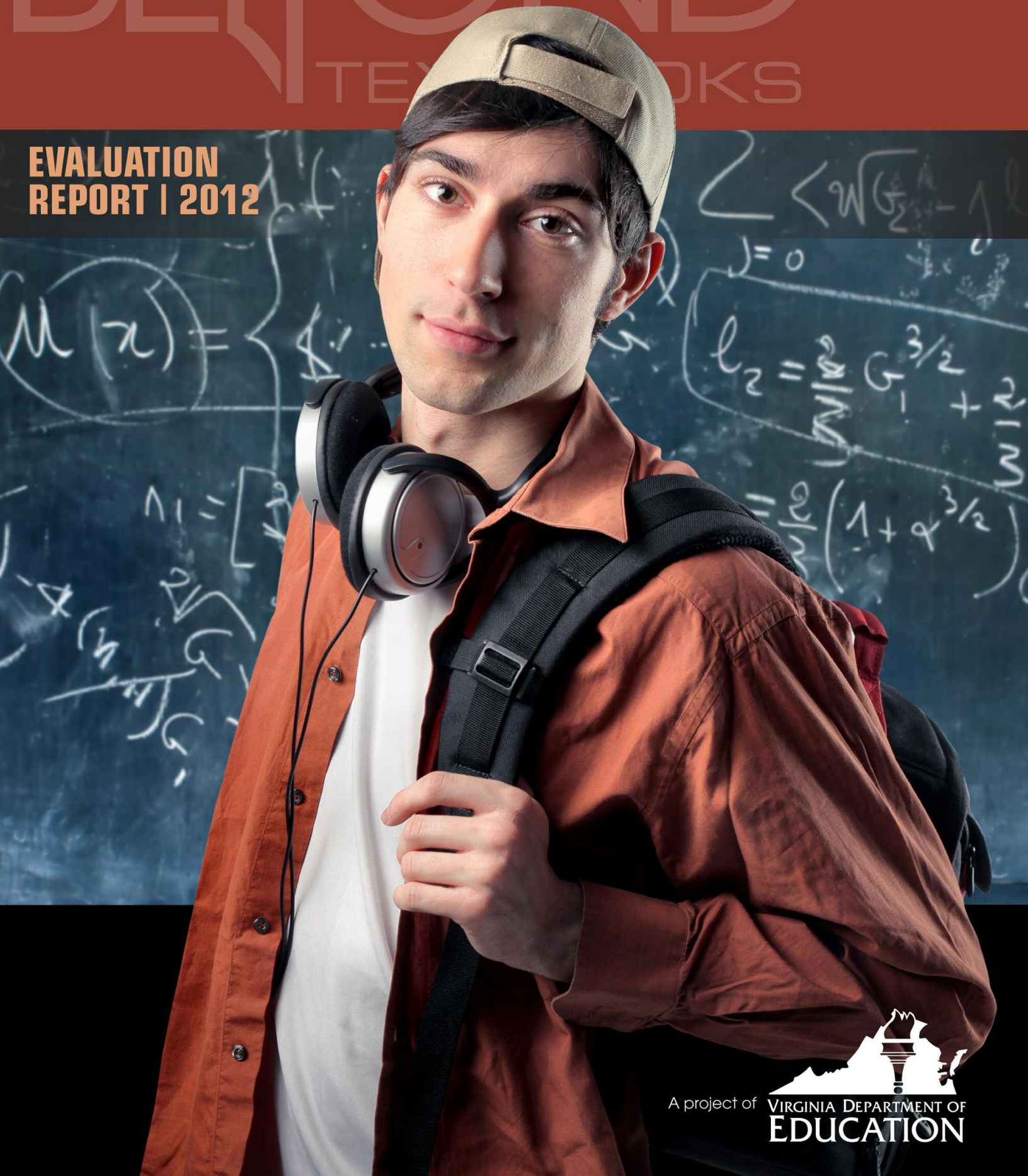
# BEYOND TEXTBOOKS

## Putting on the eLearning Backpack with TI-Nspire™ Technology

## EVALUATION REPORT | 2012



A project of Virginia Department of Education

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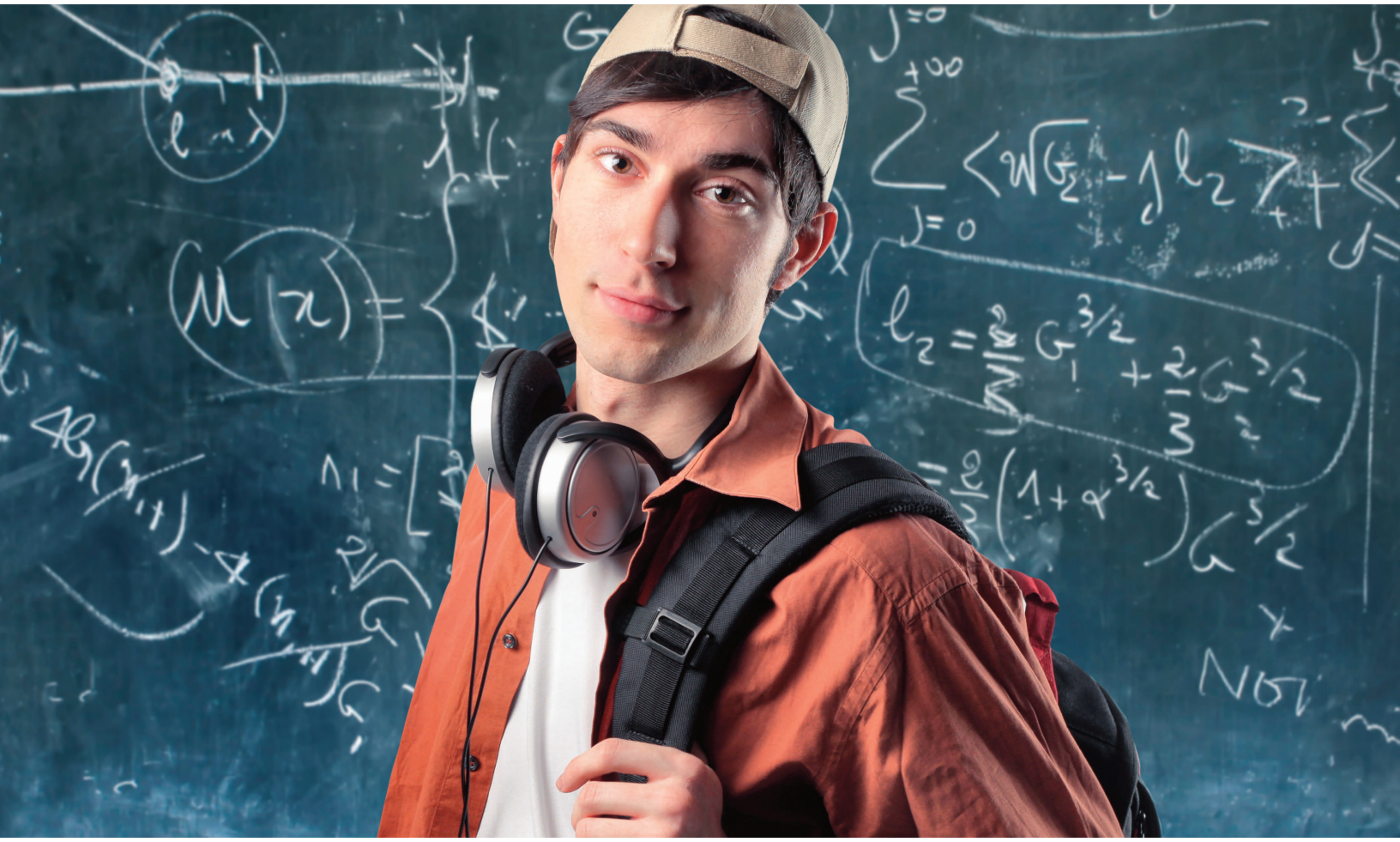
Prepared by John D. Ross, Ph.D., and Laurene Johnson
for the Virginia Department of Education • 2012



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**Putting on the eLearning Backpack with TI-Nspire™ Technology**

by John D. Ross, Ph.D., and Laurene Johnson
Consultants

# INTRODUCTION

The Virginia Department of Education has embarked upon a series of exploratory pilot studies to investigate how multipurpose portable devices can be used to support teaching and learning in K-12 classrooms. The *eLearning Backpack*, which incorporates TI-Nspire™ technology, is a pilot project from the *Beyond Textbooks* initiative, overseen by the Virginia Department of Education's Office of Educational Technology. This initiative seeks innovative ways to provide ubiquitous access to educational resources that support teaching and learning.

In spring 2012, the Department initiated a short-term pilot of the TI-Nspire™ Navigator™ System, featuring TI-Nspire™ CX Math and Science handheld computers. While these look similar to more traditional graphing calculators and can complete similar functions (see Figure 1), these devices perform like small wireless computers. They can store instructional content and problems, and the student can interact with text and full-color images through both the traditional calculator keys and a full text keyboard. They fit into wireless cradles that communicate with one another, so students can collaborate on problems and send information to each other and their teacher. The system also includes software that allows the teacher to connect with and display information from the student devices, run polls and assessments, and present information to support their instruction.

This pilot was conducted in three algebra classrooms at a Virginia high school and was intended to investigate how both teachers and students use and react to the TI-Nspire™ Navigator™ System. The goal of this evaluation was to determine what impact, if any, the TI-Nspire™ Navigator™ System had on teacher practice and student academic behaviors related to algebra skills and knowledge. It considered the system's ease of use—by both teachers and students—to determine steps other educators should take to use this or similar devices and interactive technologies in their classrooms. Specifically, the evaluation was guided by the following questions:

- How did teachers incorporate the devices into their daily practices?
- What impact, if any, did it have on student academic behaviors inside and outside the classroom?
- What advice did students and teachers suggest when implementing the TI-Nspire™ Navigator™ System?

This report provides findings from interviews with teachers and students from both classrooms as well as some performance data related to algebra content covered during the pilot. Some student performance data are also included; although, this report focuses on how the teachers and students used the TI-Nspire™ Navigator System.

The authors of this report wish to thank the teachers involved in the pilot program, especially Jarrod Lisker, Powhatan's instructional technology resource teacher (ITRT), for their willingness to share information through several rounds of data gathering and analysis.

# OVERVIEW OF THE PROGRAM

Powhatan High School is located outside the metropolitan area of Richmond in an area that transitions from suburban to more rural settings. In 2011-12, the school's 138 faculty and staff served approximately 1,400 students in grades nine through twelve. The student population was nearly equally split by gender. Eighty-nine percent of the students were white, 10 percent were black, and one percent (1%) were Hispanic; 12.7 percent qualified for free or reduced-price lunches.

As a faculty, mathematics teachers at Powhatan High School have been using Texas Instruments graphing calculators exclusively since 1997, beginning with the TI-83 and switching to the TI-92 in 2000. Earlier versions of the Navigator™ System have been used in the school since 2003.

Two teachers participated in the pilot program. At the conclusion of the pilot, 48 students (15 girls, 33 boys) participated (the total number of students over the course of the year was 53, but student and course transfers account for the final number); 44 students were ninth graders, three were 10th graders, and one was an 11th grader. Four students were repeating the class. Seven students (14.6%) had Individual Education Plans. The school offers an additional 10 sections of Algebra I taught by other teachers.

In August 2011, prior to the beginning of the school year, the two algebra teachers and an ITRT from Powhatan High School attended a three-day professional development session provided by trainers from Texas Instruments. The summer session offered an overview of the TI-Nspire™ Navigator™ System and its features, including common functionality of the handheld devices and the teacher software. It also introduced curricular resources developed for the system, including files aligned with an algebra textbook that could be run on the handheld devices as well as lesson activities and supporting instructional material found on the TI Math NSpired Lesson Resource Center Web site (http://education.ti.com/calculators/timathnspired/).

The three-day professional development helped identify units of instruction as a focus for the pilot program and for a benchmark assessment compiled by the teachers and the ITRT:

- Relations versus functions
- Matching a table of values to an equation
- Evaluating a function
- Graph of a function
- Domain and range of a function
- Range of a function
- Function rules
- Direct variation
- Inverse variation
- Slope—from a graph
- Slope—from two points
- Slope—undefined
- Slope—from an equation


*Figure 1.* The TI-Nspire™ CX Math and Science handheld computer.

Instruction on the 13 topics occurred during the second quarter of the school year, concluding with the benchmark assessment at the end of January.

Students in the pilot were provided access to TI-Nspire™ CX handheld devices. The students in two of the classes—16 in each class—could take the devices home. A third class, also taught by one of the pilot teachers and also with 16 students, did not have access to the devices at home but could use them during class. All students were provided a copy of comparable software, which could be installed on a home computer, but few students reported that they actually installed and used the software on their home computers.

At the beginning of the year, the students in these three algebra classes used the handheld devices as more traditional graphing calculators and began incorporating the digital files and other functionality from the Navigator™ system in early September. The teachers first provided their students with a brief overview of the TI-Nspire™ CX handhelds using a presentation developed at Texas Instruments. At least one teacher also had students complete a tutorial for the calculator. The presentation introduced different keys on the application and some functionality similar to that found on computer keyboards, such as keyboard shortcuts for common tasks.

Based on the popular TI graphing calculator, these devices have full color screens and extended functionality through student software. Students can access problems through files that correspond to assignments in Pearson's *Prentice Hall Mathematics: Algebra I* textbook. Students can use the devices in ways similar to other graphing calculators but have the ability to color-code parts of equations and objects in graphs (see Figure 2); they also can graph and rotate 3-D functions. The devices also can import or display digital images or photos as a basis for problem solving (see Figure 3). The keyboard for the lightweight devices includes numeric keys with common mathematics functions, a full alphabetic keyboard for entering text, and navigation keys surrounding a touchpad that allow students to operate the software.

Each teacher also had access to a TI-Nspire™ Navigator™ System, which comprises teacher software, cradles for the CX handhelds that connect wirelessly to the teacher's computer, a wireless access point, and a bay for charging the cradles. The teacher software emulates common learning management system software by allowing the teacher to create lessons, store lesson activities and grades, and track student performance. The software supports file transfers between the teacher's

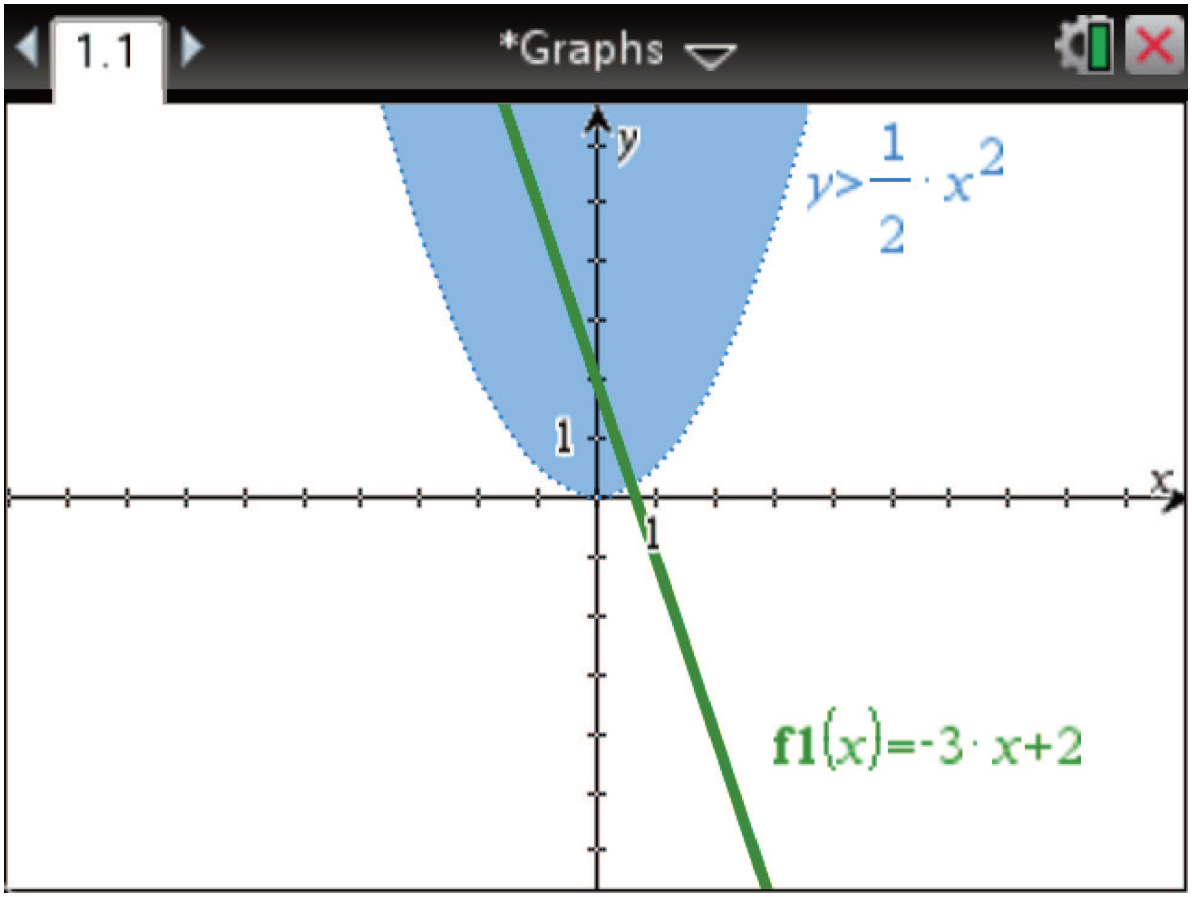


*Figure 2.* Color highlights parts of graphs and calculations.

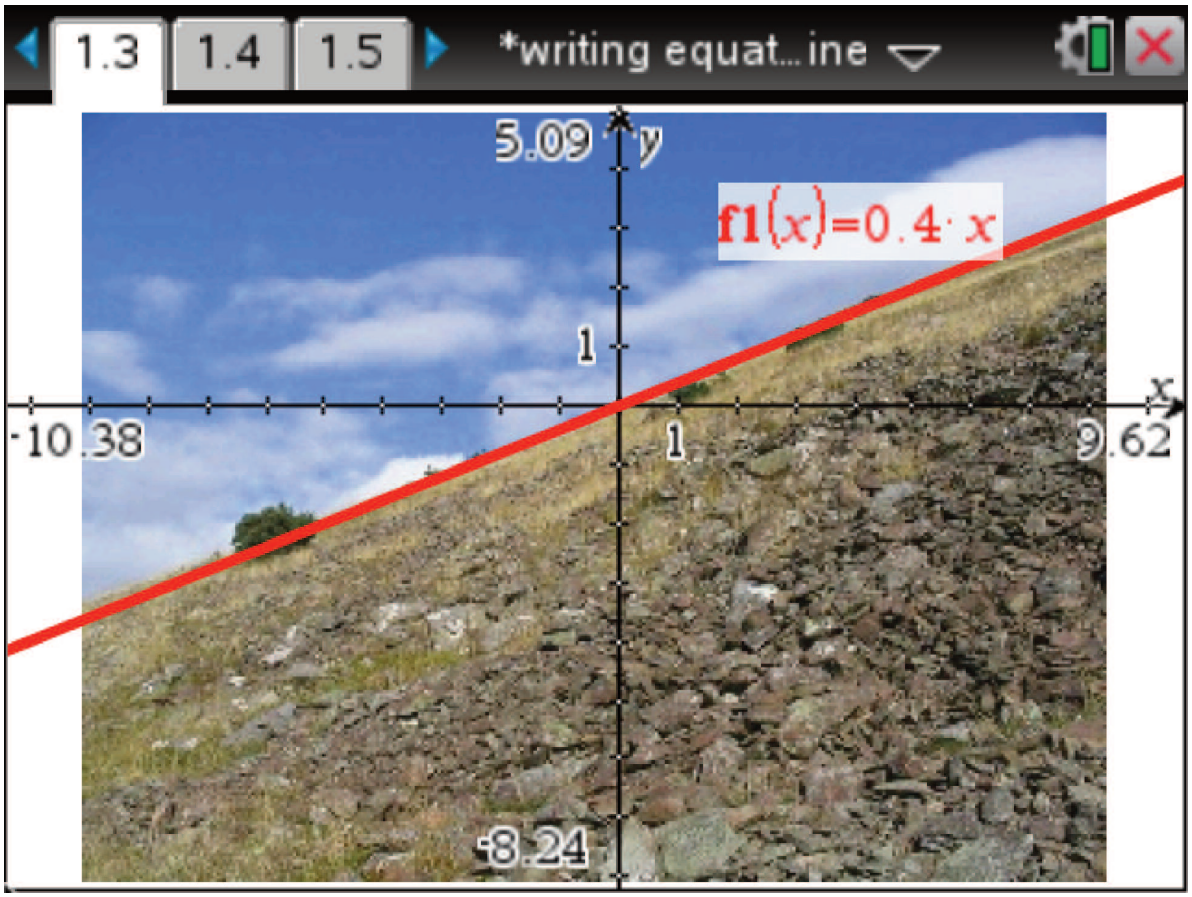


*Figure 3.* Images can be used to support problem-solving activities.

computer and the student devices as well as polling and quizzing functionality that simulates personal response systems. The software also allows the teacher to view the screen for every student device simultaneously as a means of classroom management and instructional support. In addition, it allows any student device to be projected for the class so students can show their work on a larger display. Students can also be assigned to work on problems collaboratively so that they retain their own handheld devices.

Specific functionality used during the pilot includes the following:

- Live presenter: Any student device can be displayed to the class to show student work.
- Screen capture: This lab-management function allows teachers to view the screens of all student devices at one time.
- Quick poll: This feature allows teachers to poll students wirelessly.
- Multiple representations. The system can display graphical and numerical representations of a problem simultaneously.

# EVALUATION DATA

Interview data were collected from teachers and a sample of students in September prior to the pilot and then again in February following the benchmark assessment: 33 students interviewed in September, and 31 interviewed in February. Twenty of the 31 students also participated in the September survey, but the questions in the two sessions were different and not intended as pre/post comparison. The interview questions prior to the study related to current student practices and their perceptions about the devices; the February follow-up questions focused on actual use of the TI-Nspire™ devices and issues with their operation (see the Appendix interview questions).

The data from the interviews were reviewed for themes, which were identified and refined through an iterative process common to qualitative studies (Creswell, 2009). This process of cyclical review identified additional questions and the need for more data, which was obtained through ongoing communications with staff at the Virginia Department of Education and Powhatan High School.

In addition, evaluators reviewed an item analysis by class of the answers from the benchmark assessment: 22 questions corresponding to the 13 topics listed previously. The benchmark assessment, developed by the Algebra I teachers and the ITRT, drew primarily from released items from old state assessments (the Standards of Learning assessments for Algebra I).

Scores from the benchmark assessment were also compared using quantitative analysis techniques to determine if there were significant differences in mean scores among the students who participated in the pilot and students in other Algebra I courses.

# LIMITATIONS

This report is based on data collected from a small group of interviews. While an interview protocol kept questioning consistent across groups and sites, it should be acknowledged that personal and group dynamics can influence responses. Sometimes, the interview process itself generates new ideas or perceptions. Every intent was made to draw reasonable conclusions and interpretations from the data, especially noting points of high agreement; however, caution should be applied in generalizing this information beyond this pilot and these participants. These data do provide insight into the use of the TI-Nspire™ Navigator™ System by teachers and students in these classes, but similar results may not be experienced in different settings.

# DATA ANALYSIS

In September, the teachers reported that it took two-to-three hours to open all the packaging and prepare 60 devices. They also had to consider where and how the devices would be placed in the classroom. Additional set-up tasks included setting up rosters and class portfolios in the Navigator™ system. One teacher provided plastic bags to provide extra protection for the devices being transported to and from home.

Both teachers reported that the system was overwhelming at first. They compared it to learning a new textbook or other curricular resource and wished they had more lead time between the professional development in August and the beginning of school. Both felt that having greater preparation time prior to the beginning of school—something they would have normally done with any new resource—would have been beneficial.

In terms of providing instruction on the calculator to the students, both teachers used the Quick Start guide. At least one teacher also had students use the calculators to complete the Quick Start guide tutorial. During this process, students had difficulty finding the exponent key. One teacher noted that the guide needed a "little bit more" additional information.

The teachers reported that many of the students had never used a graphing calculator prior to the Algebra I class; however, by mid-September, most of the interviewed students confirmed that they could use the TI-Nspire™ CX handheld as a basic graphing calculator in their Algebra I class. Some confirmed that they had never used a graphing calculator prior to this class. In the follow-up interview, students give multiple examples of different types of graphs and documents they had created, such as a graphing slope intercept, linear and nonlinear graphing. Several students described activities in which the teacher embedded pictures that the students could use for problem solving; one noted, "Seeing a picture made it easier to concentrate on the slope."

By February, the teachers reported that the students seemed to feel very comfortable with the devices, often picking up a device at the beginning of class (for the class that did not take them home). One

student, a repeater, had used a TI-84 in the past but found the TI-Nspire™ CX more useful. The teacher noted that this student had become one of the top performers in the class and relied on the device. In one instance, the teacher was demonstrating an activity by hand, when the student encouraged her to solve the problem with the calculator. She asked, "You think you can do that?" and the student replied, "Oh yeah. You just go here, here, and here" and demonstrated the process for the class. The other teacher shared a similar story, where a "quieter student" showed greater interest and participation with the devices, often asking, "Can it do this?" or even showing her what he had learned to do on his own with the device.

Teachers reported using a variety of resources to create instructional activities for the system. They created their own materials or obtained some from colleagues. They reported using a variety of books and digital materials, including the TI Math NSpired Lesson Resource Center Web site and others, such as YouTube or other information from the Internet. The teachers reported that the activities that aligned with Pearson's *Prentice Hall Mathematics: Algebra I* textbook were too long to complete in a 50-minute class, so they either customized or administered them over two class periods. They noted that the material was "more student friendly," with the worksheets "written in a student-focused language." They commented on how this was a positive change from previous versions of the curricular materials.

In terms of features of the Navigator™ system, the teachers were positive about the Live Presenter and Multiple Representations functions; although, neither function was used extensively. Both teachers also used the Screen Capture function to view student devices. In terms of pedagogy, this made it easier to identify students in need and provide them with support. In terms of classroom management, one of the teachers showed her students the Screen Capture function and how it could take snapshots of their screens, which stopped some students from displaying inappropriate messages. The teachers also reported using the Quick Poll feature "a couple of times a week" at one point before moving into activities that relied more heavily on graphing.

Most students reported "no worries" when asked if there was anything about the technology that made them nervous. A couple were nervous about breaking or losing the devices. One student thought initially that it would be complicated but, after just a few weeks of basic use, found the device easy to use and liked the text keyboard. Two students—one in September and one in February—noted that the keyboard did not follow the standard QWERTY layout. Rather, it is in alphabetical order, and they were unfamiliar with this layout. In the February follow-up interviews, students confirmed that the devices were not complicated to use, and several mentioned that they were "easier" to use than a more traditional calculator, indicating that they could perform multiple steps that would be harder to replicate on a standard calculator. One told his friends, "Use it every chance you get. It makes every step easy. If you never graphed before, it makes it easy."

Regarding the inclusion of color, most students noted that it helped them identify different features, such as buttons and parts of graphs. Color seemed to be especially helpful when graphing multiple lines or generating multiple graphs. One student reported that reading the text was easy on the screen. Some noted that the color display reminded them of other handheld devices, such as a phone or iPad.

The students reported using the calculation and graphing functionality most often, but students did use additional features. A couple of students mentioned using the Notes feature and a couple others mentioned using the List and Spreadsheet features.

The students had mixed reports about how often they transferred files with the devices, even students in the same class: ranging from "never," to "about five times total," to "about four or five times a month," to "once or twice a week," to "almost every day." The lack of agreement makes it difficult to identify actual use patterns.

The students reported few technical issues. Some problems were related to lack of experience with the devices and eventually overcome. Besides a few stuck keys, one student reported having to reset the device. Other issues related to early struggles with learning how to send files and logging in to the Navigator™ system—this seemed to be a problem for students who were new to the class.

Of the students interviewed at the beginning of the year, 25 of 29 (86%) responded that they did have a computer at home for their use, but only seven reported using it to support their mathematics homework—a calculator application was the most frequently mentioned use. Few students reported using the Navigator™ software at home. Many reported difficulties with the installation, which could be related to not having adequate supporting software, such as the current version of Java, or to having difficulties completing the installation process.

One teacher followed up with the students in her two classes on their use of the software at home after an assignment. Of the 28 who responded to her questions, only five were able to complete the homework using the software provided (on a flash drive); 19 had attempted to install the software on their home computers; but only seven were able to install the software successfully. One student had only an iPad, which does not have a port for a flash drive, and could not install the software.

Most students reported that the TI-Nspire™ CX helped them with their mathematics work in class. In the follow-up survey, almost all students made some statement about how the device had made their work "easier." Several also felt that they could complete their work faster and did not want to go back to using paper and pencil. One student said, "I can't imagine not using it (the TI-Nspire™ CX)." Another said, "I am understanding much better now. My grades are much better. I have failed this class twice before. Now, I am making an A." Several students reported that they would like to use the calculator in their geometry classes.

Teachers advise others who are considering adopting the system to obtain a device early so they have plenty of lead time to practice with it; although, all the teachers and students reported that the device is easy to use. The teachers noted that the professional development from Texas Instruments was helpful, especially as it provided instruction on the system within the context of delivering instruction. They are considering using the devices in their future geometry classes. One teacher reported that she has been using a class set of the TI-Nspire™ CX in her geometry class. She said that, at first, students were reluctant to use the devices and wanted to using their existing TI-84 calculators—"clutching them and not wanting to switch." Now, all but one geometry student uses the CX devices.

# STUDENT ACHIEVEMENT DATA

The statistical analysis for this study focused on the following question: How did the pilot group (those who received calculators) compare to the other algebra classes (those who did not receive calculators) with respect to their performances on the benchmark assessment?

For this analysis, two scales were created from the raw test scores. The Pilot Items Scale included the 21 questions that were the focus of the TI-Nspire™ pilot (Questions 12-33). The Nonpilot Items Scale included the 13 remaining questions from the test that were not the focus of the pilot (Questions 1-11, 34, and 35). Statistical tests then helped assess the internal consistency reliability of these scales. This was necessary to determine if the items in each scale related to one another to provide a meaningful measure of the desired mathematical knowledge. Generally speaking, in terms of internal reliability estimates, a reliability coefficient of .7 or above (on a scale from 0 to 1) is considered reliable in the social sciences (Leech, Barrett, & Morgan, 2008). The Pilot Items Scale had a Kuder-Richardson reliability coefficient of .698, while the Nonpilot Items Scale had a Kuder-Richardson reliability coefficient of .554. Given that reliability tests tend to underestimate the reliability of criterion-referenced tests like the one in this study (Coscarelli & Shrock, 2002), these scales were determined to be adequate for answering the research question in this study.

Attempts were made to create additional scales based on the topics represented in the questions. Reliability estimates, however, indicated that these scales were not adequate for use in data analysis.

Scale scores were then calculated for each student—representing the number of correct answers. For the Pilot Items Scale, these scores ranged from 1 to 21. For the Nonpilot Items Scale, these scores ranged from 2 to 13. The students were then placed into two groups: the calculator group and the noncalculator group. A *t*-test comparing the mean scores for the calculator and noncalculator groups on the two scales was then conducted.

The test of the group means for the Pilot Items Scale indicated that the mean for the calculator group ($M = 11.28$) was significantly lower on both scales than the means for the noncalculator group ($M = 13.38$). The effect size, measuring the magnitude of the difference between the two groups, was .59. This is generally considered a medium-sized effect (Cohen, 1969; Leech, 2008).

The test of the group means for the Nonpilot Items Scale again indicated that the mean for the calculator group ($M = 7.09$) was significantly lower on both scales than the mean for the noncalculator group ($M = 8.22$). The effect size was .50, also considered a medium-sized effect (Cohen, 1969; Leech, 2008).

Because the noncalculator group scored higher on both scales, including the scale that represented topics not covered in the TI-Nspire™ pilot, this lends support to the argument that variables outside of the calculator intervention potentially impacted the results. Additional data for all students were obtained.

A t-test was conducted to determine if there were preexisting differences in the two groups' mathematics achievement levels prior to the calculator intervention. Based on this test, the control group had significantly higher mean eighth-grade SOL mathematics scores than the treatment group. The mean for the control group was 484, while the mean for the treatment group was 452 ($p = .009$). As a result, the groups were significantly different with respect to mathematics achievement prior to the calculator intervention.

For future research, adding a pretest would better isolate the effect of the calculators on student learning. The amount of time that students use the calculators outside class could also potentially affect the learning benefits. As a result, in the future, it would be helpful to measure student use of the calculators.

# FINDINGS

The following interpretations of the data present themes identified in the analysis. Recommendations are based primarily on data from the pilot study and are provided only as suggestions for consideration.

| Interpretations | Recommendations |
|---|---|
| **Preparation.** Preparation for using the devices required time. It took time for teachers to open, prepare, and determine where the devices would be stored, assigned, and used during instruction. And while the teachers did have three days of professional development on the system shortly before the school year, it took additional time to better understand the materials and how they should be incorporated into instruction. Unfortunately, some of this time occurred after the school year had already started. | Educators wishing to implement any new curricular resource or technology should provide adequate time prior to the opening of school for teachers to prepare for the materials in physical settings and with pedagogical practices. The teachers confirmed that the three days of professional development in August was helpful and suggested that others wishing to implement the devices should undergo at least the same amount of training. They suggested that a follow-up training, perhaps a month or so after actually using the devices in the classroom, would have been beneficial—better preparing them to ask questions and identify specific needs related to their instruction. |

| Interpretations | Recommendations |
|---|---|
| **Student operation.** While many students had never used a graphing calculator prior to the pilot, they provided a number of examples demonstrating that they could use the device as a graphing calculator proficiently. While some reported being nervous about breaking or losing the device, most noted it was easy to use; some felt it was easier than they had first expected. Teachers and students also reported using some of the unique features, such as incorporating images and transferring files, which they felt were beneficial. Fewer students mentioned using the Notes or List and Spreadsheet features. | Educators wishing to implement these or similar devices should be encouraged that the students could use the devices as intended. Several students in the pilot were repeating the course, and it appears these struggling students could operate the calculators effectively.<br><br>Since the teachers seemingly focused primarily on the replication stage of implementation—using the devices primarily as more traditional graphing calculators—the students' demand for additional features may have been limited. An increase in teacher comfort and knowledge about these additional features could lead to greater student use. |
| **Instructional materials.** The teachers reported that the materials from or associated with the textbook were written in "student-focused language" and that the activities were appropriate for their students. The teachers reported that the activities on the TI Math Nspired Lesson Resource Center Web site were also helpful but often deemed too long to complete in a 50-minute classroom. So, the teachers modified the activities or extended them over more than one class period. The teachers also noted using a variety of additional resources found online or from print-based resources. | Content providers should consider the impact of different scheduling practices, such as 50- versus 90-minute class periods. Continued use of "student friendly" language and activities are encouraged. |

| Interpretations | Recommendations |
|---|---|
| **Navigator™ system functionality.** Teachers were positive about the functionality of the Navigator™ system, such as the Live Presenter, Multiple Representations, Screen Capture, and the Quick Poll features, but did not report using them extensively. | The teachers reported that the system was "overwhelming" at first, which was complicated by implementing the devices while school was in session. As a result, they may not have been completely comfortable with or knowledgeable about the additional functions of the Navigator™ system. With the pressure of meeting curricular goals confounded by the addition of new student devices, teachers may have relied on replicating familiar instructional strategies that did not require the system at first. Additional or follow-up trainings, as recommended by the teachers, might have helped them move beyond replicating instructional strategies and implementing more of the system's functionality. Continued use and experience also would likely increase the use of additional functionality. |
| **Text keyboard.** A limited number of students commented on the text keyboard. Several students mentioned that they liked the keyboard, but two students noted that it did not follow the standard QWERTY layout. | Some consideration may be given by the developers for modifying the keyboard to follow the standard QWERTY layout in subsequent versions of the device. This should be tempered with the fact that this is a very small sample, and efforts should be made to determine the actual proficiency of a larger sample of students with this type of layout. While not all students may be proficient with typing on full-sized keyboards, it is important to acknowledge that many of these students likely are proficient at texting and using keyboards in the QWERTY format on other mobile devices. |
| **Use of color.** Most of the interviewed students agreed that the inclusion of color was beneficial. Color was helpful for identifying different keys or functions. Perhaps the most helpful aspect of the use of color, as reported by the students, was when graphing multiple lines or generating multiple graphs. | Since color was found beneficial, professional development activities and learning materials could target specific strategies for using color to support student learning. |

| Interpretations | Recommendations |
|---|---|
| **Student software.** Few students used the software provided for home use. Many students reported that it was difficult or impossible to install on their home computers. One student reported having an iPad that did not support the software. | The exact nature of the difficulties of installing the software are unknown but could include limited student knowledge about installing software, older computers or operating systems that could not support the software, or actual problems with the software itself. If the software is to be beneficial and support student learning at home, the developers should provide clear installation guidance and support for novice users. It might be provided in different formats, such as a Web-based application that requires no installation or an "app" that can be used on other mobile devices. Since so few students actually used the software at home, some consideration should be given as to the merit of including the software, under what situations it could best support student learning, or whether it is necessary or beneficial. |
| **Student reaction.** By the end of the pilot, students overwhelmingly held a positive view of the device; several reported that it had helped them learn algebra and made their work "easier." Initially, there were some concerns that the devices might be difficult. However, this did not prove to be the case—by the end, students and teachers reported that they wanted to use them in additional classes, not just algebra. | Educators wishing to incorporate these or similar devices should feel assured that they likely will support teaching and learning mathematics—even if there are early concerns. Additional observations should be conducted to determine if this positive reaction remains, or even grows, as teachers and students become more comfortable with the additional functionality of the devices and the Navigator™ system. |
| **Student achievement.** Students who had access to the TI-NSpire CX™ devices did not outperform their peers who lacked access to the devices. Because of this finding, additional data were sought, and it was confirmed that the students in these pilot classes demonstrated significantly lower levels of prior mathematics achievement, which undoubtedly impacted their performances in these classes. | Because graphing calculators have been used in and continue to be standard equipment in mathematics classrooms and on large-scale mathematics assessments, additional trials may be merited to determine the impact on student achievement. In particular, future studies need to take into account the prior achievement of all student groups. |

# CONCLUSION

The teachers and students in the pilot study reported positively about the TI-Nspire™ Navigator™ System, which features TI-Nspire™ CX handhelds. Teachers and students reported that the devices were easy to use and supported student learning. While student performance on the benchmark assessment did not support higher achievement when compared to students who did not use the devices, some consideration should be given to the significantly lower entry achievement levels of the student group in the pilot. Many of these students were struggling learners who were repeating the course. Additional trials with more closely matched students and pre- and post-assessments with higher degrees of validity and reliability could help determine the devices' actual impact on student achievement.

Another caveat to consider is the teachers' limited familiarity with the system and its impact on teacher practice. While the teachers reacted favorably to the professional development provided by Texas Instruments and some of the curricular materials from the supporting Web site and textbook, they did not report significant changes to their teaching practices when using the devices. This is likely due, in part, to the lack of adequate preparation time prior to the school year. Teachers in the school have had a long history of using graphing calculators, so they were comfortable with using these devices primarily in the same manner. Although some experimentation occurred with additional features, it was limited.

The practice of replicating familiar activities and pedagogies is common when integrating new technologies. In terms of the continuum of technology integration, these teachers appear to be at an early stage (Dwyer, Ringstaff, & Sandholtz, 1991; International Society for Technology in Education, 2008). It is not unreasonable to expect the teachers in this pilot (or in similar initiatives) to begin by replicating more familiar activities and strategies until they become adequately familiar with the devices or receive enough professional development—or both—to move along the continuum and take more advantage of the affordances of the technology. It should be mentioned that when teachers do not receive new technologies in a positive manner, the problem often is due to a lack of or inadequate professional development. That was not likely the case in this pilot due to the overwhelmingly positive reception of the devices, but others wishing to implement this or similar technologies might best determine how well prepared their teachers are to use the system and provide adequate support and professional development so the devices are adopted and not rejected.

Devices such as the TI-Nspire™ calculators used in this pilot and their related management software are examples of a continuing trend in technology—creating multipurpose devices that combine hardware and software functionality. The color display was especially well received, but some students also commented favorably about the text keyboard and the ability to share files and communicate with their teacher or other students. Over time and with greater familiarity, teachers may take greater advantage of the additional management-system features, increasing the potential that wireless mobile devices can serve multiple purposes related to teaching and learning. One of the strengths of this project may be that the new device is built upon a well-known interface—the popular graphing calculator familiar to many students and mathematics teachers. While participants in this study are at early stages of technology adoption, this project has helped to uncover potential uses for these next-generation devices that seem well matched to the needs of the curriculum and the abilities of the students.

# APPENDIX

## Student Interview Questions Before the Pilot

1. Please describe how your homework assignments are assigned currently.
2. Do you have a computer at home, and if so, do you use it for your math homework? If so, how often do you do this?
3. How often, if at all, do you electronically send files to your teacher's computer? Do you have a portal that you post to? If so, how often?
4. What types of things have you already done with the graphing calculators?
5. How do you think you might use color in graphing?
6. How do you think this calculator might help you in the class?
7. Is there anything that makes you nervous about this technology?
8. How would you describe the calculator to your friends?

## Student Interview Questions After the Pilot

1. What did you like about the calculator?
2. What types of things have you done with the graphing calculators?
3. Did color help you in using the calculator? In what ways?
4. Did you have any technical issues? If so, what were they?
5. Did you find any shortcuts? If so, which ones? How did you use them?
6. How often, if at all, do you electronically send files to your teacher's computer? Do you have a portal that you post to? If so, how often?
7. Have you used any of the following TI-Nspire™ applications? If you have used any of these, please share your reaction. What did you like best/least about the features? What is missing? Have you used these primarily in class or at home?
    a. Calculator
    b. Graphs and Geometry
    c. List and Spreadsheets
    d. Data and Stats
    e. Notes
    f. Saving work in TI-Nspire™ Documents
8. Did you take the student software home (flash drive)? If so, did you install it? If not, what was the problem? For those that did use the student software at home, how often? What was your impression of the student software? Did you have any problems with it?
9. How did the TI-Nspire help you with your math classwork? Has that increased since the beginning of the class?
10. How would you describe the calculator to your friends?

## Teacher Interview Questions Before the Pilot

1. Describe the setup process.  If there were any issues, please provide details.
2. Currently, what percentage of class time do your Algebra 1 students usually spend in the following configurations? Please describe why you have chosen these groupings.
    a. Individual work
    b. Pairs or small groups
    c. Whole class discussion
    d. Other
3. What percentage of class time do your Algebra 1 students usually spend doing the following activities?
    a. Memorizing/recalling facts, definitions, formulas
    b. Performing procedures/solving routine problems
    c. Communicating understanding of concepts
    d. Solving non-routine problems/making connections
    e. Conjecturing, generalizing, or proving
4. Where do you typically find materials?
5. What has been your students' initial impression?

## Teacher Interview Questions After the Pilot

1. How did the TI-Nspire™ Navigator impact how you were operating in the classroom?
2. Please describe your opinion of specific features. Provide any examples of their use.
    a. Live presenter
    b. Screen capture
    c. Quick poll
    d. Multiple representations
3. What was your initial impression of TI-Nspire™ Navigator™?
4. What kind of content preparation was necessary for use in the classroom?
5. Are there any other issues that came up during the pilot?

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Dr. John Ross has been an educator for 25 years and is the author of the best-selling book *Online Professional Development: Design, Deliver, Succeed!* from Corwin, which was adopted as book-of-the-month for July 2011 by Learning Forward (formerly the National Staff Development Council). He is also coauthor of the first college textbook to address the new National Educational Technology Standard for Teachers. He works with states, districts, schools, and individual teachers to help use technology to promote teaching, learning, and school management. You can find out more about him on his Web site: TeachLearnTech.com.

Laurene Johnson has 20 years of educational experience, including teaching in a classroom; coaching and mentoring teachers; designing, implementing, and evaluating educational programs; developing formative and summative evaluation instruments; and designing, collecting, and analyzing research data. She is currently a doctoral candidate in Instructional Design, Development & Evaluation at Syracuse University.


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