## Leading and Planning a Professional Development Program

The Duke University TASC Project (Teachers and Scientists Collaborating) is an NSF Mathematics and Science Partnership funded program designed to provide professional development and a loan system in science kits. These kits include curriculum units by FOSS, SEPUP, TRACS and STC, all endorsed by the National Science Foundation. TASC partners with several school systems in central North Carolina to implement this project with each system free to develop their own plans for implementation. These systems developed various plans for training their teachers and for leasing the kits from TASC. For instance, some of the school systems chose to send all primary grade teachers and others randomly chose teachers to attend the training sessions. This study seeks to discern the possible effects of the implementation of these different plans on the impact of the TASC program.

### Professional Development Design Framework

Based on the framework provided in Science for All Children (National Academy of Science, 1997), the TASC project provides professional development to teachers of grades K-8 in the surrounding school systems. The teachers were selected by the school system administrators and were therefore, not a randomized group. The program has established a science materials center which loans curriculum kits to trained participants. The training consists of a 2-day workshop spaced over a period of 3 weeks. The workshops model inquiry-based instruction often modifying the curriculum units to enhance the inquiry approach to teaching.

### Targeted School Systems

The four targeted school systems are Alamance-Burlington Schools, Chatham County Schools, Harnett County Schools and Robeson County Schools. Harnett and Robeson are rural with a higher minority population than the other targeted school systems. Alamance-Burlington Schools provided good leadership to their teachers in the program, communicating well and devising a solid plan for implementation, and the school system leaders have worked as a team with the TASC staff. This past year, their plan for implementation was to phase in the training of teachers over time by grade level across the school system. Chatham County Schools saw changes in their system leadership, which consequently affected the plans for implementing this program and participation as a team member. Their plan this past year altered quite a bit, first sending teachers of particular schools to the workshops, and then randomly choosing teachers from across the system for participation. Harnett County Schools lacked strong leadership this past year. However, they sent large numbers of teachers (422) wanting to train most teachers, grade by grade. Poor communication occurred within the system with their teachers and with the TASC staff as well. They seemed to have struggled with their plan for implementation and used a “shotgun approach” for implementation. Robeson County Schools represented excellent communications and had a teamwork attitude. Whereas they were sending teachers by grade level to the program at the beginning of the year, their plans later changed after that sending no teachers to the TASC program during the

latter training cycles of the year. They are instead planning to train their own teachers this coming year.

**Teacher Attitude Toward Science Investigations**

To determine if the project had any immediate impact on the teachers' attitude toward science, a pre- and post-TOSRA survey (The Test of Science Related Attitudes (TOSRA), Preference for Experimenting) was given to the teachers during the workshops. The data was analyzed to determine if there was any difference among the participants of the four targeted school systems with regard to changes in attitude toward science investigations. This was not a randomized group of teachers so frequency of responses was made only. The results were analyzed for each school system and are shown in Tables 1 below. The participants of Alamance-Burlington Schools changed (13%) to the responses in the statement, "In science experiments, I like to use new methods that I have not used before." They changed very little with the remaining statements.

Responses of the Chatham county schoolteachers were different. Their responses for statements about doing experiments such as statements 1, 4, and especially 5 reflect attitudes toward more passive learning rather than learning through experimentation. Yet, they agreed slightly more with learning through problem solving, and they showed a large change with statement 6, that they would rather learn by doing experiments. These teachers also showed a change in wanting to use new methods that they have not used before. In follow-up interviews, teachers indicated they are under a great deal of pressure to teach reading and problem-solving. This may explain why they showed a large change in statement 5 in preferring to read about a topic than do an experiment. Instructional time is another issue that teachers face and experimentation takes time. These teachers seem torn between these issues coupled with the pressures of high-stakes end-of grade testing. Varying degrees of support from the administrative levels of the school system may have influenced the responses of these teachers.

Teachers from Harnett County Schools also indicated a change with wanting to learn about a topic through experimentation rather than asking an expert (statement 6) and wanting to use new methods in experiments (statement 10), albeit the change for statement 6 was double that of the change for statement 10. Interviews of teachers from this system regarding these changes indicated a desire to want to learn new concepts and new teaching strategies.

Teachers from Robeson County also showed a change in statement 6 about learning through experimentation but they only showed a slight change in statement 10 about using new methods. They disagreed more with statement 8 that doing experiments is not as good as finding out information from teachers, and slightly disagreed with statement 9 concerning agreeing with others rather than doing an experiment. Their responses decreased in agreement with the statement of being a scientist would be fun. Interviews with these teachers indicated a great deal of contentment with being classroom teachers as well as enthusiasm and excitement about teaching science.

**Table 1**
**Percentage Change of Teachers Indicating Agreement and Disagreement with Attitude-related Statements**
**Responses of Targeted School System Teachers**

| In a classroom setting, … | Targeted School Systems | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Alamance-Burlington (N=169) | | Chatham (N=38) | | Harnett (N=313) | | Robeson (N=78) | |
| | Agree Changes | Disagree Changes | Agree Changes | Disagree Changes | Agree Changes | Disagree Changes | Agree Changes | Disagree Changes |
| 1. I would prefer to find out why something happens by doing an experiment than by being told. | 5 | -3 | -6 | 4 | 1 | 0 | -1 | 2 |
| 2. I would prefer to read about an experiment than do one. | -2 | -1 | 2 | -6 | -2 | 4 | 0 | -4 |
| 3. I would rather solve a problem by doing an experiment than be told the answer. | 3 | -2 | 6 | 2 | 3 | -1 | -1 | 0 |
| 4. It is better to be told scientific facts than to find them out from experiments. | -2 | 0 | 7 | -6 | 1 | -4 | -3 | 3 |
| 5. I would prefer to do an experiment on a topic than to read about it in a science magazine. | -3 | 0 | -24 | 16 | 3 | 0 | 0 | 3 |
| 6. I would rather find out about things by asking an expert than by doing an experiment. | 1 | -2 | -17 | 12 | -4 | 13 | -5 | 13 |
| 7. It is better to ask the teacher the answer than to find out by doing experiments. | 2 | -3 | 0 | -7 | -2 | 2 | 4 | -1 |
| 8. Doing experiments is not as good as finding out information from teachers. | 2 | -1 | -3 | -2 | 3 | -4 | -6 | 10 |
| 9. I would rather agree with other people than do an experiment to find out for myself. | 2 | 1 | 0 | -6 | -2 | 4 | -1 | 5 |
| 10. In science experiments, I like to use new methods that I have not used before. | 13 | -2 | 11 | 2 | 11 | -3 | 4 | 0 |
| 11. Solving problems is one of the best ways for me to understand science. | 4 | -1 | 6 | 0 | 3 | 0 | 5 | -1 |
| 12. I enjoy doing experiments. | -1 | 1 | -2 | 0 | 3 | 0 | 0 | -1 |
| 13. I like to find out about new ideas in science. | -1 | -1 | 11 | 0 | -2 | 1 | 2 | -1 |
| 14. As a science teacher, I encourage students to ask questions. | 2 | -1 | -4 | 0 | -2 | 0 | -1 | 1 |
| 15. Being a scientist would be fun. | 5 | 1 | -2 | 4 | 4 | 1 | -7 | 3 |

**Confidence to Teach Science**

A survey was given at the beginning and end of the workshop to determine changes in the comfort level of the participants to teach science. Tables 2-5 focus on the differences among the four targeted school systems with regards to comfort to teach science and feelings of preparedness. All of the school systems showed improvements in confidence and comfort with most of the statements. Examining each individual school system, teachers of Alamance-Burlington Schools showed the highest overall confidence improvement (combining extremely confident and somewhat confident responses) with providing deeper coverage of science concepts and gained the most in extremely confident responses in developing students' conceptual understanding of science. Chatham County teachers also showed the highest overall gain in confidence responses with providing deeper coverage of science concepts. The highest gains for Chatham teachers with extreme confidence change were with two statements, developing students' conceptual understanding and teaching science using the TASC-provided curriculum kits. Both Harnett and Robeson county teachers had the highest overall gain in confidence and greatest extreme confidence change with teaching science using the TASC-provided curriculum kits. The lowest change in confidence occurred with the statement of encouraging students' interest in science for all of the school systems. Teachers already felt either confident or extremely confident with this statement and showed little if any overall confidence change in this area of perception. However, the lowest change with extreme confidence occurred with managing a classroom of students engaged in hands-on activities for all of the school systems. Managing students was an often-heard concern when interviewing teachers. Providing a deeper coverage of science concepts had the lowest number of initial responses for confidence for both the pre- and the post survey results; although, the statement reflected notable gains for several school systems such as Alamance-Burlington, Chatham and Harnett Schools as referenced above. Gains were not achieved for Robeson County teachers as the teachers indicated a decrease in extreme confidence to provide deeper coverage of science concepts but were noticeably higher than other systems on the pre-survey with this statement.

**Table 2**
**Percent of Teachers Indicating Level of Comfort with Teaching Science**
**Responses of Alamance-Burlington School System Teachers**

| | Pre-Survey (N=168) | | Post-Survey (N=177) | |
|---|---|---|---|---|
| Statement | Extremely Confident | Somewhat Confident | Extremely Confident | Somewhat Confident |
| 1. Develop students' conceptual understanding of science | 13 | 77 | 29 | 65 |
| 2. Provide deeper coverage of science concepts | 15 | 57 | 23 | 58 |
| 3. Teach science using the TASC-provided curriculum kits | 36 | 50 | 46 | 46 |
| 4. Lead a class of students using inquiry-based teaching strategies | 33 | 53 | 32 | 58 |
| 5. Manage a class of students engaged in hands-on/project-based work | 42 | 48 | 41 | 52 |
| 6. Encourage students' interest in science | 48 | 48 | 50 | 47 |

**Table 3**
**Percent of Teachers Indicating Level of Comfort with Teaching Science**
**Responses of Chatham School System Teachers**

| | Pre-Survey (N38) | | Post -Survey (N=42) | |
|---|---|---|---|---|
| Statement | Extremely Confident | Somewhat Confident | Extremely Confident | Somewhat Confident |
| 1. Develop students' conceptual understanding of science | 13 | 63 | 24 | 71 |
| 2. Provide deeper coverage of science concepts | 8 | 63 | 12 | 76 |
| 3. Teach science using the TASC-provided curriculum kits | 37 | 61 | 48 | 48 |
| 4. Lead a class of students using inquiry-based teaching strategies | 26 | 61 | 29 | 69 |
| 5. Manage a class of students engaged in hands-on/project-based work | 40 | 50 | 36 | 64 |
| 6. Encourage students' interest in science | 58 | 40 | 57 | 41 |

**Table 4**
**Percent of Teachers Indicating Level of Comfort with Teaching Science**
**Responses of Harnett School System Teachers**

| | Pre-Survey (N=316) | | Post-Survey (N=313) | |
|---|---|---|---|---|
| Statement | Extremely Confident | Somewhat Confident | Extremely Confident | Somewhat Confident |
| 1. Develop students' conceptual understanding of science | 13 | 73 | 24 | 71 |
| 2. Provide deeper coverage of science concepts | 12 | 59 | 22 | 65 |
| 3. Teach science using the TASC-provided curriculum kits | 22 | 52 | 44 | 51 |
| 4. Lead a class of students using inquiry-based teaching strategies | 16 | 64 | 27 | 64 |
| 5. Manage a class of students engaged in hands-on/project-based work | 32 | 61 | 38 | 58 |
| 6. Encourage students' interest in science | 38 | 59 | 49 | 50 |

**Table 5**
**Percent of Teachers Indicating Level of Comfort with Teaching Science**
**Responses of Robeson School System Teachers**

| | Pre-Survey (N=78) | | Post -Survey (N=83) | |
|---|---|---|---|---|
| Statement | Extremely Confident | Somewhat Confident | Extremely Confident | Somewhat Confident |
| 1. Develop students' conceptual understanding of science | 26 | 64 | 21 | 68 |
| 2. Provide deeper coverage of science concepts | 22 | 58 | 17 | 70 |
| 3. Teach science using the TASC-provided curriculum kits | 33 | 53 | 44 | 54 |
| 4. Lead a class of students using inquiry-based teaching strategies | 26 | 61 | 33 | 59 |
| 5. Manage a class of students engaged in hands-on/project-based work | 37 | 58 | 42 | 50 |
| 6. Encourage students' interest in science | 42 | 58 | 49 | 49 |

**Teacher Classroom Behaviors**

The evaluation focused on the classroom practices of the four targeted school systems, and classroom observations and interviews were conducted during the kit loan period. Teachers completed a classroom practices survey at the beginning of the workshops and at the end of the academic year; the return rate for the post-survey was 43 percent (the post workshop survey was sent to participants by mail). The evaluation focused on teachers of grades 3, 5 and 8 since these are the critical years for End-of-Grade testing and due to program budgetary limitations.

Classroom Observations

Twenty-eight classroom observations were made in the targeted school systems using the Horizon Classroom Observation Protocol. The purpose of these observations was to validate quantitative survey data and gain additional insights into the use of the kits and related activities. The students' classroom journals were also reviewed to determine extent of use, writing, and data entries. Interviews were made to gain an understanding of the teachers' perspectives and thoughts for improving the program.

Classroom Practices Survey Results

On the classroom practices survey, teachers indicated the frequency of occurrence with stated instructional practices as shown in Tables 6 below. Teachers of Alamance-Burlington Schools and Chatham County Schools indicated an increase in the frequency of occurrence with doing experiments or demonstrations for the whole class. However, both Harnett and Robeson County teachers indicated a decrease in frequency with this mode of instruction. With regards to students doing hands-on exploratory activities, an expected result of the program would be an increase in frequency of instruction. However, the teachers of Alamance-Burlington Schools indicated no change and both Harnett and Robeson County teachers indicated a large decrease in frequency of instruction. Only Chatham County teachers indicated an increase of 32% occurring often or very often. Teachers of Alamance-Burlington Schools indicated an increase in the occurrence of students following prescribed steps in an activity. Both Harnett and Robeson County teachers indicated a decrease and Chatham County teachers were about the same. Several of the kits emphasized prescribed steps in procedures so this item response may not necessarily reflect non-use of the curriculum kits. As one might expect due to the testing emphasis on reading, teachers of all four-school systems indicated an increase in reading about science with Alamance-Burlington and Chatham teachers showing the largest increases of or nearing 25%. The frequency of students answering written questions in a worksheet or workbook increased in all systems except Alamance-Burlington. Although the use of worksheets is not considered typical inquiry-based instruction, the use of the kits, of which many emphasize the use of worksheets, may have influenced the response to this question. Only Chatham County teachers indicated an increase in student participation in whole-class discussions and in fact, Robeson County teachers indicated a large decrease of 33%. Students going on field trips decreased in frequency with all four groups of teachers. Students explaining concepts to

each other actually decreased in Harnett and Robeson County Schools and remained essentially the same in Alamance-Burlington and Chatham County Schools. Of these responses, participants from Chatham County Schools indicated increased frequency of modes of instruction that were beneficial to learning. They clearly indicated an increase in their students doing exploratory, hands-on activities, participating in whole-class instruction and considering alternative explanations or solutions.

**Table 6**
**Percentage of Teachers Indicating Frequency of Instruction Occurring Often or Very Often**

| Statement | Alamance-Burlington | | Chatham | | Harnett | | Robeson | |
|---|---|---|---|---|---|---|---|---|
| | Pre (N=63) | Post (N=27) | Pre (N=19) | Post (N=14) | Pre (N=140) | Post (N=40) | Pre (N=32) | Post (N=18) |
| 1. Teacher or a student does experiments or demonstrations for the whole class. | 35 | 42 | 21 | 43 | 37 | 30 | 40 | 28 |
| 2. Students do hands-on exploratory activities. | 65 | 65 | 53 | 85 | 74 | 38 | 78 | 44 |
| 3. Students follow prescribed steps in an activity. | 51 | 62 | 47 | 50 | 63 | 52 | 66 | 50 |
| 4. Students read about science. | 29 | 54 | 26 | 50 | 44 | 62 | 50 | 61 |
| 5. Students answer written questions in a worksheet or workbook. | 22 | 11 | 11 | 29 | 16 | 40 | 19 | 28 |
| 6. Students participate in whole-class discussions. | 79 | 77 | 73 | 86 | 87 | 75 | 94 | 61 |
| 7. Students go on field trips or do outside projects. | 35 | 19 | 58 | 21 | 34 | 12 | 38 | 28 |
| 8. Students explain concepts to one another in class. | 54 | 58 | 42 | 43 | 52 | 38 | 69 | 39 |
| 9. Students consider alternative explanations or solutions. | 47 | 46 | 26 | 43 | 43 | 38 | 63 | 39 |

Table 7 below shows the results of teachers responding to frequency of occurrence of writing activities in science teaching. The objective is to find an increase in occurrence in several of these writing practices. Classroom observation included reviewing student journals for evidence of writing activities, which was used to corroborate the statement

results below. Only TASC teachers from Chatham County Schools indicated an increase in frequency (6%) of their students writing about what worked in an experiment and what didn't work. The remaining school systems teachers' responses showed a decrease in this mode of instruction. All of the groups revealed an increase in students writing about data, labeling drawings, and using charts and graphs. Reviews of the journals verified this. These reviews showed little journal use except for recording data and making a few graphs and charts with most of the projects' participants. There were exceptions to this with journals of teachers' students from Chatham County Schools, as noted above.

Teachers of all of the targeted school systems except Robeson County indicated an increase in students writing about what they learned by doing the experiment. For the most part, review of journals did not validate this response but rather showed prescribed summary statements provided by the teachers. This was often observed, with some exceptions, even though survey results for all systems except Alamance-Burlington showed a decrease in teacher responses regarding their students writing what the teacher tells them to write. These brief statements were usually one or two sentences long. Responses of Chatham County teachers indicated an increase in students writing "I wonder" questions. This actually took several forms as noted when reviewing the journals. Sometimes the Chatham teachers had the students keep a log of the questions they asked; others embedded this into the reflective summary writing. Others kept a chart of these questions posted in the classroom. Teachers of Robeson County Schools also indicated an increase with this mode of writing but the observers did not see evidence of such with the teachers observed or the journals reviewed. Both Alamance-Burlington and Chatham teachers showed an increase in students writing using their own words, as verified in classroom observations in these systems. In general, classroom observations and journal reviews showed most teachers directed the students what to write in their journals usually word-for-word except for some teachers in Alamance-Burlington and Chatham Schools.

Teachers were asked to indicate the frequency of use of science educational materials. Only participants of Alamance-Burlington Schools indicated a decrease in the use of commercially published textbooks; the other groups indicated an increase. Many of these targeted school systems have decided to purchase instructional kits but to also purchase one set of textbooks for classroom use. However, only teachers of Alamance-Burlington Schools showed an increase in the use of commercially published kits. This is a surprising fact considering the emphasis of these systems on preparing teachers to use the kits. Alamance-Burlington participants indicated a two-fold increase with the use of district-developed materials. All of the groups showed a decrease in the use of local teacher-made materials.

**Table 7**
**Percent of Teachers Indicating**
**Frequency of Writing Activities in Science Teaching**
**Occurring Often or Very Often**

| Statement | Alamance-Burlington | | Chatham | | Harnett | | Robeson | |
|---|---|---|---|---|---|---|---|---|
| | Pre (N=63) | Post (N=27) | Pre (N=19) | Post (N=14) | Pre (N=140) | Post (N=40) | Pre (N=32) | Post (N=18) |
| 1. Students write about what worked in an experiment and what didn't. | 52 | 42 | 37 | 43 | 51 | 42 | 69 | 44 |
| 2. Students write about data, label drawings, and use charts and graphs. | 49 | 61 | 42 | 71 | 53 | 72 | 69 | 56 |
| 3. Students write about what they learned by doing the experiment. | 57 | 65 | 42 | 79 | 56 | 62 | 75 | 44 |
| 4. Students write "I wonder" questions. | 22 | 19 | 24 | 36 | 26 | 12 | 25 | 39 |
| 5. Students write using their own words. | 52 | 73 | 32 | 86 | 62 | 70 | 71 | 56 |
| 6. Students write what the teacher tells them to write. | 10 | 11 | 16 | 7 | 13 | 8 | 16 | 6 |

Teachers also reported changes in their classroom teaching practices and in their school's science program (see Tables 8 below). When asked about changes in their classroom regarding the amount of time students spent on science, participants in all the groups except Robeson County marked an increase in the time. The same result occurred with changes in the amount of students' hands-on experiences. All groups except Robeson County participants indicated an increase with Chatham County showing the largest positive change. For the most part, the teachers indicated the use of textbooks remained the same. However, teachers of Harnett Schools revealed less use of the textbooks over the past few years. All four groups of teachers indicated a large positive change in the use of science kits with Alamance-Burlington teachers showing a two-fold increase. Teachers of Robeson County indicated an increase in students using open-ended investigations while participants of Alamance-Burlington and Harnett systems remained basically the same. Chatham County participants showed less decrease with this mode of instruction. All systems, as expected, showed an increase in students' engagement in writing about science activities. For the most part however, the observed writing in journals was sketchy consisting primarily of vocabulary and data tables. But of course, this may be more than they have been doing in the past. In general, these results reflect positive trends in all of the school systems

**Table 8**
**Percentage of Teachers Indicating**
**Changes in Classroom Instructional Methods**

| | Decreased | | No Change | | Increased | |
|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post |
| 1. The amount of time students spent on science in the classroom | | | | | | |
| Alamance-Burlington | 10 | 8 | 43 | 38 | 48 | 54 |
| Chatham | 21 | 0 | 42 | 43 | 37 | 57 |
| Harnett | 12 | 0 | 39 | 40 | 49 | 60 |
| Robeson | 3 | 11 | 38 | 28 | 59 | 61 |
| 2. The amount of hands-on experience students have | | | | | | |
| Alamance-Burlington | 21 | 4 | 16 | 27 | 63 | 69 |
| Chatham | 17 | 0 | 22 | 21 | 61 | 79 |
| Harnett | 19 | 5 | 16 | 21 | 65 | 74 |
| Robeson | 13 | 11 | 12 | 17 | 75 | 72 |
| 3. Student use of textbooks | | | | | | |
| Alamance-Burlington | 57 | 58 | 35 | 34 | 8 | 8 |
| Chatham | 45 | 50 | 39 | 43 | 16 | 7 |
| Harnett | 58 | 39 | 34 | 53 | 9 | 8 |
| Robeson | 66 | 50 | 28 | 33 | 6 | 17 |
| 4. Student use of science kits | | | | | | |
| Alamance-Burlington | 6 | 0 | 46 | 19 | 48 | 81 |
| Chatham | 11 | 0 | 28 | 14 | 61 | 86 |
| Harnett | 13 | 0 | 31 | 16 | 56 | 84 |
| Robeson | 10 | 11 | 28 | 11 | 62 | 78 |
| 5. Student use of open-ended investigations | | | | | | |
| Alamance-Burlington | 3 | 4 | 43 | 37 | 54 | 56 |
| Chatham | 17 | 0 | 28 | 43 | 55 | 57 |
| Harnett | 11 | 0 | 30 | 40 | 59 | 60 |
| Robeson | 3 | 6 | 31 | 11 | 66 | 83 |
| 6. Student engagement in writing about science activities | | | | | | |
| Alamance-Burlington | 8 | 0 | 53 | 38 | 39 | 62 |
| Chatham | 17 | 0 | 39 | 14 | 44 | 86 |
| Harnett | 11 | 3 | 37 | 34 | 52 | 63 |
| Robeson | 3 | 5 | 31 | 17 | 66 | 78 |

* Same N values as in Table 7

Changes in the teachers' school science program as shown in Table 9 below reflected greater support from the school systems than the previous year. All of the groups except Robeson County participants revealed improvement with provision of sufficient instructional supplies and materials. Participants of Robeson County actually indicated less provision of supplies. Except for Harnett County teacher participants, all of the groups indicated strong positive changes in the development of a strong, clear, shared vision for science instruction by the school leadership. Again, all of the groups, except Harnett County participants, showed an increase in the support and guidance from the school and school system leadership. These results are supported by the observations and interviews, and general dialogue made by the evaluation team. Regarding leadership support, all of the school systems except Harnett County have demonstrated strong leadership for their teachers. Teachers in Harnett County expressed frustration with the lack of communication, direction and professional development plan. They seem to have been burdened as a result of this system's lack of committed leadership.

**Table 9**
**Percentage of Teachers Indicating**
**Changes in Their School's Science Program**

| | Greatly Decreased | | No Change | | Greatly Increased | |
|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post |
| 1. Teachers are provided sufficient instructional supplies and materials for science instruction. | | | | | | |
| Alamance-Burlington | 8 | 11 | 38 | 19 | 54 | 70 |
| Chatham | 22 | 0 | 28 | 14 | 50 | 86 |
| Harnett | 14 | 8 | 29 | 20 | 57 | 72 |
| Robeson | 10 | 28 | 34 | 22 | 56 | 50 |
| 2. The development of a strong, clear, shared vision for science instruction by the school leadership | 13 | 15 | 49 | 31 | 38 | 54 |
| Alamance-Burlington | 11 | 0 | 39 | 36 | 50 | 64 |
| Chatham | 12 | 13 | 37 | 56 | 51 | 31 |
| Harnett | 16 | 28 | 37 | 11 | 47 | 61 |
| Robeson | | | | | | |
| 3. Support and guidance in science teaching by school and system leadership | | | | | | |
| Alamance-Burlington | 14 | 19 | 38 | 22 | 48 | 59 |
| Chatham | 11 | 0 | 39 | 29 | 50 | 71 |
| Harnett | 12 | 2 | 37 | 54 | 51 | 44 |
| Robeson | 12 | 28 | 41 | 0 | 47 | 72 |
| 4. Amount of support and guidance in science teaching by school and system leadership | | | | | | |
| Alamance-Burlington | 22 | 22 | 33 | 11 | 45 | 67 |
| Chatham | 17 | 0 | 39 | 14 | 44 | 86 |
| Harnett | 19 | 8 | 34 | 41 | 47 | 51 |
| Robeson | 16 | 28 | 37 | 0 | 47 | 72 |

**Student Achievement: End-of-Grade Math and Language Arts Test Scores**

Currently North Carolina does not test elementary and middle school student in science. Therefore, this study examined End-of-Grade achievement test results in mathematics and reading. As presented in Tables 10 and 11 below, the numbers in parentheses represent all of the students in the system. The Alamance-Burlington students of TASC-trained teachers had a slightly higher percentage of students who were at or above Level III compared to those of the school system for reading in grades 5 and 8 and for mathematics in grades 3, 5, and 8 for mathematics. The Chatham County students of teachers trained to use the TASC kits had a higher percentage of students at or above Level III in reading compared to the rest of the systems' students for grade 8. This was also true in mathematics for grades 3 and 5 but not so for grade 8; they were lower than the rest of the systems' students. Only the 8$^{th}$ grade students of Harnett County Schools TASC-trained teachers were slightly higher (1 percentage point) than the rest of the system in reading. The students of the TASC teachers in Harnett County Schools were lower in the scores compared to the rest of the system in all grades for mathematics. Robeson County students of TASC-trained teachers were lower in their reading scores compared to the rest of the system but higher in mathematics. The fifth grade scores were not available from this system.

**Table 10**
**Student EOG Reading Scores for Grades 3, 5 and 8**
**(Scores in parentheses indicate school system averages)**
**By Targeted School System**

| School System | Mean Score | Std. Deviation | # At or Above Level III | # Valid Scores | Percent At or Above Level III |
|---|---|---|---|---|---|
| Alamance-Burlington Schools | | | | | |
| Grade 3 | 246 | 9.94 | 197 | 262 | 75 % |
| | (246) | (9.21) | | | (77%) |
| Grade 5 | 257 | 7.53 | 332 | 371 | 89% |
| | (257) | (8.0) | | | (88%) |
| Grade 8 | 264 | 8.76 | 411 | 469 | 87% |
| | (263) | (9.5) | | | (85%) |
| Chatham County Schools | | | | | |
| Grade 3 | 251 | 8.63 | 99 | 110 | 90% |
| | (249) | (7.9) | | | (90%) |
| Grade 5 | 259 | 8.00 | 103 | 111 | 93% |
| | (258) | (7.5) | | | (93%) |
| Grade 8 | 266 | 8.33 | 223 | 236 | 94% |
| | (266) | (7.9) | | | (83%) |
| Harnett County Schools | | | | | |
| Grade 3 | 247 | 9.18 | 306 | 384 | 80% |
| | (248) | (9.1) | | | (81%) |
| Grade 5 | 257 | 5.56 | 166 | 194 | 86% |
| | (256) | (7.6) | | | (88%) |
| Grade 8 | 263 | 7.55 | 447 | 496 | 90% |
| | (264) | (8.3) | | | (89%) |
| Robeson County Schools | | | | | |
| Grade 3 | 244 | | 203 | 277 | 73% |
| | (245) | (8.9) | | | (75%) |
| Grade 8 | 264 | 6.13 | 619 | 725 | 84% |
| | (261) | | | | (84%) |

**Table 11**
**Student EOG Mathematics Scores for Grades 3, 5 and 8**
**By Targeted School System**
**(Scores in parentheses indicate school system averages)**

| School System | Mean Score | Std. Deviation | # At or Above Level III | # Valid Scores | Percent At or Above Level III |
|---|---|---|---|---|---|
| Alamance-Burlington Schools | | | | | |
| Grade 3 | 252 | 6.50 | 252 | 288 | 88% |
| | (253) | (6.5) | | | (85%) |
| Grade 5 | 264 | 8.28 | 359 | 372 | 96% |
| | (264) | (8.6) | | | (95%) |
| Grade 8 | 274 | 11.1 | 404 | 469 | 86% |
| | (272) | (11.3) | | | (83%) |
| Chatham County Schools | | | | | |
| Grade 3 | 255 | 5.80 | 105 | 110 | 95% |
| | (254) | (5.5) | | | (94%) |
| Grade 5 | 265 | 7.82 | 108 | 111 | 97% |
| | (264) | (7.7) | | | (>=95%) |
| Grade 8 | 273 | 9.79 | 208 | 236 | 88% |
| | (274) | (9.6) | | | (91%) |
| Harnett County Schools | | | | | |
| Grade 3 | 253 | 6.09 | 340 | 387 | 88% |
| | (253) | (5.9) | | | (89%) |
| Grade 5 | 260 | 6.55 | 166 | 194 | 86% |
| | (261) | (8.2) | | | (93%) |
| Grade 8 | 269 | 9.04 | 412 | 497 | 83% |
| | (271) | (10.2) | | | (84%) |
| Robeson County Schools | | | | | |
| Grade 3 | 254 | 4.75 | 244 | 285 | 86% |
| | (252) | (5.8) | | | (85%) |
| Grade 8 | 271 | 7.29 | 605 | 733 | 83% |
| | (269) | (9.5) | | | (81%) |

## Student Attitude Surveys

A random selection of teachers was asked to give their students a science attitude survey to determine any changes in attitude after completion of the instructional kit unit. The middle school students were given the same TOSRA survey as the teachers, and the elementary students were given the survey developed by Enger and Yager (2001)[2].

Teachers of the targeted school systems were asked to give the survey to the students both at the beginning and end of the instructional unit. The survey results are listed below in Tables 12 and 13.

With the elementary students of the TASC trained-teachers of Alamance-Burlington Schools, no significant difference ($P<.05$) was found with any of the survey statements between the pre- and post-survey results. With the students of participating teachers of Chatham County Schools, significant differences between the pre- and post-surveys results were found with only statement 2, “Things I learn in science help me understand things at home.” This is a statement that focuses on concept learning in science. Responses from Harnett County Schools' elementary students of TASC-trained teachers on the pre- and post-surveys showed significant differences with statements 1, 3, and 4 - statements that focus on enjoying science and building confidence to do science. Responses from Robeson County Schools' students of TASC-trained teachers on the pre- and post-survey showed significant differences with statements 2 and 4, statements that focus on enjoying science and on learning concepts.

**Table 12**
**Significant Changes in Mean Scores on Elementary Student Attitude Survey Scale (1 = Agree, 2= Neutral, 3 = Disagree)**

| Item | PreSurvey Mean | Post Survey Mean | MS (DF) Between Groups | MS (DF) Within Groups | F | P |
|---|---|---|---|---|---|---|
| All participants | | | | | | |
| 1. Science time is fun. | 1.36 (N=1380) | 1.29 (N=900) | 2.06 | .321 | 6.43 | .002 |
| 3. I can do science things. | 1.27 (N=1383) | 1.24 (N=902) | .929 | .307 | 3.03 | .049 |
| 4. We do fun things in science class. | 1.31 (N=1378) | 1.20 (N=900) | 3.69 | .297 | 12.4 | .000 |
| 6. I might want to do a science job when I grow up. | 1.88 (N=1378) | 2.08 (N=899) | 10.56 | .811 | 13.0 | .000 |
| Alamance-Burlington School No significant difference found with any statement | | | | | | |
| Chatham County Schools | | | | | | |
| 2. Things I learn in science help me understand things at home. | 1.16 (N=32) | 1.81 (N=31) | 6.66 | .509 | 13.1 | .001 |
| Harnett County Schools | | | | | | |
| 1. Science time is fun. | 1.38 (N=320) | 1.22 (N=239) | 3.04 | .307 | 9.91 | .002 |
| 3. I can do science things. | 1.24 (N=320) | 1.14 (N=242) | 1.559 | .269 | 5.79 | .016 |
| 4. We do fun things in science class. | 1.28 (N=320) | 1.17 (N=241) | 1.51 | .264 | 5.72 | .017 |
| Robeson County Schools | | | | | | |
| 2. Things I learn in science help me understand things at home. | 1.50 (N=196) | 1.21 (N=43) | 3.08 | .465 | 6.64 | .011 |
| 4. We do fun things in science class. | 1.35 (N=195) | 1.09 (N=43) | 2.30 | .330 | 6.98 | .009 |

The middle school students demonstrated several statements of increased agreement and positive attitudes toward science (Table 13). However, two statements actually demonstrated increased disagreements: "Doing science is not as good as finding out information from teachers," and "I would rather agree with other people than do an experiment to find out for myself." This is a rather interesting finding and will be monitored in future years of the project. Overall, the middle school findings support the notion that the students' positive attitudes increased toward doing investigations, solving problems and self-directed learning.

**Table 13**
**Significant Change in Mean Scores on Middle School Student Attitude Survey Scale (1 = Agree, 2= Neutral, 3 = Disagree)**

| Item | Grade | PreSurvey Mean | Post Survey Mean | MS (DF) Between Groups | MS (DF) Within Groups | F | P |
|---|---|---|---|---|---|---|---|
| 1. I would prefer to find out why something happens by doing an experiment than by being told. | 6 | 2.83 (N=256) | 2.44 (N=189) | 16.8 | 1.78 | 9.71 | .002 |
| 2. I would prefer to read about an experiment than do one. | 7 | 2.27 (N=442) | 1.95 (N=188) | 13.64 | 1.40 | 9.78 | .002 |
| 3. I would rather solve a problem by doing an experiment than be told the answer. | 6 | 3.71 (N=256) | 4.17 (N=189) | 22.5 | 1.63 | 13.8 | .000 |
| 5. I would prefer to do an experiment on a topic than to read about it in a science magazine. | 6 | 3.37 (N=256) | 3.88 (N=189) | 29.0 | 1.70 | 17.5 | .000 |
| 5. I would prefer to do an experiment on a topic than to read about it in a science magazine. | 7 | 3.59 (N=440) | 3.86 (N=188) | 9.66 | 1.42 | 6.80 | .009 |
| 6. I would rather find out things by asking an expert than by doing an experiment. | 6 | 3.76 (N=256) | 4.02 (N=189) | 7.30 | 1.33 | 5.50 | .02 |
| 9. I would rather agree with other people than do an experiment to find out for myself. | 6 | 1.86 (N=256) | 1.63 (N=189) | 5.67 | 1.06 | 5.34 | .02 |
| 9. I would rather agree with other people than do an experiment to find out for myself. | 8 | 1.65 (N=432) | 1.82 (N=358) | 6.22 | .950 | 6.54 | .01 |
| 11. Solving problems is one of the best ways for me to understand science. | 8 | 1.61 (N=430) | 1.81 (N=358) | 8.06 | .949 | 8.49 | .004 |
| 15. Being a scientist would be fun. | 8 | 2.96 (N=432) | 3.18 (N=358) | 9.34 | 1.47 | 6.38 | .01 |

## Summary

The impact on the teachers from the four different school systems was notable regarding comfort to teach science, attitudes toward science investigations and classroom practices. The teachers of the targeted school systems may have moved from passive to active learning attitudes with the exception of Chatham County Schools to a degree. Chatham and Alamance-Burlington possibly showed more positive changes with comfort to teach science concepts. Teachers of these two school systems also self-reported the greatest changes in their classroom practices to enhance science learning as well.

The possible impact on the students of teachers trained by TASC among the four targeted school systems was evident with changes in attitudes toward science investigations. However, changes in attitudes from the survey were most pronounced by Harnett and Robeson County students; the change for Chatham County students was found in the learning of concepts rather than the enjoyment of doing science.

This project found the leadership impact on the system might have had an impact on the outcomes for the teachers and students. Having good leadership and a plan for implementation appears to have contributed to the difference with the observed impacts. Again, all of the groups, except Harnett County participants, showed an increase in the support and guidance from the school and school system leadership. Harnett County results for the teachers were the least favorable of the outcomes. However, this is not to say the program was not successful in this system as evidenced by the positive, significant changes in student attitudes toward science investigations.

**Bibliography**

[1]National Science Resource Center, Smithsonian Institution. 1997. Science For All Children. Academy Press, Washington, D.C.

[2]Enger, S. & Yager, R. 2001. Assessing Student Understanding in Science. Corwin Press, Inc.: Thousand Oaks, CA