Science educators are often among the first to use emerging technologies in the classroom and laboratory. For the technologically savvy science teacher, the handheld computer is a terrific tool. A handheld computer is a portable electronic device that helps organize (via calendars, contact lists, to-do lists) and integrate electronic data (documents, spreadsheets, media, e-mail, companion software) into the mobile lifestyle of busy professionals and many students.
Handheld devices have long had the potential for applications in the classroom, but recent advances and affordability in wireless technologies have enhanced their applicability in schools and created opportunities for educators to improve on process and management efficiencies. Handheld devices have become more than just convenient, expensive, electronic date books. Current models have a variety of features and programs, expanded memory, and extended battery life, making them useful tools for all educators to collect many types of assessment data.

Streamlining attendance and grading
Using the handheld in the classroom can improve the efficiency of checking homework, which is time-consuming when using a clipboard or paper grade book. Science teachers routinely spend valuable class and prep time transferring homework data a second time into electronic grade books. The handheld device allows teachers to enter the data only once.

Many grade book software packages come bundled with a handheld component (or it can be purchased for a nominal additional fee). This establishes a nearly seamless transition between handheld interface and the familiar desktop companion, virtually eliminating software “ramp-up” time. When synched with the desktop PC, the homework record will be up-to-date without requiring additional steps for the teacher.

The use of handhelds for electronic grading is a great tool for communicating up-to-date information about a student’s progress. During parent conferences, electronic grade book reports on the handheld allow a teacher to instantly sort assessment data to focus on specific areas needing improvement. For students, handheld grade book reports can quickly communicate paperless and truly confidential grades without divulging every student grade, class average, or rank.

Handhelds in the lab
Many handheld devices have built-in digital cameras, which can be invaluable during lab work. After taking pictures of lab setups, photos can be posted online for students to integrate into their lab reports. These photos give students a visual reminder of what they did in lab and the ability to comment specifically on setup issues using evidence from the photos.

Handhelds can be effectively used for assessing student work during laboratory exercises. Grading scales and rubrics for lab activities are written into the desktop computer (using programs such as Word and Excel) and synchronized onto the handheld computer for use during lab. As students work on a particular part of the laboratory exercise, the teacher records the progress of student work onto the handheld computer. These data can be input in the form of pictures of laboratory setup and progression, a narrative in a word processing document, or entries into a rubric set up on a spreadsheet. Figure 1 shows a rubric for group work that also has space for individualized notes. The teacher then carries the handheld computer while circulating among students and enters data without the cumbersome paperwork. By inputting data as students work, immediate assessment is performed and available for the students and teacher. Grades on laboratory tasks are calculated instantly and can be synchronized to the desktop computer. Although printed paper copies can be made if desired, no paperwork is necessary.

The camera can also be used for a postlab assessment. While projecting the photos of the setup of a laboratory experiment using a LCD projector, the teacher can ask students questions about elements of an effective setup versus one that could be improved. By immediately analyzing their experimental setups, students gain valuable skills in lab design and analysis that might contribute to their future performance. The handheld allows nearly instant scrutiny as the photos can be transferred wirelessly via Bluetooth technology (for more information about this technology, see the “Data Synchronization” section). This analysis can be powerful because the lab work is still fresh in students’ minds.
Handhelds in the Classroom.

A short tutorial on setting up cooperative assessment rubrics in Excel
(from www.kaplo.net/handheld.htm)

Putting together an Excel workbook to help you manage assessment in the classroom is a snap! You’ll be off and running in minutes, but first, let’s outline the big picture.

1. Create a suitable spreadsheet in Excel or other handheld compatible spreadsheet.
2. Synchronize (handheld to desktop/laptop) so that an instance of this spreadsheet is located on your handheld.
3. Use your spreadsheet in the classroom as you grade the student cooperative activity—save your work!
4. You may choose to synchronize again in order to have access to the newly acquired data from your desktop/laptop.

Details
1. Generate a spreadsheet file (such as Excel) that contains the pertinent information. Generally this file will contain (at a minimum) columns for student names and assessment categories. If you are using numbers within your rubric, a key might help you to remember the expectations for each level of work. Bear in mind that generally speaking, your handheld software version of a spreadsheet file (the one loaded on your handheld, such as “Pocket Excel” or “Spreadsheet to Go”) will likely not have the same dynamic range of functionality as your computer-based version. You might try experimenting a little with this, but I have found limitations with the abilities of some formulas to execute.
2. Synchronize your computer with your handheld device—usually performed with a “hotsynch” on Palm OS devices or by starting ActiveSync with Microsoft OS handhelds. Synchronization is accomplished automatically by simply docking the handheld device to a cradle or other connection to the computer, or by connecting wirelessly using Bluetooth technology.
3. Open the newly acquired file on your handheld and populate the appropriate fields as you assess student work. See Figure 1 (p. 27) for an example of a handheld view of a sample spreadsheet rubric.
4. If electing to save this back on your computer, perform a synchronization again.

Students can also use the handhelds to collect their own data. Entering their information directly into spreadsheet software using either a stylus or attachable keyboard allows students to immediately graph their data. The major probeware technologies available to science educators also have options to use the handheld computer as a visual interface (Metcalf and Tinger 2004). These systems allow for precise collection of large numbers of data that would be nearly impossible to do by hand. The immediacy of the data analysis, whether it stems from manual or probe entry, allows students to more easily understand how manipulations in experimental setup affect the resulting data. In addition, this technology is more cost-effective than supplying every student group with a laptop or desktop computer.

Managing cooperative learning
Increasingly, many science teachers want to incorporate cooperative learning in their classrooms but struggle with ways to accurately assess learning associated with this teaching approach. While observing cooperative groups, teachers must continually record assessments and note student progress. It is quite likely that during the process one might be missing critical information for feedback that would help students improve their performance. Using handheld technology can offer a solution to managing cooperative learning.

By setting up a spreadsheet that holds copies of a rubric for group work, teachers can quickly and efficiently take notes and evaluate student work. The spreadsheet can hold individual pages for each group, linked to a master class roster. Each group page has the individual rubric with spaces for notes. While assessment of cooperative work also can be done on paper, the advantage of the handheld is that total scores are automatically tallied and transferred to the master roster. When the handheld is synched back to the computer, the spreadsheet is updated on the hard drive, and the teacher then has a convenient record of notes and students’ grades that can be accessed and modified from the teacher’s desktop computer. This takes minimum setup and can greatly improve a teacher’s ability to accurately assess student group work.

Figure 1 (p. 27) shows a biology teacher’s sample rubric for a jigsaw cooperative group activity to learn about different types of genetic technology. Once the scores are entered in the individual categories for each home team, they are automatically totaled and sent to a different sheet, which contains a summary of students.
and their scores. The instructor can click on each descriptor for a full explanation of the point values, and he or she can also take notes on each group, which will be saved and transferred to the desktop when syncing.

Handhelds can also be used for evaluating student presentations in a similar manner. Taking and recording notes about presentations can be time-consuming and the turnaround time for students to receive feedback can be quite long when there are many students in a class. Using rubrics synched into the handheld from the desktop computer, the teacher can immediately assess and evaluate student work for instant feedback. During a presentation the teacher records student work using the electronic rubric and can later synchronize students’ work to a desktop computer. Familiarizing oneself with the Graffiti programs in handheld computers also allows the teacher to write in other comments to give the student valuable feedback. With a little practice the teacher can easily master this handwriting program. Some models of handhelds are also equipped with QWERTY keyboards, similar to traditional computers. These may be more efficient than Graffiti for some users and are also available as separate modules that can be attached to most handhelds.

**Data synchronization**

Teachers can sync handhelds to desktop computers by using a dock, but many teachers have found that setting up a local Bluetooth network has been a quick, easy, affordable, and effective solution for minimizing data synchronization operations. Essentially replacing a wired data transmission connection (such as a USB or Firewire cable), Bluetooth allows the teacher to connect the handheld to the desktop computer from anywhere in the classroom. Since many devices are sold with integrated Bluetooth capabilities, a teacher needs only to enable the classroom desktop PC with a Bluetooth antenna (many USB varieties sell for under $20) to provide the connection with a handheld.

For example, after taking attendance, checking homework, documenting learning with pictures or video, or any other data collection, a teacher can simply tap a single button to begin and then slip the device into a pocket and begin the lesson while data is transmitted to a desktop computer for future use.

**Freeing up time**

Trying to collect and give feedback in a lab environment can be challenging. Handhelds can support science classroom and laboratory activities while also allowing teachers to provide students with feedback in a timely manner. Handhelds can also greatly reduce the turnaround time of graded work and can eliminate some of the paperwork that can overburden teachers. In addition, introducing this technology in a lab setting provides a model for students in ways to use technology to collect and analyze data. With a small amount of practice, handhelds are excellent tools to help teachers spend less time managing grades and more time interacting with students and facilitating their learning.

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**References**


**Additional resources**

