School Squeaking

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Teacher Talk

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Memories
What do you remember learning in school? This question usually elicits a variety of responses, depending on the educational system each of us attended. Many people I have asked this question of talk about projects they designed and built, or experiments they conducted. All related how interested they were in the topic and that they were allowed to pursue their interest. Most people comment on the inordinate amount of time they spent on the project, the resources and people they had to contact for expertise, the depth of their understanding in the topic area, the extensive planning involved, and the problems and frustrations they endured. Yet the excitement of those all too few experiences stayed with them and shaped their learning and widened their view of the world.

Most people remember projects, science fairs or experiments that involved some kind of active learning. Few remember with any relish at all times spent working alone on a ditto sheet of math problems. Usually the math problems were the follow-up to a math lesson, which introduced rules and algorithms without any real understanding of the math involved. The light has to go on for the learning to be productive. The light can't go on unless the learner is involved and active in his or her own learning. The first situation creates passive learners, who sit waiting for the expert, the teacher to open their head and pour in knowledge. But knowledge is constructed, just like a building, one block at a time. You can't put the roof on until the foundation and the walls have gone up. Learning is the same. Kids may be able to memorize math algorithms without understanding them, but sooner or later it catches up with them in some way. They may not later be able to understand more advanced math because the foundations have not been laid. They may go through advanced math, but when asked simple questions about understanding and making connections between the big ideas, they are lost. Richard Feynman, once walked into a very prestigious university, asked advanced physics students easy questions about connections with real-world phenomena. He was surprised to learn that most of these advanced students were not able to make the connections. With all of their formal training, the advanced physics students had been taught without gaining understanding. Although they could quote and work out complex problems through the rules and algorithms they had been taught, they could not make the connections necessary to solve problems. This kind of connection making and problem solving comes from thinking dexterity, or flexibility in solving problems in different ways, or creativity.

Doing the Same Things Differently
All the elements mentioned (personal interest in topic, expert sources, planning, time, depth of learning, communication with others, problem solving), are present in progressive school settings and project based educational environments which are student centered and constructionist in nature. Classrooms that empower children to plan, design, and build personally meaningful projects engage children in ways that motivate students to spend inordinate (and by traditional educational standards, fairly unusual) amounts of

time mastering difficult skills. Much technology use in classrooms is limited to presentation of already learned information, using presentation systems like HyperStudio and PowerPoint presentations, or assisting research for these "term papers" on computers. These programs allow students to present their findings and their completed learning on the computer instead of on paper. In this way, we are reproducing the old instructional paradigm with the new powerful technology. Instead, we can use computers in a new way to do something different, instead of doing the same things differently.

Doing Different Things

Computers can be utilized to help create technological educational environments that take advantage of computer interactivity to enhance learning. Tool programs allow students to learn while working on the computer, versus just presenting their research via computer. These programs use the computer as a tool for learning, instead of mimicking past educational practices for instruction and learning, and then using the computer as the presentation system. Students create their own learning environment and manipulate it to understand it more deeply.

I've just been introduced to Squeak in March of 2001. However, I have many years experience using Microworlds Logo, an iteration of Logo developed by a team from MIT with Seymour Papert, and Cocoa, which was originally developed at Apple as open source, but was later sold to become a commercial venture, Stagecast Creator. My experience using these programs in classrooms has resulted in students constructing simulations of complex, high level, conceptual understandings of science phenomena. Students have been involved, motivated, developed collaborative skills, and have built simulations such as ocean ecosystems, neurons, and planetary systems. Because these programs have been integral elements in my classroom environment, and exemplified deep conceptual learning, I was open to explore Squeak.

Squeak Can Do Different Things

Squeak can serve students and teachers as a powerful tool to amplify learning. Kids can construct their own deep understanding of big ideas as they interact with objects in Squeak. Although I am a neophyte Squeak programmer myself, the more I discover about objects in squeak, the media available within the program, the ease of construction of representations, the more excited I become about Squeak's possibilities in classroom settings.

Students can interact almost immediately with Squeak by learning a few commands. This immediate interactivity allows students to manipulate simple objects using many different media, including graphics, sound, music, motion, and books. The power and ease of making something move is innately motivating. Students see each other's work and begin to collaborate with "How did you get it to do that?" They start to problem solve to create new object behaviors. In a classroom, an experienced teacher can take advantage of learning opportunities to point out observable phenomena and ask pertinent questions to stimulate students thinking and problem solving. Observing the headings when an object, a car, for example is moving creates a sense of unease when students can't immediately explain the relationships between the heading and the car. Classroom discourse encourages creation of hypothesis. Students debate and discuss deeply their ideas, then are able to go back into Squeak to test out immediately. In the hands of a skilled teacher, Squeak offers tremendous opportunity to explore big, complex ideas in mathematics and science, and to explore these ideas fully in ways that encourage a real, visceral understanding of the concept.

Spring 2001

In April and May 2001, I introduced Squeak to my sixth grade classes. One observation I have about introducing Squeak is regarding the comfort level with a new technology. The students I had for three years had used Logo in design projects in science about three times a year. The students new to my class first used Logo in the fall of 2000, and had been introduced to several other technology applications that were new to them. The old-timers seemed to have more comfort in the new setting with Squeak. They seem to have a higher threshold for working through problems, intuiting the new platform, and a higher frustration level. They were more apt to be able to "mess around" to borrow the phrase from Mr. Toad. The new timers seemed to want more direction and input and were a bit less comfortable at first in trying to make something work. They seemed a bit less willing to play with the numbers to see what happened, for example, when they changed the ratios on the wheel heading. The new-timers seemed more likely to want to get the car driving, and then sit with a working "finished" product instead of experimenting with the possibilities. The old-timers, on the other hand, have opened up all the menus, and pulled several items out of the toolbox to play with and explore what happens. Several of the old-timers worked quickly to successfully controlling the car and having the car drive itself on the track. Then, they wanted new challenges, and were motivated were willing to help other students, and to begin real "meson" around" with Squeak. One of them quickly programmed a superman game with a comet, where Superman intercepts the comet.

The differences I observed in the short time with Squeak illustrate the powerful influence of a continuing, evolving classroom culture of inquiry and curiosity about how the world works. Squeak can serve as the tool through which this curiosity is nurtured and encouraged. The more students are exposed to real problems, such as they encounter in an open ended technological learning environment like Squeak, they refine their problem solving skills and their ability to reason logically and fluently explain their thinking. Student frustration index rises as they become more used to applying their ideas to behaviors of objects on the screen and testing and sharing their results. Confidence in their abilities increases, as their success as programmers feeds the circle of motivation to do more. Teacher intervention in posing questions and observing connections extends Squeak's effect as a powerful amplifier of learning.

I have found that having a brief demonstration that allows students to get working on a new task, then adding pieces as students successfully find ways to continue working, helps most to be successful quickly and minimize frustration. For example, the classroom culture allows for quick bits of input. A signal is given to which students are used to responding, they stop and focus for a brief minute while new information is shared, usually by students who have mastered a new task or difficult problem, and they are off to work again. Since students know that the interruption is very brief, and it is introduced quickly as information they may need just about now, or in a very few minutes, they do focus and then go back to work to try to apply the new information. If they're given too much at the beginning, and they are not yet using it, the information is usually lost and they will again need that information individually if they do not intuit it themselves. This seems to be especially true of the students who do not have as much experience working with simulation tools. Their more extensive background in working with simulation tools seemed to offer the old-timers a stronger context for intuiting the new program nuts and bolts.

Although I paired the students, or had them in threes on computers, old-timers saw the value in being the only one at the computer, and always jumped at that opportunity when available. When that opportunity was presented to new-timers, many of them lamented, "I couldn't work alone, I don't know this yet". The new timers seem to be more hesitant to "mess around" especially on their own. The old timers seem willing to experiment in pairs or a group, readily using the group input to extend their manipulative abilities, and yet, to relish on their own time too. I think these observations, although informal, speak to the benefits of a whole-school community becoming involved in using tool technologies. Since girls and boys are equally well enucleated into the classroom culture when there is an apprenticeship model in a two-grade classroom, I have not seen gender differences in the past several years in ability to learn new technology or willingness to do so. However, this spring, when introducing Squeak, the old timer girls have been absorbed by learning something new, and are not yet available as mentors and models of technological competence. Since they are not competent yet in Squeak, they don't offer that model of "you can get there too" to the other girls. This just reminds me that often the models that are chosen in schools to first be introduced to new technologies, and to serve as mentors to others as they gain confidence, are often the boys. Just a reminder that we need to spend time assisting girls to the competent mentor level, not only for their own competence, but to be a powerful model to other girls as they learn.

Big Ideas

The reason for using Squeak, or any simulation tool, is to over time develop through design and experimentation your understanding of how principles work through your manipulation of Squeak. As your ability in Squeak grows, you get better at understanding various principles and beginning to solve and visualize problems and concepts. These problems should not just be calculation problems; they should be authentic problems to be solved so that something works better. The idea of using gear ratios to make the car drive better is an example. One must have an understanding of how the concept of gears is applied to the problem. By experimenting with different ratios, and likening it to the kid's world using bicycles and gears climbing a hill, students develop visceral understandings of big concepts. The problem that they can't control the car is an authentic problem within Squeak. Driving the car successfully is motivating. Solving the problem becomes important the students. It is not a problem posed by the teacher of just using Squeak to create artificial data sets to solve problems with no real world interest. Solving the problems must require students to make decisions, make choices and test out their hypothesis to solve the problem.

Sixth Grade Student Feedback: Fall 2001
Sixth graders in my class this year have been using Squeak for about a month. We talk a lot about possibilities and ways to use Squeak. We've explored building cars, headings, driving the cars, making a steering wheel drive the car, discovering gears and their relationship to the ease or difficulty of controlling the car, and making robot cars to follow a maze. Discourse is an important part of understanding your learning and your learning environment, so we share a lot with each other about what we do and how we do it. Some of my present sixth graders were with me in fourth grade, and built several Logo simulations. We've discussed using Squeak in some of the ways we've used Logo in the past, as well as looking at all the math we've learned with Squeak so far. I thought I would get their feedback on why they like Squeak and think Squeak should be in classrooms. Here are some of their thoughts:

"I think Squeak is good. It's not just like learning about the brain, you're learning not just about the frontal lobe, but you can build the lobe and make it work. You just get inside what's going on because you're doing it at the same time." (This student had experience building simulations with logo.)

"You are so eager to get your car driving that you know the facts of what to do, so you can have fun driving your car. You're making an opportunity for yourself to express your creativity through math and science."

"Squeak is really fun because you're having fun, but you're learning math at the same time. Some people think I'll put in 53 as a heading, and then you think, " what's 53 times 2?" And you get 106. You don't know what will happen, but you try it and see. You're just doing math and you're having fun like that."

"Sometimes people can say that math or science can be boring. You go on Squeak, and you realize that making cars turn, you have learned things that you thought might be boring, it has become fun, as opposed to just memorizing, it s playing our way to learning."

"People just say 1+1=2, remember that. If they say, you turn a 90 degree angle, it's this, but you go on Squeak and you type it in and you see your car turn, you learn it, you don't forget it."

Home Use
At UES, we are fortunate to have administration and resources which value students having computer access at home. Students without home computers are offered older computers when the school buys new computers in order to help encourage use at home. The vast majority of my students now have computers at home, and by Thanksgiving all will have this access. They have been encouraged to download Squeak from the internet. Those that have trouble downloading, or do not have internet access, have been given a Squeak CD to take home to install the program. Having Squeak at home has extended school learning time. Now students can work on Squeak with teacher intervention at school and continue at home with the benefit of focused play and observation.

Future of Squeak in Education

Following Logo, there were other software products: all constructivist tools (enabling children to construct and reconstruct their understandings of the workings of the world--Boxer, Cocoa, and now Squeak! However, the revolution never caught on completely. Why? This is the question we need to reconcile. We now have Squeak--combining the best of smalltalk, alice, starlogo, logo computing ideas, on an internet, multi platform basis, available to all who can access the internet. Swikis provide the platform that enables projects to be published, used and changed, and republished. Children and adults become users and creators of intellectual property available in the public domain.

The ideas incorporated into Squeak make it easier to use-object oriented programming. Users have the ability to share ideas on the web with other students, with experts. Users get clearer concept understandings by mediating projects with the world instead of just turning it into the teacher. (Often students in traditional settings don't even view each other's projects) Squeak allows immediate publication to the world via the internet, and the building and manipulating of interactive simulations and animations. This publication ability will eventually enable students to interface with experts and other students globally. Student publishing work creates a forum for intellectual discussion of their ideas and processes. Here, they will need to defend and change their ideas as the occasion arises.

How can we make the revolution happen in classrooms all over? How can we get classrooms to use the computer as a tool to amplify learning, rather than just word process or present? How can the computer become the tool to enhance learning?

We need classrooms wherein children are encouraged and taught to think, to plan, to process, to problem solve. Although this sounds simple it is not, and in many cases it is not happening. It is possible and probable that many students are going through schools, passing tests, getting decent grades, but not learning to learn or learning to think. They do learn to memorize and regurgitate, but not deconstruct and construct their own understandings. Then how are they prepared for the world? How can they interact in teams and in communities as they grow? If they are lucky, they learn some of these skills at home, through an exceptional teacher, or through a mentor they have been lucky enough to know.

How can we free students to learn and think? How can we free teachers to facilitate student learning and understanding, rather than regurgitation or just test taking?

Squeak may have some answers. If Squeak catches on with students, and teachers become comfortable facilitating learning in an environment in which students can learn concepts by playing and manipulating variables in Squeak, perhaps it can be a useful tool helping to form the new paradigm for education. It is in this new paradigm that students become active, not passive learners. They learn to create and build their own understandings of the world, facilitated by an opportunistic teacher who can utilize learning opportunities to point out powerful connections, question, mediate classroom discourse and nurture the development of curious thinkers and problem solvers of the future.

Squeak is a tool to amplify learning. Squeaking in classrooms may have an impact on the school memories of this generation. Will they remember building a maze and successfully programming their car to drive through it? Will they remember getting the car to drive more easily with a steering wheel after experimenting with several different ratios and immediately seeing the results? Will they be comfortable manipulating powerful ideas and changing variables to explore new possibilities? And these are just the getting acquainted with Squeak ideas. What memories, and thus deep learning and understanding, can we create when we really get "inside what's going on"?