44	5%	11%	32%	36%	16%
	Comprehensive schools	217	14%	15%	29%	29%	13%

Survey findings indicate that the vast majority of students in schools of participating teachers use technology for six, broad types of activities either monthly, weekly, or daily. Students most frequently:

- Use a variety of technologies, e.g., productivity, visualization, research, and communication tools (90% of teachers report students do this "monthly," "weekly," or "daily");
- Use technology to access online resources and information as a part of classroom or homework activities (86%); and
- Use technology to help solve problems (82%).

Teachers report that students least frequently:

- Use the same kinds of tools that professional researchers use, e.g., simulations, databases, satellite imagery (54% of teachers report students do this "once per semester" or "never");
- Work on technology-enhanced projects that approach real-world applications of technology (44%); and

- Use technology during the school day to communicate and collaborate with others, beyond the classroom (35%).

When compared by school type, survey respondents reported that instructional technology was used slightly more frequently at anchor schools and small new schools and STEM academies than at comprehensive schools.

Table H11. Frequency of Staff Meetings about STEM Teaching and Learning

"The last set of questions concerns the environment of the school. Please indicate how often school staff meet in groups (formally or informally) to do the following activities."

School staff meet in groups to …	**School Type**	*n*	**Percentage of Responses**				
			Never	***Once per Semester***	***Monthly***	***Weekly***	***Daily***
1. Plan STEM-related activities.	All schools	302	27%	30%	25%	14%	3%
	Anchor schools	43	7%	30%	19%	35%	9%
	Small new schools and STEM Academies	43	0%	21%	58%	16%	5%
	Comprehensive schools	216	36%	32%	20%	9%	2%
2. Discuss STEM-related outcomes for students.	All schools	299	30%	31%	24%	12%	3%
	Anchor schools	43	7%	26%	33%	26%	9%
	Small new schools and STEM Academies	42	2%	24%	52%	19%	2%
	Comprehensive schools	214	40%	33%	17%	8%	1%
3. Examine and evaluate STEM-related school data.	All schools	301	35%	31%	22%	10%	2%
	Anchor schools	43	14%	28%	30%	23%	5%
	Small new schools and STEM Academies	43	9%	37%	35%	16%	2%
	Comprehensive schools	215	45%	30%	18%	6%	1%
4. For the purpose of STEM-related professional development or learning (such as PLC).	All schools	299	18%	35%	31%	13%	2%
	Anchor schools	43	5%	37%	30%	21%	7%
	Small new schools and STEM Academies	42	0%	26%	60%	12%	2%
	Comprehensive schools	214	25%	37%	26%	11%	1%

When asked about the frequency with which school staff meet in formal or informal groups to do certain activities, survey results indicate that there is disagreement between teachers about how often this happens, or teachers have different experiences with these types of meetings. On average, with some consistency (differences from the average did not vary much by individual survey item), for each type of staff meeting:

- About 28% of teachers report school staff "never" meet;
- About 32% report "a few times this year";
- About 26% report "once or twice a month";
- About 12% report "once or twice a week"; and
- About 3% report "almost every day."

When compared by school type, however, there does seem to be some variation. Teachers in comprehensive schools report meeting much less frequently than teachers in small new schools and STEM academies or anchor schools. For each of the four types of meetings, on average 70% of teachers in comprehensive schools report that these meetings happen either "once per semester" or "never," while 38% of teachers report this at anchor schools and 30% report this at small schools and STEM academies.

Table H12. School Climate

How true are the following statements about your school?	**School Type**	*n*	**Percentage of Respondents**			
			Not True at All	***Somewhat True***	***Mostly True***	***Entirely True***
1. Every student in this school is known well by at least one staff member	All schools	307	2%	14%	35%	49%
	Anchor schools	43	0%	0%	21%	79%
	Small new schools and STEM Academies	43	0%	19%	42%	40%
	Comprehensive schools	221	3%	16%	36%	45%
2. The family and home life of each student is known to at least one faculty member in this school	All schools	305	5%	28%	40%	28%
	Anchor schools	43	0%	16%	30%	53%
	Small new schools and STEM Academies	43	7%	35%	37%	21%
	Comprehensive schools	219	6%	28%	42%	24%
3. Faculty members follow up when students miss their class	All schools	306	6%	33%	42%	19%
	Anchor schools	43	0%	9%	58%	33%
	Small new schools and STEM Academies	43	5%	42%	33%	21%
	Comprehensive schools	220	8%	36%	40%	16%

How true are the following statements about your school?	School Type	*n*	Percentage of Respondents			
			Not True at All	***Somewhat True***	***Mostly True***	***Entirely True***
4. Faculty members respect all the students in this school	All schools	306	5%	21%	46%	29%
	Anchor schools	43	0%	7%	42%	51%
	Small new schools and STEM Academies	43	0%	21%	44%	35%
	Comprehensive schools	220	7%	23%	47%	23%
5. Students respect all the faculty members in this school	All schools	308	17%	31%	43%	9%
	Anchor schools	43	0%	12%	67%	21%
	Small new schools and STEM Academies	43	5%	28%	49%	19%
	Comprehensive schools	222	23%	36%	37%	5%

Survey results suggest that school climate overall is quite high at the participating schools. Teachers report that school climate is most positive with regard to the degree to which every student in the school is known well by at least one staff member (84% reported this is "mostly true" or "entirely true"). Additional findings indicate that teachers feel most positively about the degree to which faculty members respect all students in the school (75% reported this is "mostly true" or "entirely true"). The teachers were the least positive about how much students respect all the faculty members in the school (52% reported "mostly true" or "entirely true") and how much faculty members follow-up when students miss their class (61%).

When compared by school type, teachers in anchor schools reported a school climate much more favorable (on average across the five survey items 91% reported "mostly true" or "entirely true") than teachers at small schools and STEM academies overall (68%) and teachers at comprehensive schools (63%).

*Table H13. STEM Course Offerings by School Theme**

Does your school offer classes to students in any of the following STEM areas?	School Theme	*n*	Percentage of Respondents		
			Yes	***No***	***I Don't Know***
1. Engineering Design	All schools	321	18%	54%	29%
	Aerospace, Security, and Automation	14	79%	21%	0%
	Health & Life Sciences	47	23%	53%	23%
	Energy & Sustainability	26	65%	23%	12%
	Biotechnology & Agriscience	234	8%	59%	33%
2. Technology or Programming	All schools	321	57%	21%	22%
	Aerospace, Security, and Automation	14	71%	29%	0%
	Health & Life Sciences	45	44%	36%	20%
	Energy & Sustainability	27	81%	11%	7%
	Biotechnology & Agriscience	235	55%	19%	26%
3. Health Sciences	All schools	324	59%	22%	19%
	Aerospace, Security, and Automation	13	15%	85%	0%
	Health & Life Sciences	50	84%	10%	6%
	Energy & Sustainability	26	50%	42%	8%
	Biotechnology & Agriscience	235	57%	18%	25%

*Note: The schools' themes are listed in Appendix A. The numbers of schools in each group are as follows:

Does your school offer classes to students in any of the following STEM areas?	School Theme	*n*	Percentage of Respondents		
			Yes	***No***	***I Don't Know***
4. Energy and Sustainability	All schools	314	13%	57%	30%
	Aerospace, Security, and Automation	13	8%	92%	0%
	Health & Life Sciences	46	43%	30%	26%
	Energy & Sustainability	25	44%	48%	8%
	Biotechnology & Agriscience	230	4%	61%	35%
5. Biotechnology and Agriscience	All schools	318	47%	28%	25%
	Aerospace, Security, and Automation	13	8%	92%	0%
	Health & Life Sciences	43	19%	63%	19%
	Energy & Sustainability	26	50%	42%	8%
	Biotechnology & Agriscience	236	53%	17%	30%
6. Aerospace, Advanced Manufacturing, or Security	All schools	312	2%	70%	28%
	Aerospace, Security, and Automation	13	23%	62%	15%
	Health & Life Sciences	43	0%	74%	26%
	Energy & Sustainability	25	8%	72%	20%
	Biotechnology & Agriscience	231	1%	69%	30%

Aerospace, Security, and Automation – 3 schools
Health & Life Sciences - 4 schools
Energy & Sustainability - 4 schools
Biotechnology & Agriscience - 9 schools

Appendix I. Additional Table for the Intermediate Outcomes

Table I1. STEM-specific Observation Mean Scores with Indicators

Dimension	Mean	SD
1. Quality of Common Instructional Framework	**2.83**	**0.58**
1a. Students worked collaboratively in teams or groups.	3.17	0.94
1b. Students used writing to communicate what they had learned.	2.00	1.04
1c. Students participated in guided reading discussions. (all students)	1.25	0.46
1d. Teachers asked open-ended questions that required higher level thinking.	2.42	0.79
1e. Teachers provided assistance/scaffolding when students struggle.	3.42	0.51
1f. Students engaged in discussion with each other.	2.83	1.06
2. Quality of STEM Content	**2.83**	**0.58**
2a. Content information was accurate. Teacher used accurate and appropriate mathematics or science vocabulary.	3.56	0.53
2b. Teacher's presentation or clarification of mathematics or science content knowledge was clear.	3.17	0.72
2c. Teacher and students discussed key mathematical or science ideas and concepts in depth.	2.25	0.87
2d. Students' errors or misconceptions were corrected (emphasis on conveying correct content).	3.00	0.89
2e. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	2.92	1.00
3. Quality of Inquiry Learning; Engineering Design Process, Project-based learning; and Problem-based Instruction	**2.58**	**1.00**
3a. Students were engaged in open-ended tasks or questions, or in solving authentic problems.	2.50	1.24
3b. Students experienced tasks with high cognitive demand which was not reduced by the teacher (they had to think on their own on a non-trivial task).	2.50	1.09
3c. Students engaged in hands-on problem solving activities or a lab experiment.	1.92	1.38
3d. Students engaged in scientific inquiry process (developed their own questions and/or hypotheses, tested hypotheses, researched a topic, and made inferences)	1.83	1.00
3e. Students worked on a project requiring design and/or creativity.	1.92	1.34
3h. There was an explicit evidence of teacher modeling engineering (or reverse engineering) design process.	2.17	1.16
3i. There was an explicit evidence of students using engineering (or reverse engineering) design process.	2.58	1.19

Dimension	Mean	SD
4. Quality of Formative Assessment	**2.42**	**0.51**
4a. Teacher provided clear learning goals to students.	2.67	.89
4b. Teacher provided clear criteria for success/examples of good work to students.	1.92	.79
4c. Teacher used a variety of strategies to monitor student learning and understanding throughout the lesson.	2.92	.90
4d. Teacher provided specific feedback to students.	3.17	.83
4e. Students were engaged in self-and/or peer-assessment.	2.08	1.24
4f. Teacher adjusted or differentiated instruction based on evidence of student learning.	2.25	0.87
4g. Students were given opportunities to reflect on their own learning.	1.92	1.00
5. Quality of Use of Technology	**2.27**	**0.79**
5a. Technology was used to a high extent (as a proportion of time of the lesson and intensity of use) – use a weight metaphor	2.25	1.06
5b. Students used technology to explore or confirm relationships, ideas, hypotheses, or develop conceptual understanding.	1.17	0.39
5c. Students used technology to generate or manipulate one or more representations of a given concept or idea.	1.50	1.00
5d. Students used technology as a tool to meet a discreet instructional outcome (like an assignment or specific objective).	2.33	1.23
5e. Students used technology to practice skills or reinforce knowledge.	1.58	1.00
5f. Technology was used but did not appear to provide any added benefit.	1.67	0.89
5g. Teacher used technology to achieve instructional goals. (Emphasis on the "teacher" here)	2.50	1.00

Appendix J. North Carolina New Schools Response to the Evaluation Report

10TH ANNIVERSARY 2003 - 2013
NORTH CAROLINA NEW SCHOOLS

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September 23, 2013

Dr. Nina Arshavsky
Senior Research Specialist
SERVE Center, University of North Carolina at Greensboro
5900 Summit Avenue, #201
Browns Summit, NC 27214

Dear Dr. Arshavsky:

On behalf of North Carolina New Schools, I extend thanks and appreciation to the entire SERVE and Friday Institute collaborative team which is supporting the Race to the Top evaluation and reporting process. The objective assessments, depth of the observation and evidence-based recommendations included in the annual reports have proven to be enormously helpful as we continuously strive to improve and better align our services with North Carolina's education priorities.

NC New Schools is honored to partner with the NC Department of Public Instruction and the State Board of Education in the implementation of the Race to the Top initiative. We are pleased to see observations included in the year three report such as, *"The single most notable impact of the initiative on students reported across all schools was an increase in student engagement."* We believe that student engagement is the gateway to student achievement; as such, there are few statements that we find more encouraging.

We are also pleased to see recognition in the report "*that structures for networking, professional development, curriculum development, and partnerships are in place to support anchor and affinity schools, as intended.*"

We would also like to provide some context that might explicate some of the findings and recommendations included in the year three report:

- Professional Development Section: *"Sessions at the Scaling STEM Conference received the lowest average ratings (2.67) among all observed professional development events on three of the four indicators for STEM content quality, as well as on the quality of design, implementation and culture of professional development."*

- The recommendations for session design improvement are duly noted and a greater emphasis will be placed on ensuring that there are tighter controls around the session vetting, approval and delivery process.
- Last year, a third party solicited the sessions at the Scaling STEM conference through an open request for proposals. Future conference presenters will be by invitation-only with a stronger vetting process emphasizing STEM content and effective session delivery. The second day of the conference will be based around STEM theme development and will prominently feature industry and higher education partners.

- Professional Development Section: *"Instructional coaching in STEM schools mostly focused on the Design Principles and Common Instructional Framework (CIF), with much less attention paid to student project work or to developing each school's STEM theme."*
    - When the Race to the Top cohort of schools was selected, the Department of Public Instruction stated a preference for schools that did not have an existing nor prior relationship with NC New Schools. This resulted in the initial year of services being focused on establishing a strong foundation in culture and pedagogy, critical drivers of success. The report cites the following comment that supports this approach:

        > *"The things that we're doing, like instructional rounds, lesson plan tuning, . . . learning about the Common Instructional Framework and then trying to implement those in what we've already done has been our biggest challenge thus far, and I think that once teachers are more comfortable with those processes and that way of teaching, then we'll be able to better implement the actual content of agriscience and biotechnology."*

    - Although this is the third year report, services from NC New Schools for most of the schools did not begin until January of 2012 due to the requested change in schools to be served. Now that the core foundational work has taken place, services are more focused on STEM and theme development. Specific plans are underway to increase authentic networking activity among schools, as well as with community partners and businesses throughout the upcoming school year.

Securing the future for all North Carolinians requires that our education systems become student-focused and fully aligned with the technological and scientific drivers of the new economy. We look forward to continuing to support the exciting STEM education work enabled by the Race to the Top initiative in North Carolina.

Sincerely,

Tony Habit, Ed.D.
President

Contact Information:
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