

CONSIDERING TECHNOLOGY

“Research has also moved beyond the simple question of whether computers can help young children learn. They can. What we need to understand is how best to aid learning, what types of learning we should facilitate, and how to serve the needs of diverse populations” (Clements, 1999, p. 93).

Technology offers wonderful opportunities for children to play, to learn, to create. Researchers have concluded that technology has great potential to enhance student achievement, when used in ways appropriate to the developmental levels of the children. As with any materials, however, these tools also can be used in ways that will not benefit students.

The design of the curriculum and the social setting are critical to the educational value of technology use. It’s up to each teacher to provide guidance and make sure that it is used to meet appropriate instructional goals. The National Association for the Education of Young Children (NAEYC) underscores the role of the teacher in this process in its position paper: “Educators must use professional judgment in evaluating and using this learning tool appropriately, applying the same criteria they would to any other learning tool or experience. They must also weigh the costs of technology with the costs of other learning materials and program resources to arrive at an appropriate balance for their classrooms” (NAEYC, 1996).

The National Reading Panel has concluded that many questions still need to be addressed regarding technology’s use for reading instruction (2000b). While we wait for research to catch up

with educational applications of technology, this may be an opportune time for teachers to evaluate whether the newest technologies are delivering any better education for children in the early elementary grades than more old-fashioned tools—art supplies, blocks, books, and props to encourage pretend play (Healy, 1998).

In light of these cautions, two important questions may be considered when introducing young children to any new tool, including technology.

- Is it developmentally appropriate—consistent with how a child develops and learns—and with the child’s current developmental stage?
- Will the activity benefit the child or will it replace other, more meaningful learning activities?

Other factors that educators should consider when incorporating technology include:

- **Time:** Young children need time to develop their memory, visualization skills, and attention span. Young children’s attention naturally jumps around, but distracting graphics on television and computer screens may increase distractibility and make it harder for them to pay attention for sustained periods. Teachers may want to limit total “screen time”—including television and video viewing, video games, and computer use—and provide a healthy balance between the “electronic world” and the “real world.” For example, if a student creates a drawing on the computer, ask her to build a three-dimensional model of it using blocks or clay. Encourage a child to sort objects in the classroom according to shape, color, or other

characteristics if he enjoys using a computer program that involves sorting symbols on the screen.

- **Motivation:** Learning takes persistence. Children need practice sticking with a task to develop the habits of mind necessary for solving problems and learning from mistakes. Some worry about the effect of software programs that reward impulsive, trial-and-error guessing over thoughtful problem solving, or that condition children to expect a reward (such as sound effects or enticing graphics) for every task completed. Teachers need to provide the necessary guidance to help children develop confidence in their ability as problem solvers and to persist, even if a task appears difficult on first try.
- **Presentation:** Word processing programs, ready-made graphics, and other publishing tools make it relatively easy for students to “dress up” their work. Teachers need to teach students that writing and art projects may go through many drafts or revisions before they reach final form—content involves much more than packaging. Rather than using ready-made graphics to illustrate their stories, encourage students to make their own drawings, which they can then scan for use on the screen. If students are writing for an audience—for a class newspaper or Web site, for example—make sure they edit and revise their work before it is published.

When used wisely, computers and other technologies give children opportunities to collaborate and socialize, to use language in meaningful ways, to engage their senses in play and discovery, and to connect with the wider world beyond the classroom.

For technology to be a useful learning tool, it needs to be accessible, available, and a part of regular classroom activities.

Guidelines for Success

Some general guidelines will help teachers use these tools to best advance student learning.

1. Integrate technology into classroom activities.

For technology to be a useful learning tool, it needs to be accessible, available, and a part of regular classroom activities. When technology is available within the classroom the message sent to children is that it’s part of the set of tools to be used in daily activities. Computers can be used when needed, rather than according to the computer lab schedule. Clements writes of young students who naturally turn to a talking word processor to use in their learning.

“Two young girls were examining a picture-word card with a colored triangle. They were unsure what the word ‘triangle’ was and, after a brief discussion, walked over to the word processor, typed it in, and satisfied their curiosity” (Clements, 1994, pp. 34-35).

2. Let students use technology regularly, for real tasks.

Technology is of value when it accomplishes a purpose. When it becomes part of the regular classroom program the attention shifts from the tools themselves to their function: the ability to help perform a task. In the following example the technology is invisible—the children use the portable keyboards as naturally as any other classroom materials.

A group of primary students clusters around a table, writing and solving story problems. One child hands an AlphaSmart, a portable keyboard,

to the teacher who reads the problem aloud to the group. The group discusses the problem, and after agreeing on the solution, the children return to writing problems. Most of their time is spent on thinking through the language and concepts to create and solve the problems, the important elements of the activity.

3. Encourage students to work together.

Students benefit from an atmosphere that encourages collaboration and problem solving (Murphy & Thunte, 1995). Research supports the use of cooperative group interactions to increase understanding and success, as well as positive social interactions. Technology provides many opportunities for students to collaborate, and a classroom arrangement that allows two or more children to sit and work together encourages interaction and language opportunities. The students work in pairs in the following example, and discussion is built into the project.

Second-graders are guessing how many of each color of M & M's will

be in their packets. After each pair makes a prediction, students open the packages and sort and count the candies by color. When they have their totals, they go to the computer and enter the numbers into a spreadsheet. The children easily convert the data to a bar graph and a pie chart, and print out both versions to post on the wall.



PHOTO BY DENISE JARRETT-WEEKS

Technology allows students to easily create different “pictures” that help them to compare and understand the results. These visual displays lead into class discussions comparing results across groups, hypothesizing the reasons for different findings, and introducing important vocabulary in a meaningful context.

4. Make a variety of tools available for student use.

Many classroom uses of technology do not require the newest or most sophisticated equipment. For example, tape recorders and cameras are useful learning tools. When students are offered choices, they are involved in making decisions about their learning. Teachers can incorporate a variety of technologies, giving students choices to address their range of learning styles and needs.

Students working on “convincing” writing are invited to use any available classroom resources to present their finished work. Some students decide to make a persuasive speech and display graphics and photos

to support their arguments visually. One child writes and records a song to tell her ideas. Others use a word processing program on the computer to write, edit, and print their writing. Other students write the script for a commercial, which they act out and videotape.

5. Do not teach technology skills in isolation.

Real learning is based on connecting new information with existing knowledge. Rather than teaching technology skills in isolation, introduce specific skills as they are needed as part of classroom learning activities. A topic of study can be used as a way to introduce and practice certain skills while students accomplish real work, as the following example illustrates.

Students chronicle the growth of trees through the seasons with drawings, photos, and written descriptions. Children learn to use a camera when they take pictures of the trees. They practice keyboarding while they type their observations, and learn how to indent a paragraph when that skill is needed to organize their writing. By the end of the project, students have documented the growth of their writing and word-processing skills as well as the growth of the trees.

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technology
being used.

6. Use technology to support active learning.

Children learn by doing. Whether using a microscope to explore or paints and brushes to create, they need to interact with tools and with others. Experiential learning activities enhance understanding in a diverse classroom; such activities provide all students with common experiences. In a classroom in Concord, New Hampshire, a diverse group of children with a variety of needs combines technology with other learning experiences.

In a combination first- and second-grade classroom, students are preparing to share their reports on animals that hatch from eggs. These written reports are one piece of a project that required them to work in different modalities using art, construction, and writing. The classroom is filled with dioramas depicting environmental scenes, complete with clay chickens and snakes.

For their reports, each student had to produce a draft that was handwritten and use the word processor for the final version (Ethier, 1999).

* * *

While not all six of these suggestions may be applicable at all times, keeping them in mind will encourage students to use technology appropriately and effectively to enhance learning.

Research also makes clear that very young children, and probably all of us, learn better in a stress-free environment. For learners of all ages, stress and threat negatively affect the brain—learning is enhanced by challenge but inhibited by threat.

In the classroom this translates to a nonthreatening environment that fosters exploration and discovery so that children can test both their cognitive and emotional limits (Caine & Caine, 1997; D’Arcangelo, 2000).

So, too, must technology used by young children allow for exploration and discovery to align with their developmental and learning needs. Thoughtful planning by the teacher is essential so that the focus is on the learning, not on the technology being used to support the learning. Nor should teachers have students use computers and other tools of technology only to add special effects; such “bells and whistles” are not likely to offer educational advantages.

Selecting Software

Although there is a great variety of software available, educators have limited time and energy to evaluate and select programs. It is important to remember that software is not the curriculum, but rather is a tool to support learning. Computers or software cannot and should

not replace skilled and caring teachers. Research on learning and the human brain highlight the importance of children having caring interactions with responsive adults. But as a tool to help children learn, create, understand, explore, and present, software can be a powerful and effective aid.

As a first step, consider the intended purpose of the software. When educators search for new books to use in the classroom, they have in mind a mental list of the criteria they consider essential. Similarly, knowing what the software is intended to support will help to narrow the field dramatically. For young children especially, it is also important that the software be developmentally appropriate—that is, consistent with the way children learn and develop—and is used appropriately in the context of the curriculum (NAEYC, 1996).

Young learners benefit from software that:

- Allows for active learning with students making decisions
 - Is multisensory and multidimensional
 - Has age-appropriate expectations
 - Is flexible, easy to use, and open-ended
 - Allows children to explore without fear of making mistakes, and responds to their exploration in ways that encourage further investigation
 - Encourages language by eliciting excitement
- (Davidson & Wright, 1994; Davis & Shade, 1994; Murphy & Thuente, 1995; NAEYC, 1996)

As the earlier section on play discusses, young children learn through exploration and play, through open-ended activities. This is true with software and technology as well as with blocks and dress-up clothes. Software that is open-ended allows children to explore and discover. Open-



PHOTO BY MOUNT BURNS

ended software is more likely to support active learning as children make real choices and then find out the effect of their decisions. For instance, this type of software may ask children to decide what to create in a picture, how to end a story, or in what direction to take an inquiry. Drawing programs, word-processing programs, and music-making programs are examples of software that may have these characteristics, allowing children to create pictures, writing, and music that reflect a variety of abilities and interests.

Software with appealing graphics and bouncy animation that asks students to fill in the blanks with words is still drill and practice, albeit in a more attractive package. A more open-ended opportunity might ask students to select or create a picture, then write a complete sentence or story about it.

Open-ended software encourages wondering and hypothesizing, problem solving, collaboration, motivation, and a more positive attitude toward learning. These are the types of active learning and intellectual involvement encouraged by the National Research Council (Bransford et al., 2000). Well-selected software gives children opportunities to explore and create, limited only by their imaginations.

Tools and Applications

One of the benefits of incorporating technology into the early elementary classroom is that it allows students to combine words, pictures, and sounds in engaging, multisensory ways. However, teachers may find it helpful to consider how tech-

nology supports specific activities, such as using word-processing software for writing. In the following pages, we will explore how tools and applications of technology can be used to support specific learning goals, including:

- Working With Words
- Student Publishing
- Working With Images
- Using Audio/Visual Recorders
- Making Connections

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Working With Words

Many types of software programs can provide children with scaffolding as they develop literacy skills, support that enables them to perform more advanced tasks than they could do otherwise. Bransford and colleagues (2000) compare technology to training wheels—which allow young bike riders to practice cycling, when they would otherwise fall without the support.

Bell and Beard (2000) suggest using software that supports young writers at various stages,

matching the software with the stage of writing. During the scribbling stage simple drawing programs can be available in the classroom, along with blank paper and writing tools. As children begin to use real letters, they may find it helpful to use programs with picture components, such as KidPix and KidDesk. When children cluster letters together into words with phonetic spelling, text-to-speech capability or “talking word processors” such as ClarisWorks for Kids allow children to hear the words they have written.

Talking word processors: Playing with words is an important aspect of experimenting with and thereby coming to understand language. Talking word processors allow experimental writing as young children play with rhyming words and put together groups of letters. The text-to-speech capability also supports early writers as they try to get the ideas in their heads onto paper. A child can click on a word to hear it pronounced—in effect checking to see if it is the intended word—or can hear an entire sentence or story read aloud.

Talking word processors allow children learning to read and write to experiment with letters and words and hear the results of their play. This type of software can adapt to the changing needs of the user. As reading skills increase and the child becomes more independent, he or she can select the level of support needed, highlighting a word or phrase to be spoken aloud.

As children develop writing skills, the talking word processor provides another kind of support. Talking word processors provide children with independent learning experiences as they listen to a voice reading their stories to them. Because the digital voice reads exactly what is entered on the screen, and not what the writer meant to say, it can provide the immediate, focused feedback helpful for learning. For example, a series of words without capitals or ending punctuation that is read aloud does not stop at the end of the idea. The importance of punctuation and capitals soon becomes clear. While the word processor is no substitute for a teacher, it is an effective teaching tool to support children.

Talking books are another example of computer-synthesized speech supporting literacy development. Research indicates that the addition of speech to text may be a promising use of technology (National Reading Panel, 2000a), and allows children experience with both oral and written

language. These tools also allow children learning English as their second language to hear the spoken sounds of the language while they follow along on the screen as the words are highlighted and read aloud.

Talking books commonly feature appealing graphics and animation along with the read-aloud speech. These programs can be motivating and entertaining to pre-readers and beginning readers. The teacher plays an important role as the mediator of this experience, helping children to focus on the story and engage with the ideas. Graphics and animations can be a powerful draw for children's attention, and have the potential to distract from the reading itself (Healy, 1998; Snow et al., 1998). (See also "Talking Books and Stories Told by Elders," Page 45, for a school project in which students created their own talking book about native culture.)

Hypertext: A powerful feature of multimedia and many other programs helps children make flexible connections between electronically linked resources. Hypertext—highlighted text that links to support materials, almost like an electronic footnote—shows promise for helping readers (Hasselbring & Williams Glaser, 2000; National Reading Panel 2000a). For instance, a young reader having difficulty with a passage might click on the word "rhinoceros" for a definition, to hear it pronounced, or to see a picture of the animal. Hypertext is increasingly common in software for younger children and allows them to learn through avenues in addition to the printed text. Learning environments that incorporate images and sound are especially helpful for students with limited background knowledge in a subject.

Both talking word processors and hypertext features provide extra support for students not yet fluent readers or writers of English.

Word processing: Word-processing software allows children to experiment with letters and words. Using these tools, they can focus on the meaning of the words rather than on the letter formation and fine-motor skills of handwriting.

Computers and writing programs can be successfully integrated into process-oriented writing programs as early as first grade or kindergarten, and can be used by even younger students to explore written language (Clements & Nastasi, 1993). Simple uses such as creating captions for pictures of classroom activities serve a real purpose, by providing information about school activities to families. Such activities also create spoken and written language opportunities for students, both at school and at home. This is of value for all children, and especially so for English language learners and those with limited language experiences.



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Word-processing software encourages writing, and leads to increased motivation and improvement in writing skills.

- Allows children to compose longer and more complex stories and worry less about mistakes (Davis & Shade, 1994)

- Facilitates positive attitudes toward writing and word processing among children from kindergarten through primary grades (Clements & Nastasi, 1993)
- Encourages students to write more, more effectively, and with greater fluency (Apple Classrooms of Tomorrow, 1995)
- Helps children gain confidence in their writing and increases motivation to write more when using computers than with paper and pencil (Clements & Nastasi, 1993)
- Makes revising, a key practice for improving writing skills, less daunting (Wood, 2000)
- Encourages students to put more effort into the finished product because they often take the idea of being “published” seriously (Healy, 1998)

Studies during the last decade repeatedly indicate that word-processing software encourages writing, and leads to increased motivation and improvement in writing skills. Such software:

One teacher refers to the word processor as providing a screen that students can project stories on, giving them a way to express ideas for others to enjoy. Young or reluctant writers may limit

themselves to short pieces of writing or few revisions because of the effort involved to manually rewrite, reorganize, or revise toward a finished piece. Seeing the words emerge consistently formed and neat on the page can be rewarding for writers, especially those who do not find it easy to produce a neat handwritten copy or who have not always been successful.

Portable keyboards: Lightweight, inexpensive keyboards are tools that offer basic text editing features for composing, revising, and printing. These machines offer the power of word processing in a size that's easy to take almost anywhere, allowing children (or adults or older students who take children's dictation) to write, take notes, edit, and electronically store text or record impressions outside the classroom and on field trips. The text can then be sent directly to a printer, or transferred to a computer for formatting and adding graphics if desired. The adaptable tools lend themselves to new uses, and to new ways of accomplishing familiar tasks.

Portable keyboards also can extend familiar learning activities. In a common group-writing activity, each child writes a sentence and then passes the paper on to the next student. As an alternative, each child types in a portion of the story on the keyboard, then hands it on to the next child, until the story is completed. The portable keyboard adds a new dimension by permitting children to easily revise and add to the original framework of the story. They now not only have fun collaborating on a story, but they also can continue to build on the ideas and create a final story.

Presentation: Word processing programs encourage the *process* of writing by making revisions less difficult and labor intensive. As the studies show, this is a major strength. Sometimes, however, students become enamored with other less-valuable features of the programs. Teachers may need to remind students that the content of the

writing is important, and that the presentation, including pictures and formatting, is to help get across the ideas and cannot substitute for the ideas. Writing and art projects may go through many drafts or revisions before they reach final form. This is another instance where writing for an audience encourages quality—when children know that a large audience will read their work, they better understand the need for revision and editing and are more willing to put in the effort.

Student Publishing

Writing has more meaning for students when they see that it has a purpose and reaches an audience. Technology makes the publishing process easier and more immediate, and can also help introduce students to the process of revision. When work is to be published to a broad audience, it is easy to make the case for revising and polishing the final product.

Class newsletters: As we know, students benefit when they write for a purpose, and class newsletters are a great way to inform families about classroom activities. Students can use any word processing software to write, design, and distribute a class newsletter. This project becomes a powerful instrument for encouraging writing, because students are writing for an audience they know. Working collaboratively, students engage in lively discussions about what topics should be included, which story comes first, and how graphics and fonts can be used to communicate their ideas. These activities give students a voice in making real decisions, and support the process of editing and revising written work.

Children may be surprised at first by the amount of time and effort needed to write a simple article, beginning from the initial idea. The satisfaction of hearing back from the readers—classmates, family members, and others in the school community—

makes it all worthwhile and is a powerful motivator. The newsletter is an instructional vehicle as well: Students receive instruction in context as the teacher and a small group work together through the stages of writing and editing an article.

This same idea is also useful with younger writers. A second-grade teacher uses a large monitor to write a class newsletter with her students. The newsletter serves both as a shared writing activity and as a way of informing parents about classroom activities. As children dictate their ideas she enters the text into the computer, then

they work together to revise the writing. All the writing and revising is visible to students and provides a guided practice in how to revise and improve writing.

Little books: Technology currently available in many schools allows authors of all ages to “publish” books right in their own classrooms. Given the desire for reading matter at the children’s own level, and the knowledge that young authors benefit from writing for a real audience, student publishing may accomplish multiple instructional goals. Several studies have found that children

comprehend and make inferences better when reading child-authored texts than when reading other texts (Sampson, 1997). As an added benefit, using students’ work to publish multiple copies of these “little books” can be a natural means of adding to the classroom stock of reading materials.

Encourage children to create their own art to illustrate their work, whether hand-drawn or computer-generated, rather than downloading clip art or ready-made graphics. The final product will be more personal, and better appreciated by the audience. If a color printer is not available, children can hand-color a black and white copy with crayons, markers, or water colors. Hand-drawn or computer-created art can grace the cover; photographs are easy to include along with the text; and interest is certain to be high as children read about topics they care about, written by authors they know. Photocopier machines and standard printers allow for easy printing of individual copies and group sets.



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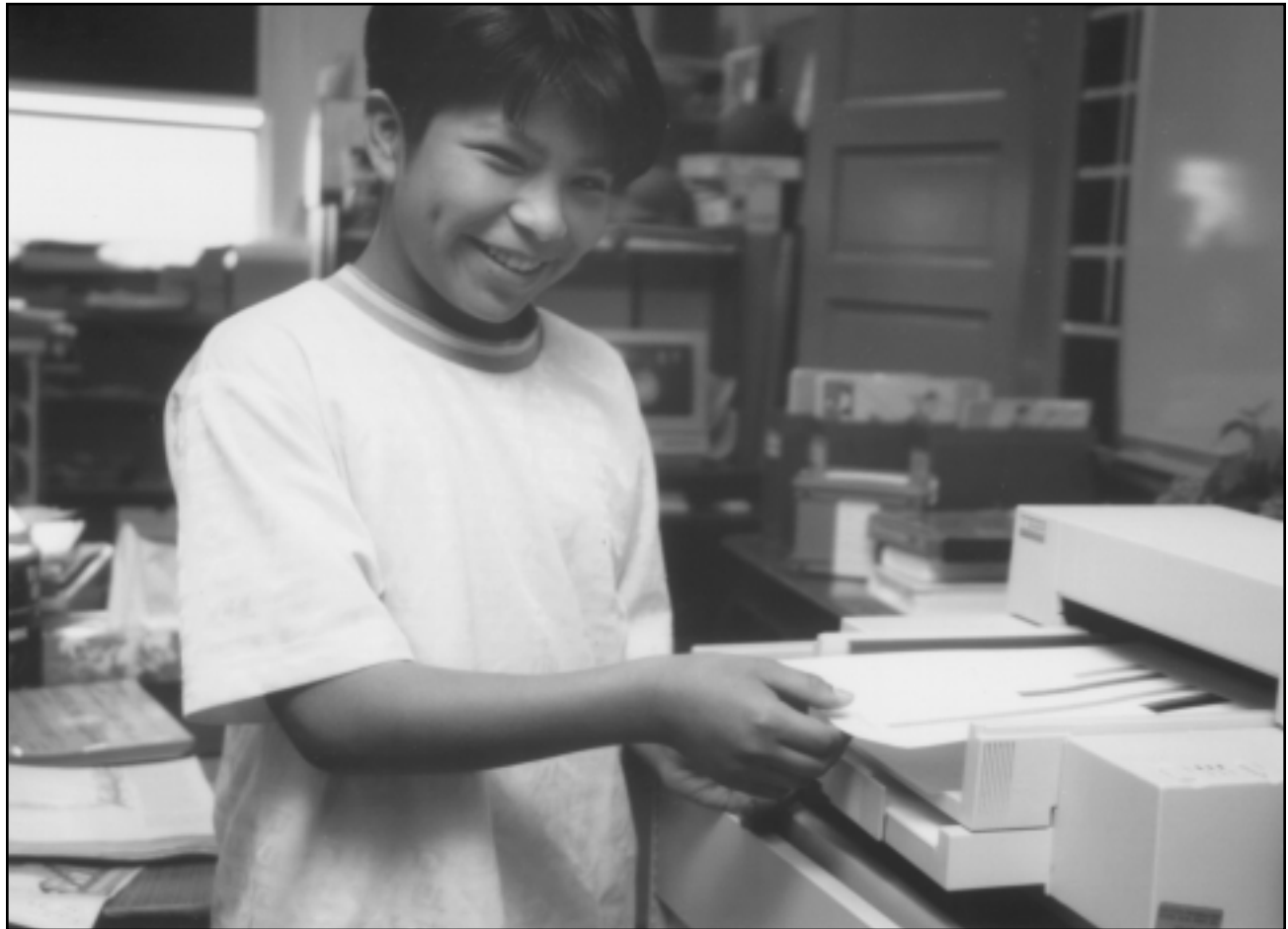


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Web sites: Many teachers publish student writing and accompanying artwork to the Web. Posting work to the Web and creating projects especially for this medium are rewarding experiences that bring motivation and encourage interaction. A class Web page can motivate young writers by letting them know that their work will have an audience, and a large one at that. Some teachers become more deeply involved in this area and add additional features to their Web sites. Others opt to focus on the written word and artwork, and avoid the technical aspects of these additional features. If you are interested in publishing to the Web, be certain to check with your school or district about guidelines, Acceptable Use Policies, and permission forms that may be required before posting student work, information, or photographs.

Reading instructional software: The issue of whether to use software specifically designed and marketed as useful for early literacy instruction is one many teachers face. Some schools choose to use large-scale programs as part of their literacy instruction. According to the authors of *Preventing Reading Difficulties* (Snow et al., 1998), preliminary evaluations indicate that well-designed software programs can produce gains in student performance. The study recommends addressing whether the programs are:

- Consistent with best practices in literacy instruction
- Consistent with classroom curricular goals, as well as the specific needs of individual children
- Used as a complement to—not a substitute for—effective teaching or a good curriculum

The role of the teacher is essential for effective teaching, as is the selection of software to be used. As with the software choices for kids, the design of software for instruction, its goals, and its appropriateness for the needs of the students are critical in the selection of the software. Wood (2000) advises that much of the currently available software is not pedagogically sound, and cites software that supposedly teaches vocabulary

that provides rich experiences with words as part of a complete vocabulary program can be part of a strategy to improve instruction; relying on the software to provide the instruction is not sound pedagogy.

Perhaps most important to keep in mind is that “the potential educational value depends on the quality of the software itself. Software can promote learning

only to the extent that it engages students’ attention—yet software that engages students’ attention may or may not promote learning” (Snow et al., 1998, p. 265). The characteristics that attract students and are marketed successfully may not include the subtle features and dynamics needed to be effective educationally.



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by having students match definitions to words. Unless words are presented in multiple contexts, students’ understanding will be limited to a narrow portion of the word’s multiple meanings, and they will not really feel comfortable with new words. The National Reading Panel (2000a) reinforces this idea: “Repetition and multiple exposures to vocabulary items are important. Learning in rich contexts, incidental learning, and use of computer technology all enhance the acquisition of vocabulary . . . dependence on a single vocabulary instruction method will not result in optimal learning” (p. 14). Including computer software

As we devise strategies to use these new tools in productive ways, we should lean on what has been learned through decades of research on learning and literacy instruction.

Working With Images

While the focus is usually on computers in discussions of educational technology, several useful tools are available that allow students to record and manipulate visual images. Whether the format involves snapshots, video footage, or digital

images, photography records students' activities while they are at work, as well as recording performances and special events. Other tools allow students to create and manipulate their own artwork, which they can use to express themselves before writing, or in combination with writing. Teachers are finding creative ways to use these visual images to promote conversations and storytelling, activities that build students' literacy skills.

Photos: Children love pictures, and digital cameras offer immediate results. During activities of the day, the teacher or students can take photos. Because the images can be viewed on the camera, there is no question whether the picture turned out. Children can add their own captions—dictated to an adult or to an older child—to tell a story in pictures and words. This is a great buddy activity for those not yet writing. Many teachers use photos as motivators, providing quick feedback to students. Photos in the hallway or classroom celebrate successes and remind students of activities and learning from the larger community. Some teachers have begun posting pictures on school Web sites. Photos share the learning with other students, parents, and community members. Photos can also introduce teachers and staff members to new students and families during home visits.

Kindergarten and early childhood teachers face a unique challenge as they try to integrate computers and technology into the curriculum in meaningful ways with students who are pre-readers and pre-writers. Pastor and Kerns (1997) designed an "experiment." Their challenge was to facilitate reading and writing literacy through computer technology without inhibiting children's creativity. To do this they focused on digital photography to document activities rather than on educational software. Because so many kindergarten activities do not use paper and pencils, digital photos were an easy and effective way to

document experiences and save the moment. Children used the camera, downloaded photos, and cropped and altered the photos. At first teachers began creating a slide show of the year's activities, then children took over the job.

The rewards of the project were that all the children were involved, including many previously intimidated by computers. Children could highlight their interests, strengths, and talents, and the immediate documentation of experiences—the photos—stimulated dialogue among the children. The photos were also a great stimulus to writing as they captured reality while it was still fresh. The children were able to express their artistic sensibilities by manipulating photos, using the computer as a tool to do this. The entire process stimulated problem-solving strategies and resulted in satisfaction and enthusiasm.

Clearly, the digital camera plays an important role in early childhood classrooms. It offers children a way to preserve and reproduce special moments for reflection, and is a potential stimulus for writing. Teachers can use these preserved moments for further discussion, for use in the curriculum, and to share with parents.

Visual aids: Public speaking can be less threatening and more effective when the speaker provides a visual element for the audience to focus on. Pictures, graphs and charts, or slide shows can show information that the student wants to convey in a visual form, while he or she provides information orally. This strategy is for all levels. Young children can create a story with pictures and record themselves telling the story aloud. Teachers find visual presentations helpful; photos of classroom activities allow parents to "see" how the teacher teaches, as well as hear about it. Many programs allow children to create electronic slide shows. Programs such as KidPix software are widely used with pre-writers, as well as with older students. These programs allow children to

PHOTO BY JEFF JONES



draw their own pictures using a variety of easy-to-learn tools. Pre-readers use icons to guide them as they create pictures, sequence them into a slide show, and present the finished project. The technology allows children to return to the project to revise and add to their work, encouraging understanding and improvement. The slides can also contain words in either written or recorded form.

Microscopes: Handheld microscopes that display high-quality magnified images on the computer screen are finding great use in classrooms. In addition to supporting curiosity and scientific investigation with students of all ages, they offer younger students a stimulant for language, opportunities for discussion, and an environment for introduction and use of academic and content-area language. Learning vocabulary in this manner allows children from all backgrounds to learn

and use words in context, cementing their understanding of the terms. For children with limited English proficiency, the use of such tools provides a shared background of experience and language with classmates.

Using Audio/Video Recorders

Storytelling, role-playing, and dramatic play offer valuable opportunities for children to develop their language skills. A variety of technologies can be used to record children's stories and capture their playful dialogues. When they listen to the tapes or watch videos of themselves later, children are captivated by their own language skills and often reflect on the activity and on their learning.

When adults write down children's stories—whether directly from children's dictated words or transcribed from a tape recorder—children see how the spoken word can turn into the written word. These activities integrate all aspects of literacy: speaking, listening, reading, and writing. They help children develop their storytelling ability and an understanding of how sound translates to print.

Children learn that:

- What they say can be written down
- What is written down can be read
- What others say can be written down
- They can read what others write down

(Novick, 1998)

Tape recorders support early literacy experiences. They allow children to listen to recorded stories or songs, or to follow along in a book as they hear a story being read on tape. Children can record family stories, their own made-up stories, poems, and songs, or themselves reading aloud. Hearing a recording offers children an opportunity to revise a story to add more details, a different ending, or new characters. The immediacy of digital and audio replay and playback on the computer offers students control and choice.

Tape recorders offer many other ways to support student skills. Recordings allow children who are uncomfortable in the spotlight to shine without discomfort. They also allow children with a variety of learning styles to learn, practice, and demonstrate skills.

Tape recorders—or tape recorders used together with still cameras, or camcorders that record

sound as well as moving images on videotape—can be used in powerful ways as children learn about their families and communities through interviews and oral history projects. (For examples, see “Putting It All Together,” starting on Page 45.)

“We discovered very quickly that the opportunity for children to talk to each other online through their written text, was providing them incredible motivation.”

Making Connections

Technology can promote understanding and help build communities by linking students from across the country and around the world. Many teachers are using e-mail to help students connect with electronic pen pals. This can be an exciting and motivating way to encourage writing and reading, and correspondence is typically faster than traditional postal service and so maintains the interest of the children.

Teachers find that children strive to communicate clearly with their distant friends and eagerly wait for responses. By exchanging digital pictures, students come to feel as though they really know the other students.

Electronic letters provide an engaging framework for children to learn about the larger world and to connect new knowledge to their own experiences. Many teachers find that having a group of children writing to a group in the other class is more successful than pursuing exchanges with individual students; that way, no one is left out if a student moves or does not answer a letter. Some teachers use e-mail to have students exchange information about a particular topic. Classes in Alaska and Arizona, for example, might use e-mail to compare rainfall patterns or learn about the people indigenous to each region.

Tammy Halfacre teaches kindergarten in Hoonah, Alaska, and uses technology to connect her students with the world outside her community. She begins the year writing to pen pals in New Jersey and Texas. As she says on the school Web site, “Starting the year writing to our new Pen Pals is an exciting way to introduce writing, letters, sounds, signing their name, and patterns.” The class loves getting mail, and they communicate with group letters, individual letters, and by e-mail, including exchanging digital photos with their pen pals. Later in the year she uses pen pals to teach letter writing, along with mapping skills and social studies.

Another exciting possibility is creating the online collaborative projects that bring together classes from around the country, or around the world. A teacher writes of online projects in collaboration with other primary teachers:

“We discovered very quickly that the opportunity for children to talk to each other online—and that’s how they describe it—through their written text, was providing them incredible motivation to work hard on the writing skills that we were doing in the classroom. ... They had the audience, they had a purpose for writing because they knew someone was going to read their writing, and they had an expectation that they would get a response back—these are all important parts of the writing process” (Interview, 2000).