The Wheeler Group -- CS92, Brown University
Revised Project Description -- February 24, 1998

Sarah Faulkner
Robert George
Emmanuel Schanzer
Chi-wang Yang

What We're Covering

Initially, the subjects Dorothy wanted to cover were Matter, Cells, and the Human Body. We've decided to focus just on Matter, as it was her first choice. If we for some reason find ourselves with extra time, we plan to move onto Cells and the Human Body, in that order.

We are very blessed in that she already has a set science curriculum that she teaches. We have access to her teaching notes, worksheet exercises, and most importantly, their textbook. Topics we will cover are matter, physical and chemical changes, mixtures, elements, compounds, and atoms.

Hardware Availability

Wheeler has something to the tune of 5 computer labs. Each of which has enough computers for a full class of students. The lab we were in had all Mac LCIII's and 75MHz Power PC's with 8 megs of RAM and only about 27 megs of hard drive space left free. None of them had CD-ROMs, but, all of them were networked and had connections to the internet (as will be the next ones). By the time our software has been implemented, the lab will be filled with all 120 MHz and above Mac Power PC's and high end Quadras, each with 12-16 Megs of RAM and "plenty" of free hard drive space (more than 200 megs free a piece). Also worth noting is the fact that there is no problem with students printing and they may do so freely and each student has their own space on the server (10 Megs a piece is what we were told).

With regards to the web, faculty must log people on to the web. All the cabling for web access is ethernet cabling (10BaseT) and the school has a T1 connection to the net. All machines are using Netscape 3.0; we have gathered that this will be changing to 4.0 very soon. We were considering having links to the web for "internet scavenger hunts," but that introduces a whole host of problems (stability of dynamic content, finding appropriate sites, dependence on connection to internet).

General Design Idea

Our program's broadest function is to present lessons to review and reinforce concepts. The review portion will include a presentation of concepts mixed in with interactive exercises. The reinforce portion will comprise of similar interactive exercises, but will more of a drilling theme. It's important here remember that Dorothy is asking for a review, not strictly an assessment tool, so we will provide support for kids who don't seem to understand concepts.

Even within the book Dorothy uses, she mixes and matches the lessons, teaching in sequence that she finds the most beneficial. We want our program to flexible so that she also can be flexible with what specifically is in a lesson. To do this, we plan to go through the textbook and classify everything into Concepts. Concepts are what we think to be individual "stand-alone" ideas. For example, instead of "Phase Changes," we will further section that into "Gasses to Solids", and "Solids to Liquids." Through a front end to a central database we create for her, Dorothy could hand pick what Concepts she wanted to review, and group them into one Lesson. Then each student's

stand-alone program will read in that database over the network and cover only appropriate topics.

After students complete the Lesson, they will get a print out of how they did and, based upon their results, the print out will also recommend areas to focus on when they study. They will get a tangible Journal (feedback sheet) that they could use as a study guide, show off to their parents, etc. Statistics on individual student performance would also be written back to the central database, so Dorothy could not only assess each child's performance, but also see if as a class there were areas of weakness that she should further address. By doing this we're hoping to reduce the burden of worksheets, for both the student and the teacher.

The Big Picture

In order to get a better sense of how we should design our software for her classroom, we asked Dorothy how she felt about technology in education, and what role she saw computers as having in the classroom. Her answers were surprising pragmatic, which reminded me that in CS92 (and in the greater software industry) we are off the hook, in the sense that we discuss high level educational issues but don't necessarily know what it's like to actually manage a classroom full of kids.

Even being in the sciences, Dorothy said that computer aided instruction, which is the category we see ourselves fitting into, is rarely (if at all) used at Wheeler. This is understandable, given Wheeler's disposition. Being a private school with small class sizes and ample facilities, Wheeler probably has no strong need for such tools.

An area where she said they did use computers as an educational tool was in visualization of information, specifically more abstract information. She mentioned hardware that could project a computer display onto a screen, allowing them to analyze data from various chemical reactions. While we easily see ourselves addressing that need through use of animation / video to show things that the students normally can't observe in class, i.e. volatile chemical reactions, there does seem to be potential benefit for individualized, self-paced review and reinforcement in Dorothy's curriculum.

A specific niche is in exam preparation. In a class period that we observed, they were reviewing for an upcoming quiz. This consisted of Dorothy going over which concepts would be on the quiz, what resources cover these topics, and examples of questions. This mass review was not specific to what each student needed the most review in. There isn't time or resources to individually cover each topic with each child. We think this is the weakness in the one teacher, one hour, twenty student classroom model we hope to address.

Dorothy sees our software being used roughly once a month. Because she is open to technology and its potential, our ultimate goal is that our product will be flexible and enjoyable enough to encourage more frequent use by her and her students. Also, being a tool aimed at exam preparation, empirical studies of exams could be particularly relevant in determining success.

Experience for Students:

The experience we hope the 7th grade students at Wheeler will have in using our program is one of progress, accomplishment, confidence and excitement.

(Progress and Accomplishment are similar, but differ in the time spans they cover)

Progress: As students move through the drilling section on each unit, we want them to feel like they've started at one place, and ended at another. We have discussed two

ways of accomplishing this graphically. One would be to have an initially empty picture, or a picture will parts of it missing. As students move through the exercises they will encounter other pieces of this picture. By the end they will have accumulated enough mini-pictures to complete the larger one. We have yet to decide the details as to whether or not they will be able to add the pieces to the puzzle as they find them, or if they will have to wait until they answer all of the questions. A variation on this theme would be an analogy of a walking down a hallway. Starting with the entire hallway ahead of them, students would progress down it as they answered questions. Perhaps they would need keys (that they would find as they answered questions) to open doors. In order for this to be effective, this option involves our allowing them to see their progress at any time during the drill. Although this approach is more consistent with our intent, we may run into trouble with students getting distracted from the primary goal of getting through the exercises.

Accomplishment: Members of our group remember the workbooks of seventh grade with all of the many pages they contained. We all agree that we felt a sense of accomplishment when, towards the end of the year, we could flip through and see all of the pages we had completed. We want students to be able to feel something similar related to our program. Sticking to the idea behind workbooks, we have discussed with Dorothy the possibility of the students keeping folders of their work. Students have full access to the printers so they would be able to print out items they encountered that they find to be interesting. The folders could serve as review material themselves, or just as a scrapbook of their year in seventh grade science. Another related approach would be for the students to make "mini-books," a book made from one sheet of paper that is folded in such a way to produce a small 8 page book. Students have experience making these books for other topics, and could add a min-book on the atom to their collection.

Confidence: We hope that the students will leave the computer at the end of the drill and feel more confident than when they started. Because they would normally be using this drill before tests, we want to give students a "read-out" of their success. They would be informed of the sections that they did very well on, but also the sections they should focus on before the test. We want the students to know that this program is for them, and that one of its goals is to guide their studying towards their weaker areas.

Excitement: Because of the resources and time allocated for 7th grade science, students are unable to see some of the exciting, but potentially dangerous, chemical reactions. For instance, the infamous sodium in water demonstration is only described. Through the use of video, we intend to bring these demonstrations to the students. This will be where we really set our program apart from other activities the students do. Because Dorothy (?) only intends to use our program during one period out of every month, we want to lure students in during their "skills"* time to use the program. We intend to stimulate students' senses with video and sound in the hopes that they will want to use the program more.

*Skills time is a block of time worked into the Wheeler schedule during which students are able to choose their learning activity.

Strategy

Given the roughly 9 weeks to implement this project, our first objective was to create a timeline, to set goals and dates for ourselves. Having already spent some time with the teacher, Dorothy Garfield, and visited the class, several goals were established, and this timeline will serve as a basis by which we will achieve these goals. Throughout the process, we will document our steps, thoughts, and progress.

After defining these possibilities, we sat down and considered the various educational values and theories we wanted to meet. From there, we enter the first major section of the timeline...

Timeline:

------DESIGN (3 Weeks)

During this stage, our group discussed a variety of topics, ranging from technical constraints to interface design and target audience. Several issues that have already arisen include the importance of flexible database access through our authoring tool, and the UI. We decided that it would be important for the program to have a question database that the teacher can update, as well as a database of student records. Dorothy could, for example, pull up a list of the day's progress, and instantly evaluate how each student was faring. The program would make it easy to see which sections were giving students trouble, and which students would need the most help. She could also search for an individual student, and chart his progress through the semester.

The user interface also became an issue. The different manner in which boys and girls approach software and science became a concern here, and we set a goal to make the interface offer something for both.

By the end of this stage, we should have a fairly comprehensive outline of our program, as well as storyboards. From there, we progress to....

------CODING (4 Weeks)

This stage should be the easiest, but will probably take up the most time. Because our plan will already be laid out from the prior stage, we will code directly from our outline/storyboard. The question architecture will be defined, as will the interface.

The questions themselves will not just be multiple choice. The drill questions will be combination of fairly static multiple choice and free-answer questions, but the exploration phase will have some fairly abstract exercises. Students will have access to hints in the drill section, and will be offered an explanation when they get a question wrong. The exercises will be more open-ended, as discussed in the design phase.

This stage will interleave with the final stage, as we will need to adjust our program to student feedback, and incorporate successful strategies into other lessons.

------TESTING/REFINEMENT (2 Weeks)

In this phase, we will bring our program to the class, and ask students to try parts of it. Their ability to understand the concepts, as well as the interface, will be important. Especially important will be how they react to the open-ended questions in the exploration phase. An open-ended question allows for a much larger range of user responses, and we want to allow this while maintaining a degree of clarity as to the point of the exercise.

We will also work with Dorothy to make the database as easy as possible for her. She will undoubtedly want one-click access to student records, and her phrasing of questions will be especially important. We are already collecting a large volume of her notes, lesson plans, and tests to give us an idea of how she does this.

After logging the responses, we will revise the program, and bring it back for another round of testing. This will be done as often as time allows. We will also try to address the hardware changes that the class will experience in the following year, by adjusting the program to make use of any new features, while keeping pace with older hardware used today.