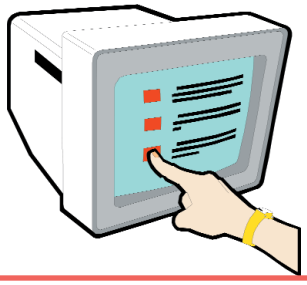
TECHNOLOGY



Self-Graphing to Success

Computerized Data Management

Philip L. Gunter • Kerrie A. Miller • Martha L. Venn
Kelly Thomas • Sandi House

This student is being taught how to record and graph data regarding his own academic behavior.

Your principal has sent forth the edict: Data, data, data. Data is the word. We need data. You must gather data. So what's a teacher to do with this time-consuming demand? How do you collect data on your students and still manage to find time to actually teach? Believe it or not, your students can help—and benefit greatly from the process. This article shows how.

Recent simplifications of computer technology software packages have the potential to make it easy for students to record and graph data regarding their academic or social behavior. Carr and Burkholder (1998) showed how to create single-subject design displays of data collected by using the Microsoft database software Excel. We have taken Carr and Burkholder's application of this concept a step further and developed procedures to empower students with disabilities to take responsibility for graphing data reflecting their own academic performance (also, see box, "What Does the Literature Say?"). By simplifying the steps in the technological applications, students we work with have become not only able to assist with the data-collection process and enhance their performance, but they often expressed enthusiasm for graphing their own performance data.

Preparing Technology

Begin the self-graphing process by identifying (a) the student behavior (e.g., academic or social), (b) the data-collection procedure, and (c) the extent to which the student can contribute to the data-collection process. The first consideration is relatively straightforward: At a minimum, you should gather data regarding student progress on each objective written on the student's individualized education program (IEP).

Students can participate in the data-collection process in several ways. For example, students can grade math worksheets either independently or cooperatively. Sometimes you or a paraprofessional—or even a student from a higher grade—will do the data collection. For instance, it would be difficult for a student to gather data on the number of words he or she reads correctly per minute. In this instance, an adult or an older student would gather the data either live or from audio recordings of student readings and then provide the performance information to the student for recording and graphing.

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Each student should have folders on the desktop, with spreadsheet and graphic files readily accessible.

Second, create a folder for each student on the desktop of a classroom computer. In a "Windows" platform this is accomplished with a "Right click" of the computer mouse on the desktop window that opens a menu with a "New" option, which, when opened, has a "Folder" choice. With a "Left click" on "Folder," a new folder will appear on the desktop. Highlight the words "New Folder" that appear under the folder icon, and type the student's name to appear there instead.

Within each student's folder are files for different academic areas. For example, a student, Jane Smith, can open her folder labeled Jane Smith's Data and in it find Excel files for subjects like math, spelling, and reading. Each file contains a teacher-generated Excel spreadsheet with an embedded graph for each academic or social-skill objective for which the student records her data. When Jane wants to record how well she did on her math homework, she simply double-clicks on the math file. As soon as Jane enters the data for that day, the graph automatically updates itself.

Third, determine the desired "celeration" line to transpose over the graph by using the simple line-drawing function. The celeration line allows the student to readily see if performance meets the criteria necessary to master the objective in the designated amount of time. The next section shows how to determine the desired celeration line.

Developing Student Graphs

In Figure 1, Joe's (a hypothetical student) objective has been placed on the graph. The most difficult aspect of this process from the teacher's perspective is determining the entry level of the student's skills and the expected learning rate (c.f., Lignugaris/Kraft, Marchand-Martella, & Martella, 2001).

What Does the Literature Say About Self-Monitoring of Progress?

Teachers encounter many difficulties while attempting to record and analyze data regarding student performance in their classrooms, particularly while they engage in the intricacies of teaching (Gunter, 2001). Scott and Goetz (1980) stated that teachers report, "I don't have time to collect data; I have to teach!" (p. 67).

Yet, even though this aspect of teachers' classroom responsibilities is complicated, support for the benefits when teachers collect data on student performance is overwhelming (Alberto & Troutman, 1999; Bloom, Hursh, Wienke, & Wold, 1992; Fuchs & Fuchs, 1986; Haring, Liberty, & White, 1980).

Benefits of Collecting Data. In their meta-analysis of the effects of formative evaluation, Fuchs and Fuchs (1986) found that the use of systematic formative evaluation procedures resulted in significant increases in academic achievement for students with disabilities. Findings from their study indicate that effect sizes are enhanced when teachers use data-evaluation rules to analyze student performance at regular intervals rather than when data are analyzed based solely on teacher judgment. Additionally, they found that "when data were graphed, effect sizes were higher than when data simply were recorded" (p. 205). Fuchs and Fuchs suggested that graphs may facilitate "more frequent performance feedback" to students. Findings from the 21 investigations reviewed were consistent across varying student ages and disabilities.

Paper-and-Pencil Versus Computer. Similar to another aspect of the Fuchs and Fuchs (1986) findings, Bloom et al. (1992) found that data collection resulted in greater child improvements when paired with behavioral interventions than when the interventions were implemented without data-collection procedures. Although Bloom et al. determined that little difference was noted on intervention effects between the use of paper-and-pencil data collection and computer-assisted collection procedures, the teachers report that they "preferred the computer methods and . . . altered their interventions more often when they used the computer" (p. 188).

Even though previous research findings indicated that data-based decision making is important for enhancing performance gains of students with disabilities, this does not negate teachers' reported difficulty in finding time to teach and collect data. Computer technology, however, may hold a great deal of promise when integrated with data-collection and analysis procedures (Bloom et al., 1992). That is, teachers may use data for decision-making purposes more readily if computerized applications are involved. With readily available or accessible computer technology in classrooms, we may be able to ameliorate at least some of the difficulty associated with data collection and analysis.

Student Self-Graphing. DiGangi, Maag, and Rutherford (1991) found other ways to reduce the response costs associated with data-collection and analysis procedures. These researchers concluded: "Self-graphing appears to be a potentially powerful variable for enhancing reactivity of self-monitoring for both on-task behavior and academic performance" (p. 228). Two students with learning disabilities (ages 10 and 11) required only 15 minutes to learn to plot the number of on-task tally marks they had recorded during observation periods on a "simple, continuous graph" (p. 224). In short, the students in this study benefited from self-monitoring their own social and academic behaviors; but the benefits of this practice were enhanced when they also graphed the results of their self-evaluations.

For Joe, assessments indicated that he accurately could add two, 2-digit problems without regrouping. Joe averaged approximately 4 calculations per minute, a rate that the IEP committee determined was too low. Therefore, the committee decided that Joe's performance rate, or fluency, should be increased to 10 correct calculations per minute within a month of beginning the objective. The team wrote the objective accordingly, and the teacher developed a protocol that graphed the data as they were compiled. Then, the teacher inserted a predesigned celeration line into the graph, starting at 4 correct problems per minute and ascending to 10 correct responses per minute by the end of the month.

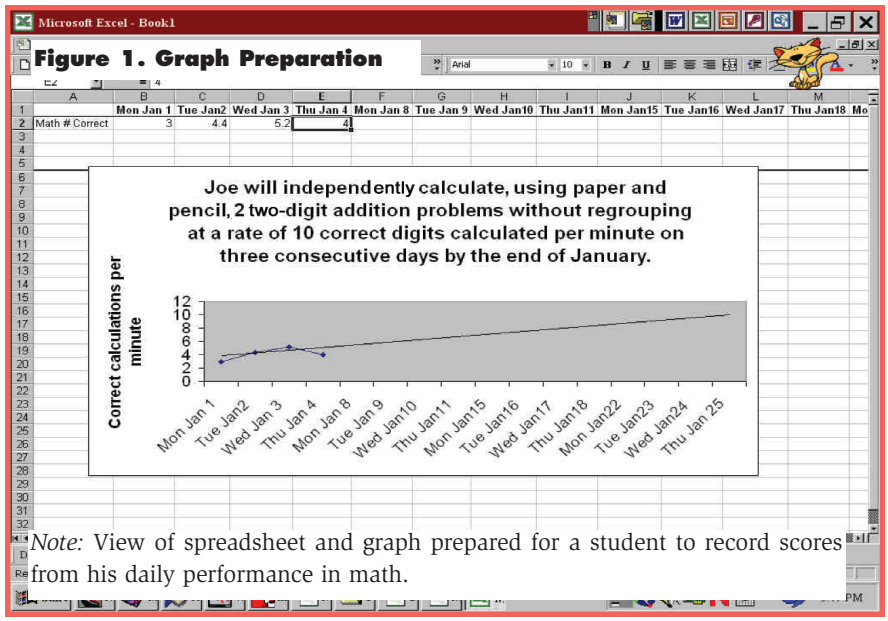
The dates on Joe's spreadsheet indicate that he will complete math worksheets and graph the data for 4 days each week. Once the IEP team has written the objective and developed the protocol for recording data, all that remains is to teach Joe how to graph the information.

Students themselves can easily complete many aspects of the instructional day, from monitoring on-task behavior to self-grading math worksheets.

Training Students

An important aspect to consider before self-graphing is how to determine the number (value) to graph. Certainly the teacher can evaluate students' work, and indicate, as in Joe's case, the number of digits calculated correctly and provide that number for Joe to graph. A number of options exist, however, in which students can complete the self-evaluation process before graphing. Maag (1999) has indicated the positive aspects of self-monitoring on both academic and social performance exists (c.f., Maag).

Indeed, students themselves can easily complete many aspects of the instructional day, from monitoring on-task behavior to self-grading math worksheets. One of the most interesting aspects of the literature on self-monitoring is that students do not necessarily have to be accurate in their self-evaluation. Certainly if the students benefit from the process of self-monitoring, the teacher also benefits by empowering the students to collect and self-graph their own data. Teachers may be more likely to adopt this practice because the immediate effect is a reduction in teacher time and responsibilities related to evaluating student work.



Note: View of spreadsheet and graph prepared for a student to record scores from his daily performance in math.

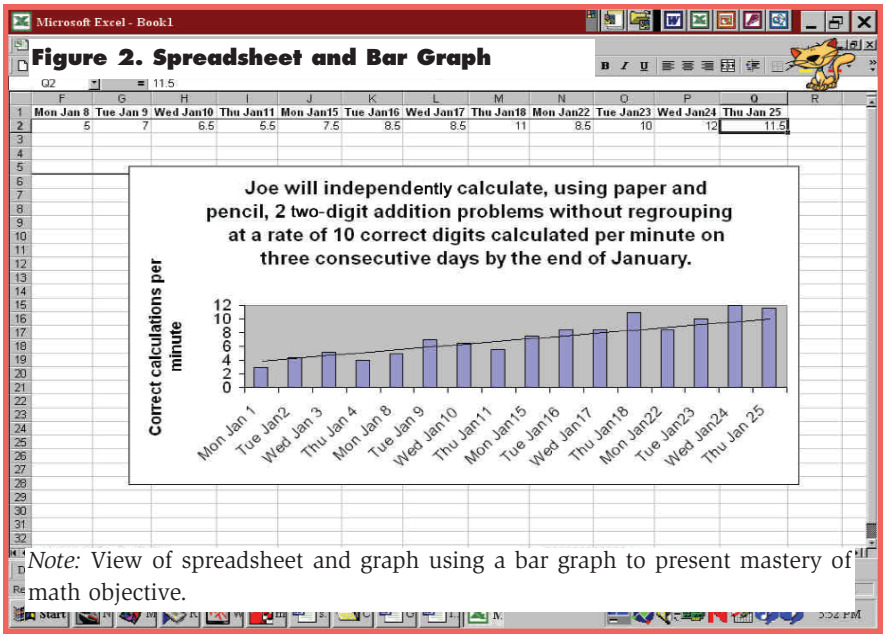
Once you have evaluated students' performance, teaching them to graph their score is simple. As indicated previously, you will need to place a folder on a designated computer's desktop for each student in the class who will be graphing his or her own behavior. Inside that folder is a file for each objective on which the student will graph data. The student only has to double-click first on the folder and then on the appropriate file. As the result, a spreadsheet such as the one presented in Figure 1 opens. The student enters the day's data value in the "cell" corresponding to the day's date. As in Figure 1, Joe entered "4" to indicate the number of problems calculated correctly per minute from his work on January 4. The teacher has selected all of the cells from January 1st to January 25th (the point at which the objective is to be evaluated) when designing the data graph; therefore, when Joe presses "Enter" the data point will automatically be graphed, allowing him to compare his performance to that expected on the projected celeration line.

Traditionally, the graphic display of data regarding classroom performance is presented in the line graph chart. Students have the option, however, to choose a bar graph, such as the one in Figure 2, or the option to paste elaborate backgrounds or clip art into the graphs, as well as choose a variety of colors. Certainly, a number of opportunities exist for exploration of the possibilities for formatting; these opportunities should allow students to not only benefit from the effects of graphing their own data, but to enhance their skills with computer applications simultaneously.

Classroom Application

The results of the self-graphing procedures of one of the students we work with are presented in Figure 3. This particular student was identified with severe behavior disorders and was in a 3rd grade classroom in a special school. The baseline data indicate that her average rate of cor-

Here's a goal to aim toward: Students should read grade-level materials in the 3rd grade at a rate of 135 correct words per minute.



Note: View of spreadsheet and graph using a bar graph to present mastery of math objective.

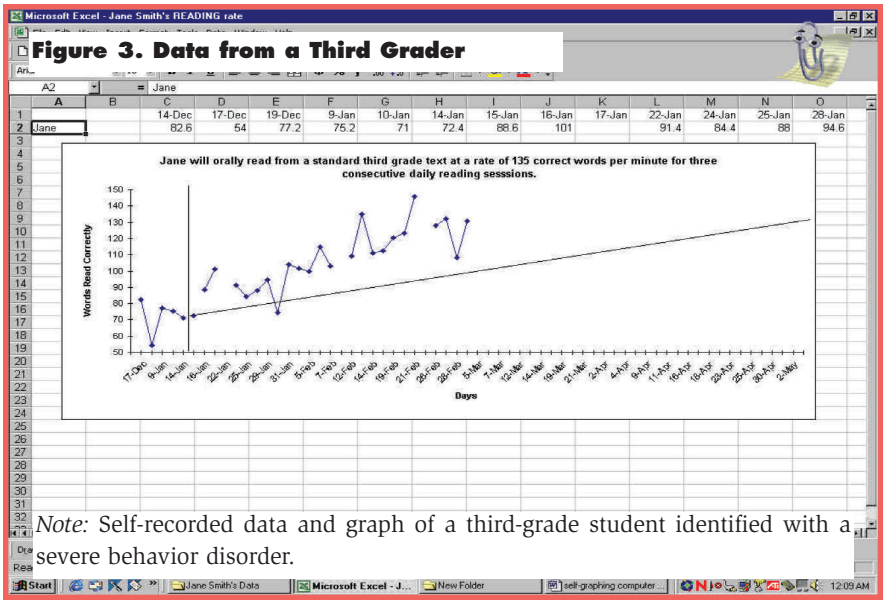
rect words read per minute was 72. According to Carnine, Silbert, and Kameenui (1997), students should read grade-level materials in the 3rd grade at a rate of 135 correct words per minute. Therefore, that level was targeted for the student by the end of the academic year.

The only change in classroom instructional procedure between the baseline data points and the intervention is that the student enters the teacher's calculation of words read correctly per minute, using the procedures described in this article. The numeric value for each data point is calculated by the teacher after allowing the student to read orally for 5 minutes while the teacher records the correct words read.

It appears that for this student, self-graphing has a positive effect. We are systematically evaluating the effect of computerized self-graphing of academic data resulting from ongoing instructional interactions involving other students with disabilities.

Final Thoughts

Having students with mild disabilities self-evaluate their social and academic performance is a strategy with proven benefits. Adding the component of self-graphing seems to further enhance the effectiveness. Finally, with improved, user-friendly technology and software packages, students can easily learn to record and graph high quality representations of their work performance. Having students involved with production of the graphic display of their performance data not only has potential benefits for students with disabilities but simultaneously enhances teachers' efficient use of time.



Note: Self-recorded data and graph of a third-grade student identified with a severe behavior disorder.

Fuchs and Fuchs (1986) found that the use of systematic formative evaluation procedures resulted in significant increases in academic achievement for students with disabilities

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Philip L. Gunter, *Professor, Department of Special Education and Communication Disorders, Valdosta State University,* Georgia. **Kerrie A. Miller,** *Teacher of Students with Severe Behavior Disorders, Dougherty County Schools, Albany, Georgia.* **Martha L. Venn,** *Associate Professor*; **Kelly Thomas**, *Graduate Student*; *and* **Sandi House,** *Graduate Student*, *Department of Special Education and Communication Disorders, Valdosta State University,* Georgia.

Address correspondence to Philip L. Gunter, Department of Special Education and Communication Disorders, Valdosta State University, Valdosta, GA 31698.

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