

Transferring Knowledge with Technology

Does computer use lead to knowledge, skills, and attitudes that are transferrable to other situations? Or maybe a better question might be, “How can students use computers in ways that will allow for this transfer?”

If you ever wonder at the end of a day just what your kids learned while working at the computers and you are dissatisfied with your thoughts, consider the following simple model. Gavriel Salomon (1992) has posed an analysis of the difference between “effects with” and “effects of” computers.

Effects *with* are the changes that take place while one is engaged in intellectual partnership with peers or with a computer tool, as, for example, is the case with the changed quality of problem solving that takes place when individuals work together in a team. On the other hand, effects *of* are those more lasting changes that take place as a consequence of the intellectual partnership, as when computer-enhanced collaboration teaches students to ask more exact and explicit questions even when not using that system.

In other words the effects *with* are the enhanced ability one gets from the use of technology. Salomon elaborates: “The combined product of human-plus-machine yields a higher level of performance.” The effects *of* are the lasting individual changes resulting from the computer-supported collaboration, the cognitive residue, one might say, the transferrable knowledge or skills.

So, just how might you go about helping your students experience the effects *of* having used the computer?

By Peter Skillen

Subject: Tech Ed, language arts, teaching for transfer

Audience: Teachers, teacher educators

Grade Level: K–8 (Ages 5–14)

Technology: Logo and word processing software, online collaborative writing environments

Standards: NETS•S 3; NETS•T II (www.iste.org/standards)

Two Tools to Teach Transfer

Two practical and replicable classroom experiences make use of quite different tools. The first uses Logo (e.g., MicroWorlds or MicroWorlds Pro by Logo Computer Systems Inc.). The second example uses an outlining tool, available within most word processing programs, such as AppleWorks or Microsoft Word. (*Editor's note.* See Resources at the end of the article for URLs.)

Logo. In Logo, as in other programming environments, you write procedures (or small programs), which may become part of larger procedures. The included ones, therefore, are called *subprocedures* and the enclosing programs are called *superprocedures*. This is much like a builder using bricks that become part of a wall, which then becomes part of a house. For example, the procedure for creating a square can become a subprocedure inside a superprocedure for creating a flower (Figure 1).

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To square
Repeat 4 [forward 50 right 90]
End
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To flower
Repeat 18 [square right 20]
End
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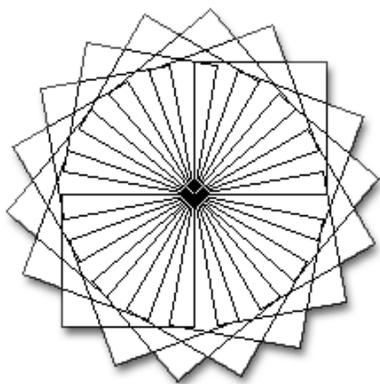


Figure 1. A subprocedure for creating a square is shown within a superprocedure for creating a flower.

Jeffrey (a Grade 2 rascal!) made a most interesting leap from Logo to a completely different domain one day.

We were having a discussion inspired by the flight of the space shuttle piggybacked on a jumbo jet. Our Grades 2/3 class had the opportunity to watch the flight. When we returned to the classroom, a discussion of space naturally arose. One child asked if Earth was in space, and in asking the question, she determined it must be, because it wasn't sitting on anything. The discussion continued until Jeffrey piped up.

"You know . . . it's sort of like Logo."

We stopped and looked at him curiously.

"What do you mean?" I asked him studiously.

He replied, "Well, Earth is like a procedure. It's like a subprocedure inside the solar system. The solar system is the superprocedure. And the solar system is like a subprocedure inside the universe. The universe is like the superprocedure."

"Fascinating," I said, then asked, "What's the biggest superprocedure?"

After a moment he replied, "I don't know. I guess the universe."

Well, I was truly amazed at the generalization across domains that Jeffrey had made. He clearly demonstrated significant transfer of a concept from his experiences with Logo to an authentic event. Although Jeffrey's illumination happened spontaneously, I learned that I could play an important role in helping students to acquire Salomon's "effects of" by providing opportunities for them to look for these comparisons across subject areas.

I started playing a game with students that I called Metaphoria. I gave them sentence starters such as "Programming in Logo is like . . ." or "Finding a bug in a program is like . . .". Students have answered: "Programming in

Logo is like playing tennis. First, I take a turn, then the computer takes a turn." "Finding a bug in a program is like looking for a needle in a haystack."

My second example of an activity that supports transfer involves the outlining function in a word processor.

Outliner. Does word processing make students better writers? Research (Bangert-Drowns, 1993; Breese, 1996; Owston & Wideman, 1991) has indicated that students write better whenever they use word processors. Their work is longer, better revised and edited, and so forth. This would constitute *effects with*. But can they subsequently write better after having used word processors? Can they write better without the use of a word processor? The answer to these questions is likely dependent on both the connections teachers explicitly make in class as well as the types of activities in which students are engaged while using word processors. For example, if they use an outlining tool within a word processor or presentation software, they would then have a functional mental structure to carry with them to other tasks.

How does using the outliner tool differ from just using indents and hard returns? The ability to expand and collapse the headings and subheadings provides, in my opinion, a significant mental model. How might this be implemented in a classroom? Let's take a look at two different examples.

1. Planning a Class Party
2. Writing a Chapter Book

1. Planning a Class Party. Imagine you are sitting with a group of second graders planning a class party. You ask, "What do we need for our party?"

Using the outliner, you can capture ideas as they are called out to you. So

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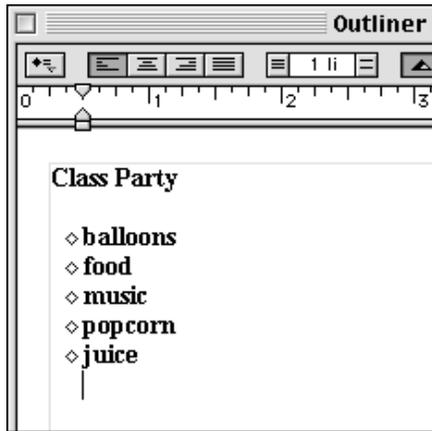


Figure 2. Students brainstormed items for party planning.

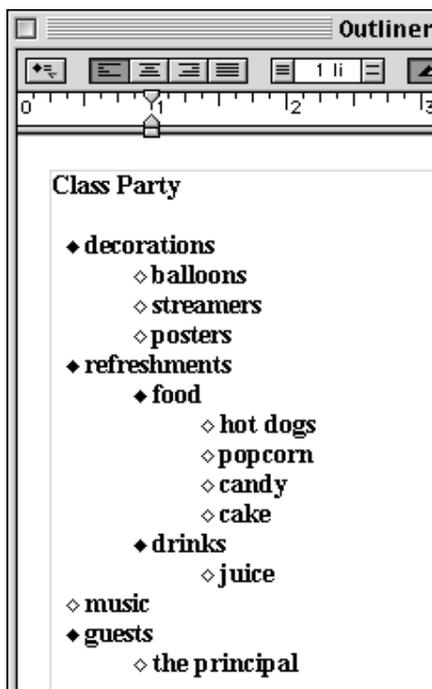


Figure 5. Students can see areas that need elaboration and can analyze the details.

the kids call out, “balloons,” “food,” “music,” and so on. You simply record these as they are mentioned without regard to classification (Figure 2). At various points, you may need to prompt them with additional questions (e.g., “Should we invite anyone else?” “What else would we need if we have food and drinks?” “What kind of music?”) Then capture more of their spontaneous responses (Figure 3).

At this point you may wish to organize the information by making categories and by placing items under their re-

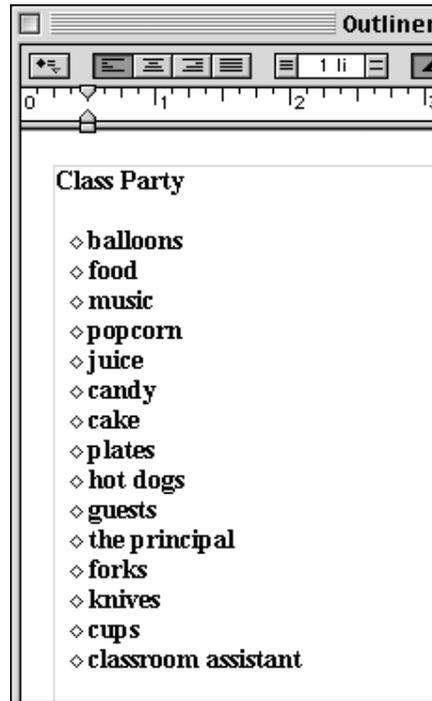


Figure 3. Prompted by the teacher's additional questions, students provided more ideas.

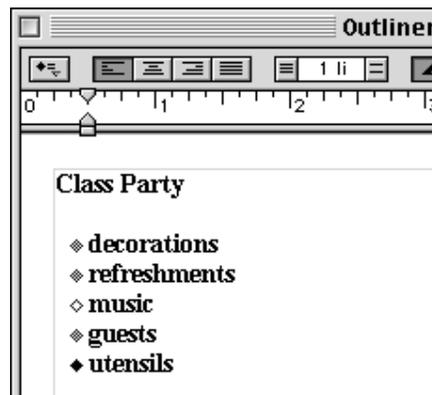


Figure 6. Students can collapse the categories to see just the main-level organization.

spective headings. The kids will start to understand the concepts of hierarchy and categorization (Figure 4). This visual, dynamic, and interactive representation of hierarchy further deepens such understandings and provides an organized way of thinking about such things.

Figure 5 shows further classification. Students can learn how to think about how this organization helps them to do a better job. They can see areas that may need elaboration (e.g., “drinks” and “music”). It allows them to analyze

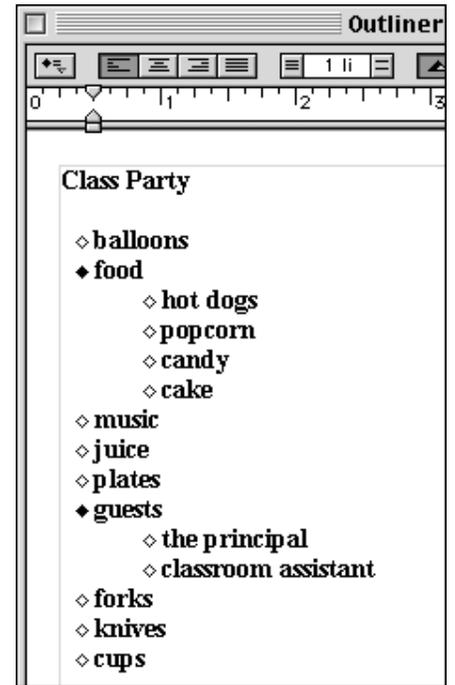


Figure 4. Students begin to develop greater understanding of hierarchy and categorization.

the details better in some structured fashion.

Indeed, up to this point, you could do all of this without a computer. Simply explain, however, that they are learning some basic outlining skills that will serve them well in a more complicated task.

As you can see in Figure 6, you can collapse the categories so that you can see just the main headings. This removes the clutter of the details and is an important generalizable understanding that students may use in other areas. For example, students need to learn to skim effectively. They need to be able to differentiate the significant from the detail. Working with outliners will give them a more complete understanding of headings, subheadings and body text. This will be useful when reading complex documents. Consider also that one of the challenges when learning new and difficult subject matter is to be able to distill out the main ideas. Working with outliners assists them in focusing on distinguishing the main ideas from the supporting ideas. Be explicit with your students in helping them bridge this transfer gap.

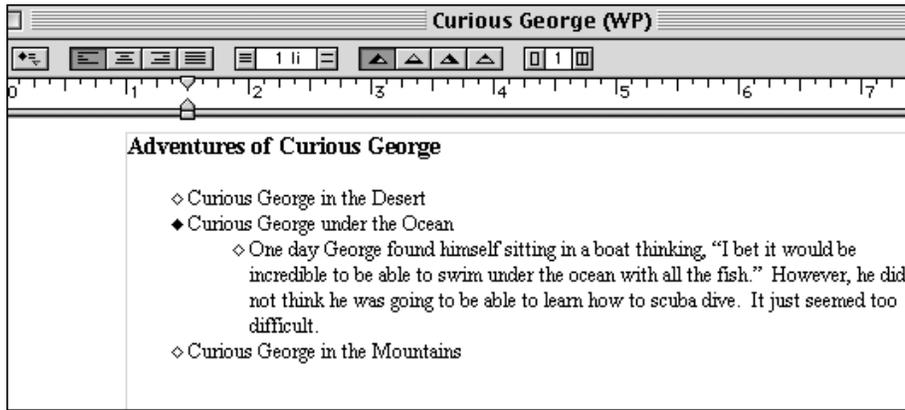


Figure 7. The outliner allows students to capture main and supporting ideas at the same time.

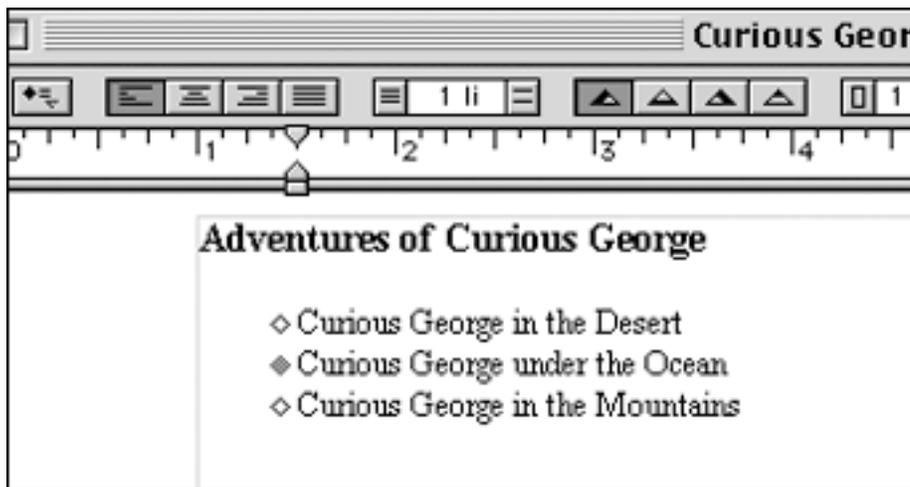


Figure 8. Colored bullets allow students to understand organization at a glance.

2. Writing a Chapter Book. As a Grade 2/3 teacher, I asked my students to write daily journal entries. I did this in a fairly traditional way. The students were simply required to spend some private time writing about whatever they wanted. Over a period of time, I noticed that their journal entries were becoming shorter and shorter. The kids had clearly lost their motivation. I could have altered the journal writing experience in a number of ways, but I decided to radically increase my writing expectations by having them write chapter books.

Imagine a girl is writing a chapter book. Typically she would use a bottom-up approach and simply start writing without necessarily planning where she was going. Or, she could take a top-down approach in which the chapters and general outline are

generated in advance of any writing of the body. Outliners can accommodate both of these styles or approaches and everything in between as well. In fact, they allow students to opportunistically move back and forth across approaches as need be as in the following Curious George example.

She may start out by thinking, "Okay, I want to write a story about Curious George traveling to all sorts of places. I will make a separate chapter for each adventure. Now, let me see ... where might he travel?"

And so, using the outliner, she decides to generate the chapter headings

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first. But, as she is doing so, she has an idea for her chapter on Curious George under the Ocean. So with ease, she is able to jot down her words before they escape her mind (Figure 7). Now, although this example is short, it illustrates how one can collapse the outline to show just the headings. This is important because sometimes the text can get so lengthy, and the students can get so caught up in the details, that they lose the overall structure.

With the double-click of a mouse, the student can return to the "top" view and reorient herself with the bigger picture (Figure 8). Text subsumed by a heading is indicated in some way. In this case, the diamond-shaped bullet is solid. It is black when expanded and gray when collapsed. I believe this to be a powerful mental model for students.

Conclusion

These are but two basic examples of software tools that provide students with a mental model—a model that is durable and independent of the computer. It is what Salomon would call a *residual effect* (1992).

One example of this residual effect became evident after the students' experience with "bug collecting" during their time with Logo. They had learned that identifying problems in their Logo code meant that they had mistakes, or bugs, in their thinking. Of course, actively seeking bugs was a necessary component to getting the program to do what they wanted. Bug seeking naturally evolved into bug collecting. Every time a bug was solved, the kids squished it—metaphorically, of course! The class had built a large papier maché turtle, and one of the students suggested that perhaps when a bug was solved it could be fed to the turtle in-

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I believe it is important to maximize the opportunity for the acquisition of these skills as your students are using computers. Do not leave it solely to the use of the computer. Be explicit in building the bridge—in making the connection of this skill to other domains. Discuss them in class. Have students describe other situations where these skills might be used.

In fact, take it one step further. Ask your students to think of particular uses of computers that give them generalizable skills. In this way, you are empowering them to take more responsibility for their own learning.

Resources

eJournal: www.aurbach.com/eJournal.html
 Journal Zone: www.journalzone.net
 Logo (all versions): <http://el.www.media.mit.edu/groups/logo-foundation/>
 Logo Computer Systems Inc.: www.microworlds.com

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