Empowering Students Using Technology, Visual Literacy, and Engagement

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Power Algebra *is a* PowerPoint*-based Algebra curriculum developed by a teacher from the Akron Public Schools in Akron, Ohio. Akron is a large, urban district (the fourth largest city and district in Ohio) and possesses student characteristics similar to many other urban districts especially in terms of the number of students with learning disabilities and the challenges meeting proficient standardized test scores.*

Introduction

Rachel Chaplin, the teacher who developed the materials, became engaged in mathematics herself as a ninth grader when she had an algebra teacher who was extremely active and visual. Prior to that, she struggled in mathematics. However, years later as an algebra teacher herself, she found that she had developed a teaching style that resembled more of that of the teachers in the classrooms where she struggled rather than the classroom where she thrived. She found her classroom teacher-centered and text-dominated. The seed of challenge came when, one year, her principal gave her all the low-achieving math students and she found herself teamed with an Intervention Specialist. Chaplin and the Intervention Specialist worked together in restructuring the algebra course in a manner so that instruction and assessment took into consideration some basic beliefs regarding the nature of these students with regard to learning strategies, technological interest, and visual engagement. The curriculum that has been developed is now being used by all Algebra I classes within the seven Akron Public High Schools.

Principles of Power Algebra

In redesigning her algebra class, Ms. Chaplin began to identify the characteristics that made this new classroom of students different. In her previous classroom, student differences were masked or were acted upon when they became problematic. In her restructured math classroom, **student differences had to be studied as the basis for planning**. Previously, assessment was most common at the end of learning to see who "got it." In her restructured math course, it was necessary for **assessment to be ongoing and diagnostic.** Previously, a single definition of excellence existed and it was based on test achievement. This restructured math classroom required that **excellence had to be defined as individual growth from a starting point.** Previously, whole class instruction dominated. In her restructured math classroom, a **variety of instructional strategies** had to be employed to meet the diverse needs of the learners. Finally, in her previous classroom, texts and curriculum drove instruction. In her restructured math classroom, **student readiness, interest, and learning profiles needed to shape instruction.** The *Power Algebra* curriculum was developed based on these core values surrounding this philosophy of student learning.

Chaplin decided that the curriculum for her new group of students must be dynamic. It needed to appeal to a technology-linked age group. She outlined the following classroom goals:

- Find a way to gain classroom control so that learning takes place every minute of the day.
- Develop a curriculum that is visually engaging and stimulating for students and that is based on the standards.
- Develop a day-by-day lesson plan that contains performance objectives, standards, benchmarks, and indicators.
- Develop pre-unit activities to gain the learners' attention.
- Develop classroom activities and strategies that are fun and promote learning.
- Develop ways to differentiate in the classroom and meet each student's needs on an individual basis.
- Develop homework that is engaging, enticing, and geared for student growth.
- Analyze continuously, beginning with a pre-assessment over each unit.
- Include pacing that contains enrichment for those who master the content and re-teaching for those who did not master the content

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PowerPoint as a Tool

Chaplin determined the best way to revise the curriculum to meet these conditions was to develop instructional materials within *Microsoft Office PowerPoint* slides. *PowerPoint* may seem like a curious choice given the abundance of recent media criticisms of the boredom-instilling nature of the tool as used by some presenters. "Death by *PowerPoint*" is now an entry in Wikipedia, and YouTube hosts several videos parodying the overuse of the tool by many professors and corporate types. However, *PowerPoint* offers many features beyond creating new slides and new bullets that give it an interface presence similar to a web site or other interactive media. In their review of the research on effective *PowerPoint* use, Lane and Wright (2009) state that little data is available. However, when they broadened their search to include other forms of presentation media, they were able to illicit four principles that can impact the effectiveness of one's use of presentation media, such as *PowerPoint*, for presentations. The four principles are (a) interactivity, (b) rich media, (c) hierarchal organization of content, and (d) media-enhanced presenter dynamics. Chaplin studied higher levels of *PowerPoint* development and applies all four of these principles within the *Power Algebra* materials.

Interactivity can be provided through hyperlinks that are inserted within the slides. These "links" can be selected by the mouse. Chaplin developed games and reviews that enable the students and/or teacher to select options within the slide. For instance, in one game, "Radical Rummage," the home slide contains several boxes that are all linked to other slides. Similar to the "Match Game," students choose two boxes and try to find the radical and the simplification of the radical that match. Chaplin has created several games for each unit based on many types of formats and rules.

Rich media refers to anything other than text. Chaplin was already aware of and learned many techniques for creating slides that had images fly in that helped mnemonic memory. Slides are filled with perky, smiley, bubble faces that evoke happy emotion. If the students are to "plug in" a value for a variable, Chaplin uses the image of an electrical plug plugging into an outlet. For solving systems of equations, the image of an "eliminator" enters the slide to combine and eliminate terms. In order to help students understand the process of substituting values in equations, the content draws upon students' prior knowledge of substituting a basketball player for another on a team. These techniques appeal to visual learners and encourage retention.

The level of animation nearly replicates a video in terms of the manner in which pieces of equations fall into place as they are found in the problem. Key values float down into the new equation so students can see from where the values originate. However, as opposed to a video, each animation is controlled by the click of the teacher's remote, thereby making the material completely interactive and responsive to the readiness of the students in the class rather than the passive experience that a video creates. And for students who are electronically engaged in all other aspects of their lives with gaming, cell phones, etc., this method holds great appeal.

Chaplin animates carefully with concern for visual attention and retention. All animation slides in from left to right since Chaplin knows that our minds are trained to take in content in that manner. Since our pencils write parentheses from top to bottom, parentheses on the slides are animated to slide in from top to bottom. All these details can be overlooked when one views the slide presentations, since the technology is intentionally seamless and the viewer is able to concentrate on the content in the best visual manner possible.

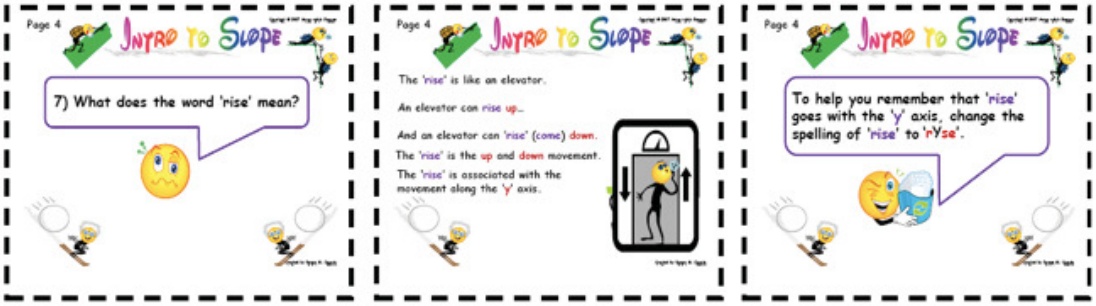

Fig 1 Sample of *Power Algebra* Slides

Hierarchical organization of content refers to having the slide material organized in a type of visual database. Chaplin has organized the curriculum by content-area topics along with supporting materials. *Media-enhanced presenter dynamics* refers to having concrete examples at your fingertips. Chaplin developed tools for the teacher to supplement the curriculum based on the needs of the students. Teachers can choose the resources that meet specific student needs.

The *PowerPoint* tool also helped to meet the goal of gaining classroom control. In her classroom of low-achieving students, Chaplin decided that she needed to face her students every minute of the day. Many teachers do this through the use of an overhead, but with *PowerPoint*, a laptop, projector, and remote mouse, Chaplin would not only face her students, but would be amongst them, next to them, and in front of them. It would no longer be an option for students to not focus or not pay attention. Instead of completing problems in class, Chaplin would complete the problems before the class began. With the clicker, she could stand among the students, and with each click, each step of the problem would appear. This classroom management strategy is effective in a classroom with students with special needs who need assistance staying focused.

Hence, the name *Power Algebra* is derived from both the *PowerPoint* slides at the heart of the curriculum and the empowerment of the students using this material. Chaplin also developed subsequent materials for her class, which included whole-class games, visually appealing homework sheets, and continuous assessment strategies.

Pre-Unit and Classroom Activities

Each unit begins with a pre-lesson activity. The activity is designed to activate prior knowledge that can connect to the new concept(s) and to activate student motivation. For instance, before discussing systems of equations, students are asked, "Your body is called a 'system.' Can you explain why?" Many students do not understand the phrase, "system of equations." However, most of them had had health and science classes where they have learned that a system is made up of many interacting parts working as a whole entity (i.e., Solar System). If Chaplin can present the idea of a "system" in this realm, then the students can connect it with their previous experiences and knowledge and, therefore, understand how a system of equations is many parts (equations) acting as a whole simultaneously.

The slides have been printed and bound into booklets along with other course supplements. The booklets contain replicas of the materials on the *PowerPoint* slide, except that, on many of the pages, key words are missing. Students can then fill in those words as they come up in class discussion. (See Figure 2.) These course workbooks limit the amount of notes a student must take. This level of "note-taking" is ability-appropriate for many special needs learners and helps them to remain focused on the content. Students who cannot write use a copy that contains the key words in red and use a highlighter pen to mark the key words in the booklet. (See Figure 3.)

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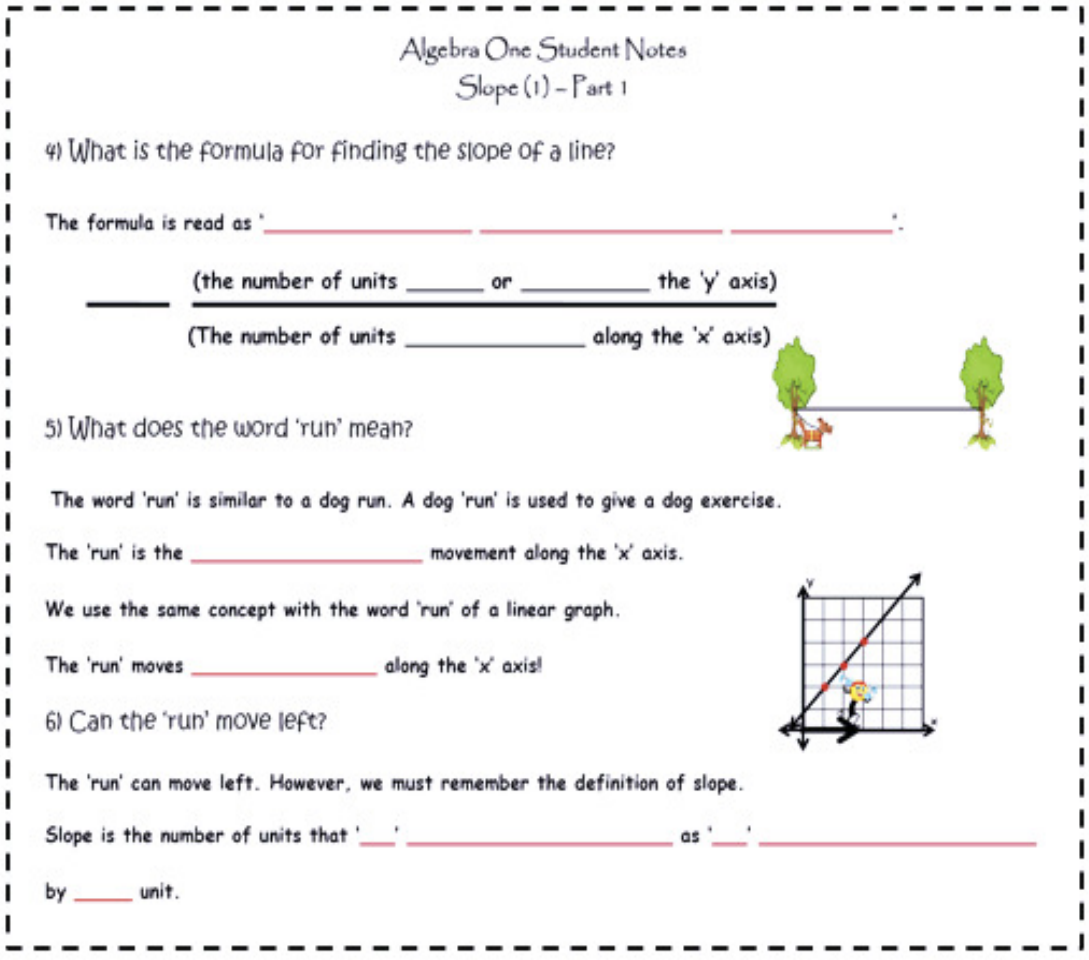
Some teachers may be concerned that students may not pay attention to the actual dis-


Algebra One Student Notes

Slope (1) – Part 1

4) What is the formula for finding the slope of a line?

The formula is read as '_____ _____ _____'.

_____ (the number of units _____ or _____ the 'y' axis)

(The number of units _____ along the 'x' axis)

5) What does the word 'run' mean?

The word 'run' is similar to a dog run. A dog 'run' is used to give a dog exercise.

The 'run' is the _____ movement along the 'x' axis.

We use the same concept with the word 'run' of a linear graph.

The 'run' moves _____ along the 'x' axis!

6) Can the 'run' move left?

The 'run' can move left. However, we must remember the definition of slope.

Slope is the number of units that '___' _____ as '___' _____

by _____ unit.

Fig 2 Sample of Note Page From a Student Booklet

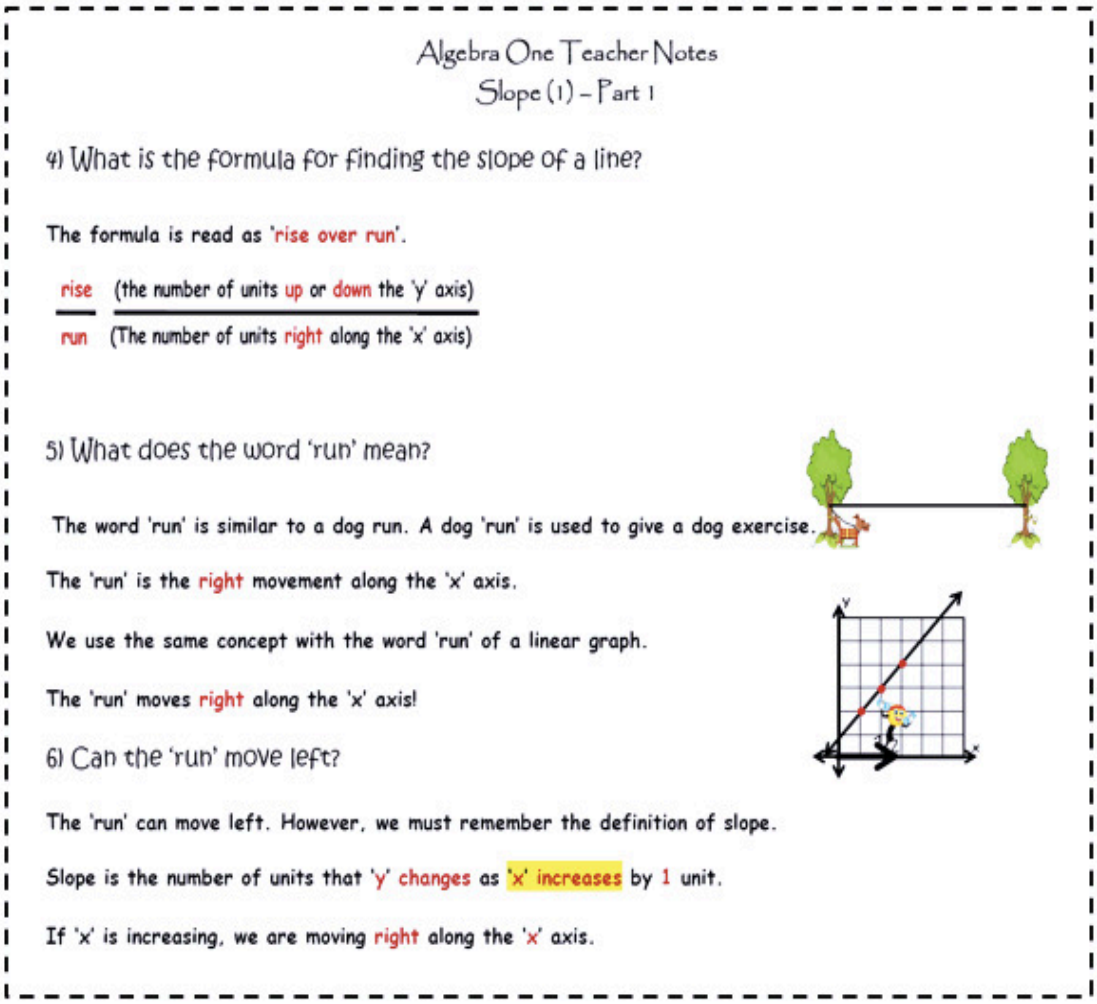


Fig 3 Sample Teacher Notes

cussion, but, rather, just listen for the correct word(s). Chaplin's response to this is that prior to *Power Algebra*, she learned that many struggling students could not write or could not write fast enough to keep up with the discussion. As a result, they stopped taking notes. Secondly, she found that many struggling students were just trying to copy down the notes on the overhead without truly understanding them. Then when they attempted the homework, they could not do it. Why? Because they couldn't read their notes or they were so busy copying notes that they really did not understand them.

Chaplin's goal was to alleviate some of the note taking so that the student would have the time to understand the process and content. When she tried this technique, she saw results. Students who never took notes were proud to do it. They felt empowered. Second, many of the students began trying to guess what word would go in the blank before the word would appear. Therefore, attention is enhanced through curiosity rather than reduced.

The examples shown in Figures 2 and 3 are "fill-in" note pages. Other pages may require students, for example, to fill in steps for finding a slope, to draw a t-table, to solve an equation, or to complete a graph.

Chaplin also developed games within the class materials (and sometimes using *PowerPoint* slides) to help further engage the

learners and to reinforce key concepts. The game of "Simon Says" projects an equation on the screen and then requires the line of students standing on the horizontal axis taped to the floor to form the graph of the equation. "To Tell the Truth" (which does not utilize *PowerPoint*) is a game that simulates the TV game show. Three contestants represent a solution to an equation. Two of the contestants are lying and one is telling the truth. The class must determine who is telling the truth.

Develop Engaging Homework Geared for Student Growth

The homework format encourages engagement and empowerment for a task that can be difficult to get lower-learning students to attempt

In order to continue the goal of keeping motivation high among the students, even for homework, Chaplin developed homework sheets that reinforced concepts and procedures from the day, but were designed to have a fun, puzzle-like appearance. (See Figure 4.) A character appears in the center of the homework sheet with several bubbles that surround it. In each bubble, there is a problem. Problems are keyed by the level of Bloom's Taxonomy that they address. (That is, "knowledge" level problems are 1 point, "comprehension" are 1.5, and so on.) Each student needs to select enough problems to complete correctly that will give him or her ten points. Students have a choice, and yet cannot simply complete only lower level problems to get a full ten points. The homework format encourages engagement and empowerment for a task that can be difficult to get lower-learning students to attempt let alone complete with effort.

Analyze Continuously

The *Power Algebra* curriculum is developed in a manner that encourages and facilitates continuous data collection throughout the learning process rather than relegating collection to end-of-unit

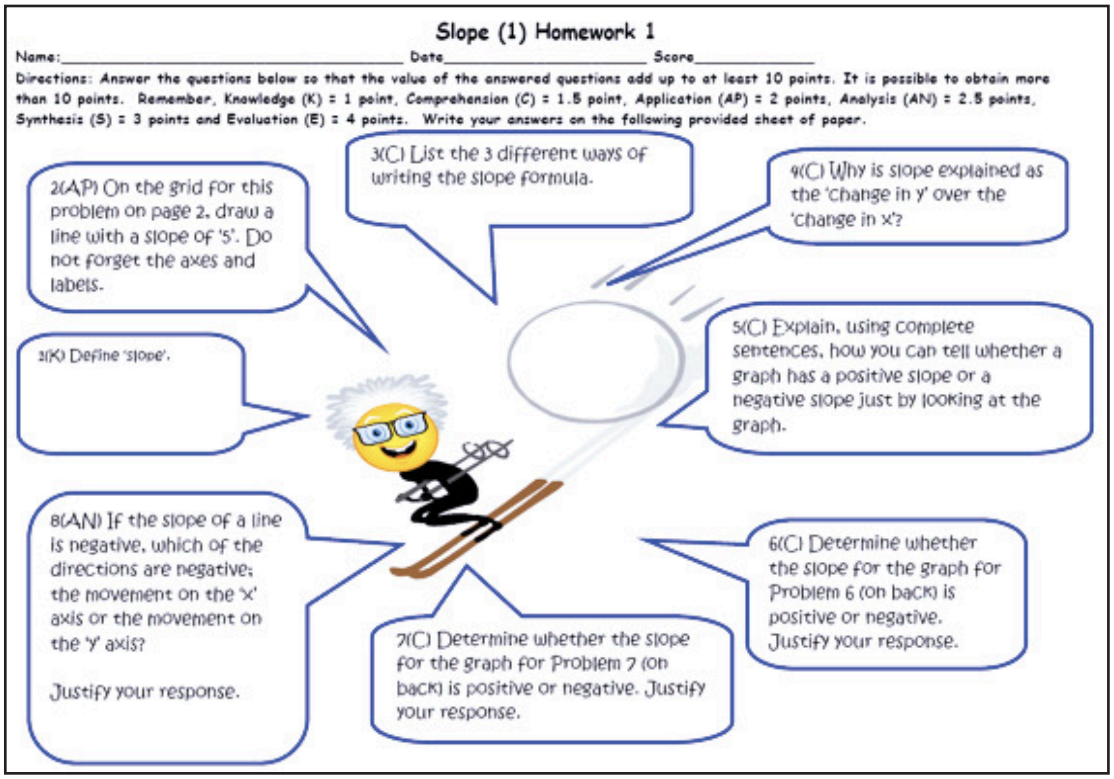


Fig 4 Sample Power Algebra Homework

and occasional quiz assessment. Chaplin discovered that she can obtain a quick error analysis by having students raise hands to show if they got the problem correct or not. Units begin with a pre-test containing approximately twenty to twenty-one items. Every unit has two regular education post-tests and two special education post-tests. Two forms of each test allow for re-test options for students who need more time to master the material. The special education test provides the students with each step of the process, yet the student needs to complete the performance. Each test question reflects a level of Bloom's Taxonomy. Chaplin would only grade those items one level above the level at which a student was operating and then provide the student the graded test along with an individual item analysis from the pre-test and the final test. However, most of the *Power Algebra* teachers grade every item. Each test is also analyzed in an item-by-item manner, and the class results are shared with all the students. The correctness of each item on the pre-test is compared with the correctness of the item on the post-test.

The Growth of *Power Algebra*

After developing, teaching, revising, and re-teaching the materials within her own classroom, Chaplin believes her materials are effective for teaching algebra to students who do not do well in traditionally-taught math classrooms. The Akron Public Schools agreed and has decided to use the *Power Algebra* materials in Algebra I courses in targeted classes across the district. Chaplin is now currently directing the development of *Power Geometry* curriculum. Chaplin notes that creating the visual components of *Power Geometry* are not as challenging as creating those of *Power Algebra*. Consistent with the philosophy of the *Power Algebra* curriculum, the *Power Geometry* curriculum encourages students to develop conceptual understanding of key geometrical concepts. For instance, no formula is ever given; rather formulas are always developed with and by the student.

These programs are still very new and the district has begun collecting and analyzing data to show the actual effectiveness or ineffectiveness of the program. Anecdotally, teachers who have piloted the *Power Algebra* program have reported advantages for students who are more visual, non-native English speaking students, and students with behavioral issues. Other teachers report increased student participation, increased student note-taking, and increased homework completion. The following are quotes from teachers who have used the program:

According to one teacher, "I have a student who was doing almost nothing in my traditional Algebra I class. His parents are from a Middle Eastern country, and he speaks English well, but he just didn't connect with the way I taught math class. Two weeks ago he moved to my *Power Algebra*. In this class, he is following along with the notes easily. We have been doing the patterns unit, and he is able to find patterns and understand the concepts -- the repetition and visual format of presentation are very helpful, while the activities promote competition! In addition, he now participates in class and answers questions all the time."

Another teacher says, "I have found *Power Algebra* to be a very visual way to present algebra to my students. They like the repetitive nature of the problems. I have more students turning in homework because of the format of the homework. Each level of Bloom's Taxonomy is usually represented in the homework, so my higher functioning students may challenge themselves and my lower functioning students are challenged on their level. The notes are concise. The graphics help keep the student

engaged in the lesson. I have fought using a pretest in the past, however I have found that by using the pretest and comparing it to the posttest provides valuable information about what my students have and haven't learned."

Finally, one teacher of students with behavioral problems states, "I have had many successes with *Power Algebra*. I have no behavior problems during math class. The students are engaged and I no longer have students that state that they are not good in math!"

Summary

The *Power Algebra* curriculum is an innovative way to teach algebra that engages students using sound pedagogical strategies such as mnemonic devices, technological effects, pre- and post-tests, cooperative learning opportunities, and activities that require students to become mobile and engaged. The curriculum also implements many strategies (including visual and content organization strategies) known to address students with learning disabilities. The *Power Algebra* is being refined and the *Power Geometry* curriculum is under development and is being piloted. Ω

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Rachel Chaplin is a graduate of the University of Akron, earning her Bachelor of Arts degree from the College of Education, specializing in Mathematics. In 1995, she joined the Akron Public Schools, teaching all levels of high school mathematics. She earned her Masters in Curriculum and Instruction from the University of Phoenix in 2006. Presently, she is assisting teachers as they implement *Power Algebra* within the Akron Public High Schools.