Chickscope: An Innovative World Wide Laboratory for K-12 Classrooms

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"This project involved my students in an area of technology that few high school students have a chance to experience. They learned the possibilities of interactive technology while learning about MRI imaging and fetal development."

High School Teacher

"My students gained knowledge about embryonic development and MRI. They learned new skills in using the World Wide Web and e-mail. My students also felt as though they were a community of learners playing an integral role in a project. They felt like respected people who were given control of an expensive machine."

Middle School Teacher

"My children are constantly involved in discovery learning, always questioning where things come from, what makes things work, etc. Being able to look inside an egg was a wonderful way to learn about life cycles and what goes on inside."

Primary School Teacher

"The children were thrilled to watch the images appear as they manipulated the MRI from our classroom. We watched in wonder as we viewed the pictures of the chick's development inside the egg, and candled our own eggs to see if we could find those same characteristics developing."

Primary School Teacher

Spring 1996 Chickscope: The Beginning

In the spring of 1996, 10 classrooms ranging from kindergarten through high school participated in Chickscope, a collaborative 21-day chick embryology project initiated by the University of Illinois at Urbana-Champaign.

Each classroom was given fertilized eggs, incubators, and educational materials on egg science and candling, courtesy of the 4-H Cooperative Extension Program. At the same time each day, a fertilized egg was placed in a magnetic resonance imaging instrument at the Beckman Institute Magnetic Resonance Imaging Laboratory. Through an interactive Web site, students remotely controlled the MRI device to obtain images of the developing chick. The Web site was developed by the Beckman Institute Visualization Facility, the Magnetic Resonance Imaging Laboratory, and the National Center for Supercomputing Applications.

The classrooms acquired daily images of the egg and shared their observations, predictions, and questions via the WWW. Through the Chickscope Web site, they received educational material, daily reports of the development of the chick, and sample MRI images for the day.

The goal for the Chickscope project was not only to provide students and teachers with access to the MRI system over the Internet, but also to provide them with the supporting infrastructure that is usually reserved for scientists. We realized our goal when the students and teachers became part of the scientific community by sharing their learning exercises, observations, predictions, and questions.

Access to remote scientific instruments using basic Internet tools from the classrooms offers opportunities for K-12 students and teachers to participate in collaborative research and data analysis. We wanted to explore how this project could be integrated in K-12 classrooms in light of the current science education reform initiatives that recommend the use of the Internet for learning and teaching (e.g., Hunter, 1995; Linn, 1992).

Based on student and teacher feedback, the project was well received, particularly in lower grades, because this was the students' first introduction to doing science on the Internet for an extended period (e.g., at least 21 days). The most successful experiences occurred when teachers creatively included Chickscope in their daily lessons. Access to unique scientific resources and expertise provided the students with motivation for learning science and stimulated interest in the scientific enterprise. A surprising result of this project is the continuing use of the Web materials by the participating classrooms (as well as by classrooms that did not originally participate in the project, or had access to the MRI system remotely).

Lessons learned from the Chickscope project relating to the Internet include:

- Students were more involved in Chickscope when it was well integrated into the classroom curriculum plans. The teachers played a critical role in integrating both Web-based and non-Web-based activities into their curriculum.
- Students working in groups were able to share computers and limited MRI time effectively to do serious Internet-based science for an extended period.
- In spite of the complexity of the technology, students and teachers across K-12 grade levels and settings (public, private, home school, after-school science club) benefited.
- After the initial interactive Chickscope project came to a conclusion, the site remained a useful resource in the classroom, using the collected database of images from the original project. The remote instrumentation portion was not essential to the continued use of the site.

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The Chickscope 1.5 Development Team: Interdisciplinary Chicken Soup

The next step required further development of curriculum materials and content that would be well integrated into the classroom curriculum plans. To that end, we recruited the help of the teachers involved in the first phase of the Chickscope project to act as co-developers for the new Chickscope site. Students and teachers learned much about how to collect and analyze data, how to ask questions, and how to communicate their findings with others. They also had opportunities to interact with experts from several disciplines, such as MR imaging, developmental biology, curriculum and instruction, and computer science.

The new Chickscope site includes content and lessons for integrating image processing, biology, chemistry, and mathematics-related materials into the curriculum. Faculty from the College of Veterinary Medicine developed chick embryology units. Faculty from the College of Education developed staff development units and reviewed the design and implementation. The mathematics units were developed by faculty and students in the Mathematics Department at the University of Illinois, using the theme of the egg as a loose framework for presenting mathematical concepts of all types. Researchers from Arizona State University's Image Processing for Teachers program are developing units for image processing and image analysis based on the MRI data sets collected in the first Chickscope implementation. Researchers at the Beckman Institute developed chemistry and biology materials.

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Illinois Chickscope: Professional Development for Teachers
www.ed.uiuc.edu/facstaff/chip/Projects/Chickscope/ccc.html

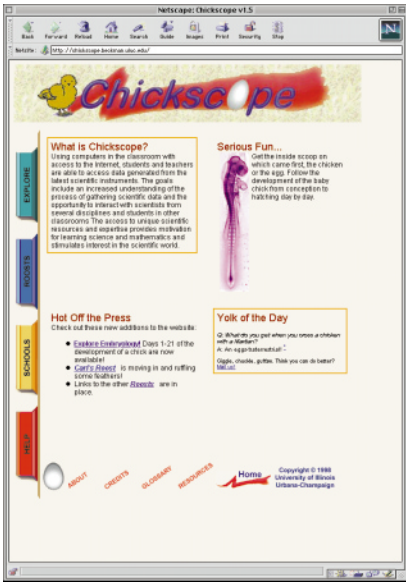
Early analyses tell us that Chickscope was successful in terms of immersing students and teachers in a small scientific community (Bruce et al., 1997). Although remote scientific instrumentation is today an exotic and expensive technology for schools, it is already part of the daily practice in research and industry (e.g., Kouzes et al., 1996). This suggests that K-12 students and teachers may need to learn more about this new technology for doing science, and that it is likely to become more commonplace and less costly in the future. This has happened with electronic mail, which is now part of everyday activity in many schools. The particular instruments and scientific domains may change, but understanding the principles underlying this mode of learning through projects like Chickscope should be generalizable to other domains involving new technologies.

The Illinois State Chickscope Proposal was funded by the Illinois State Board of Higher Education to support the participation of 30 Champaign County K-12 teachers in a professional development training program during the spring, summer, and fall semesters in 1998. The project hopes to demonstrate a capacity for sustainable systemic improvement in mathematics and science education. Participating teachers will actively collaborate with 120 pre-service teachers from the College of Education, and with faculty and staff members from several disciplines.
The Illinois State Chickscope project meets both recommendations for professional development as stated in the State Goals for Illinois Learning Technology (ISBE, 1997, p. 19):

- Develop knowledgeable educators to "establish a student-centered, technology-enriched learning environment."

- Require technology-enriched teacher preparation to "ensure that new teachers are prepared to take full advantage of the learning potential of technology."

Previous Chickscope evaluation has shown that it had a positive impact on teachers' ability to promote mathematics, science, and technology learning. As we expand to a county-wide implementation, it is crucial to evaluate what works and why in this proposed project. Specific evaluation questions will focus on the six objectives: What is required to scale up? Is collaboration among teachers, pre-service teachers, and scientists supported? How well does the information infrastructure work? Is there a useful clearinghouse for standards-based materials? Are teachers supported in inquiry-based teaching? Is the project sustainable?



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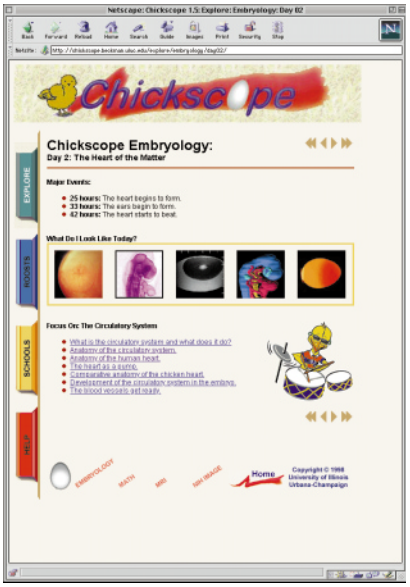
Chickscope 1.5 Revealed

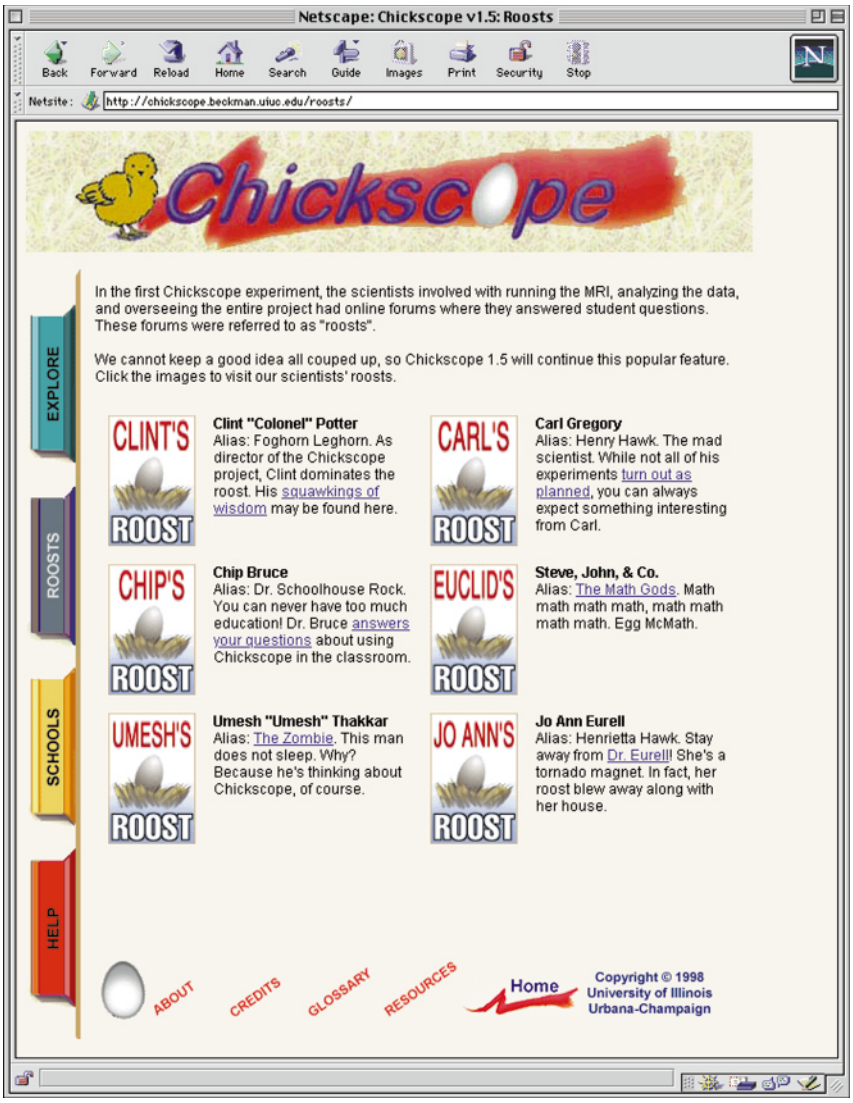
The Chickscope 1.5 Web site was designed to be an interactive web book, providing content and activities for K-12 students in various curricula. Along the left margin of every page are links that facilitate access to the major sections of the site. These sections ("Explore," "Roosts," "Schools," and "Help") are described in detail below. Along the bottom margin of every page are links to subsections or subunits that deal specifically with the major section visited.

The home page provides a brief overview of the project, the "Yolk of the Day" (a collection of the worst chicken jokes we could find), "Hot off the Press" (any new additions or changes), and "Serious Fun" (a brief description of an activity or interesting page). The page uses server-side technology to create a dynamic and engaging first impression of the Chickscope project. The "Yolk of the Day" and "Serious Fun" sections invoke two PERL scripts that randomly select and return jokes and activities, thereby changing the appearance of the home page upon each visit.



Explore: A Menu of Many Courses

Inside "Explore" one can read about several subunits. One subunit describes the Embryology unit, where students can access the development of the chick embryo day by day. Each day allows students to examine that stage of development in several modalities. Image icons representing these modalities allow the student to look at MRI images, colorful illustrations, images of candled eggs, histology sections, or 3D reconstructed volumetric renderings. Each mode is annotated and contains text related to the developmental stage or an explanation of how the image was acquired. Each day also focuses on a specific element of development and includes lessons or activities for the students. Other subunits include Math, an NIH image tutorial, a tutorial on biological imaging, and an image processing unit developed by the Image Processing for Teachers group at the University of Arizona. The Egg Math pages include Java applets explaining math concepts and exercises to do in class. Topics such as the "ham sandwich theorem" and "egg calculus" engage students in leaning math concepts. Along the bottom of the page are links to these units.



Roosts: Where Inquiring Minds Ought to Go

The roosts provide a venue for the students to communicate with the researchers. Students can email individual researchers at their roosts and ask questions or exchange ideas. Each senior researcher associated with the project supported a Web page for their area of expertise, such as Carl's Roost, which was developed by Carl Gregory, an MRI specialist. Frequently, these roosts were loosely constructed pages put together by the scientists involved with the project. For Chickscope 1.5, many of the roosts became the basis for activities and lessons found in the Explore section. The roosts are used to document project results and respond to students and teachers. Annotated images with notes on the daily growth of the chick are also recorded here.

Schools: The Roots of the Project

The Schools section provides a place for each school to publish its own Web page to report progress in the project. Each school may publish a page providing information on individual experiments they may be attempting as well as contact information for other schools to communicate with them about their projects. This is the place for each participant to establish a unique ownership or presence in the project. Through links on this page, the teachers and the students can communicate with each other via HyperNews, a product from the National Center for Supercomputing Applications that allows teachers and students to post comments using a Web browser and gives greater flexibility in communicating.

Help: "I need somebody..."

The Help section provides online guidance with navigating the site and finding resources. The site includes downloadable software for several of the activities, and the help section covers some of the technical questions that might arise. These downloadable packages are located under the Resources section of the site. Help also provides information on how to use the database, how to use HyperNews, and where to find useful tools.

The Future of Chickscope

What started out as a proof of concept for a remote instrumentation project has become a critical survey of curriculum integration and information design for the K-12 classroom. Chickscope 1.5 opens avenues for many design elements and tools to be used as a framework for delivering content and curriculum to K-12 classrooms. What remains is to demonstrate that Chickscope can scale to a larger national community and to implement this style of delivery to other areas that nurture interdisciplinary study. Chickscope opens the door to bringing new tools and technology to support inquiry-based learning into the classroom via the World Wide Web.

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