The Academy of Electronic Media

VISION

Computers are now an integral part of our day-to-day regime and prevalent in all aspects of our society. Yet with all this available technology, we have only begun to scratch the surface of how we may harness the influence and power of the microprocessor. The development and use of engaging interactive electronic media which simultaneously stimulate multiple senses will revolutionize the way in which knowledge is garnered and technology is utilized at all levels—from young child to lifelong learner. We believe this revolution will be significantly accelerated by the Academy of Electronic Media (the Academy) which specializes in the creation of interactive multimedia, the development of new pedagogy for how they should be most effectively utilized, and the discovery of new technology to aid in the development, deployment and dissemination of these materials.

Traditional methods of delivering education and training no longer provide the insight necessary to be effective within the dynamic and interdisciplinary nature of today’s highly technical environment. For example, those responsible for product development now need to integrate the most current analytical, modeling, visualization and decision-making processes associated with real-world applications which are typically beyond the scope of most textbook, lecture and tutorial materials. New user interfaces and visualization technologies hold the promise for many to now grasp and utilize information and concepts that were once the domain of a select few. New collaborations will occur between those from differing backgrounds with greater resulting output due to an ability to provide a more uniform understanding of complex undertakings—such as with the development of a next generation of microprocessors. Increased use of interactive electronic multimedia will allow us to address these issues with greater hope of achieving success in shorter cycles, using learning technologies, web-based environments and interactive materials to aid those competing in an increasingly technical and global market.

Rensselaer is already one of the world’s leaders in developing and deploying new technologically-created learning environments. As a result of our long-term strategic investments and human commitment to learning technologies, we have chosen to make a major contribution to the way future students are educated and trained to apply their knowledge. It is, however, just the dawn of what we feel can be accomplished. Future progress in this arena is not dependent on vast capital resources but on a commitment among faculty and staff to develop, integrate and utilize the most effective materials and methods possible. Rensselaer’s integrated interdisciplinary approach to developing electronic media, deploying educational products and improving learning via the Academy is intended to generate an impact far beyond that which single-dimensional books or static web pages can accomplish. Our vision is to unleash the potential for the individual to feed at the information smorgasbord that the web offers by engaging the user as both a teacher and student at the same time. Individuals will no longer be restricted by the walls of a classroom, the bindings of a book, or the capabilities of a single lecturer or supervisor. The web has provided a
means for access to information at anytime, from anywhere. Our challenge is to entice and maintain interest by providing content that fuels a desire to “stay tuned”, similar to that which the long-running tv show “mash” once generated. The Academy intends to meet this challenge via the use of dynamic, multidimensional media that entices the user to dig deeper into materials to gain a more in-depth understanding of technical concepts and applications—while providing “playspaces” where one can assemble, test and assess virtual experiments to better grasp the underlying theory. The Academy sees the future as a time in which the only limit to what can be learned and utilized by an individual is exhaustion.

The Academy is a magnet for scholarly students, faculty/staff, and corporate partners to work together on a path that leads to extending the potential for learning far beyond our current understanding. It is a home for those who are just as excited by a new high performance cpu as a new killer 3d cad-modeling-visualization application, because of the new creative potential now capable of being explored in an interactive way. The Academy offers a community where both the creative and analytical feel equally involved, while additionally serving as a national resource to facilitate the utilization of multimedia and offer the guidance necessary to allow content providers to produce innovative and engaging materials. We welcome corporate partners, K-12 systems, and other universities who share our vision and are interested in adopting, adapting, and using the materials, approaches and technologies developed.
**GOALS**

All my life I've felt obliged to teach anyone who would listen. I've always believed you don't truly know something yourself until you can take it from your mind and put it in someone else's. I also know that the only way we continue to live on this earth is by giving our talents to the younger generation.

~Milt Hinton (Jazz Bassist, Historian)

The Academy's goal is to aid in the development and utilization of multimedia materials specifically tailored to technical education and the application of science, and demonstrate their effectiveness in academic, industrial and commercial environments. Compelling interactive learning modules; design/analysis/modeling tools; challenging simulation exercises and games; tutorials and case studies; and new avenues for learning will be developed to allow users to explore science and technology. We intend to utilize these in a combination of high school, undergraduate and graduate level curricula and corporate training programs. With today's web access available from anywhere at anytime, the Academy will allow users to further explore materials from basic concepts to engineering solutions whenever needed in their self-directed, life-long educational pursuits. The figure below represents the activities and sequential cyclical modality in which the Academy's activities are conducted.

![Academy goals & activities flow representation](image)

The development activity is informed by research in cognitive theory around the broad topic of how people learn. The modules are applied, tested, and evaluated in a range of settings from k-12 classrooms to undergraduate studio learning environments, corporate training, and skills development. The Academy deployment involves both the use of technologies and methods for teaching the students and teachers to effectively integrate new materials and educational practices. The three zones of Academy activity: cognitive research, development, and deployment work together through intense collaborations at every level and by the tightly woven cycles of feedback among the three areas. A common goal influencing all three areas is to change the Web from its current
use based on the tv mentality of channel-surfing to passively obtain content, to a means of engaging the learner (in an active mode) to further explore a subject at deeper and deeper levels. The specific goals of the Academy are embodied in the following ongoing activities in each of the three zones.

Cognition:
Under the broad goal of understanding about how people learn, the Academy seeks answers to the following questions:

1. What are the effects of presenting material combining and stimulating two or more sensory modalities, in a variety of combinations? Visual, aural, and kinesthetic modes are explored using combinations of graphics, color, and dimensionality; types and speeds of motion; interactions involving moving and recombining elements in a simulation space or drawing. Design of a module involves many viewpoints—the teacher, the artist, the psychologist, the programmer—all contributing ideas. The Academy fosters multidisciplinary collaborations between those from various departments, schools and organizations, who offer different approaches to material generation and problem solving. It is from this rich mosaic that the most creative, stimulating and engaging materials evolve.

2. Can learner involvement and comprehension be increased using progressive levels of presentation of the materials? Beginning with a view “from 30,000 feet,” which introduces the subject (such as electrical circuits) contextually through real-life applications familiar to the learners (e.g. electric guitars), can we entice them by developing their interest, curiosity, and response to challenge to pursue the more abstract theoretical underpinnings of the subject?

3. Can we utilize the tendency of the technically inclined (to first dive into a using a piece of equipment without initially reading the instructions) to creatively combine things from materials at hand by providing highly interactive “playspaces” such as simulated circuits with interchangeable components, variable values, and real-time graphics illustrating the results? Will trial and error testing, wild guesses, and play enable learners to discover relationships between elements and motivate them to seek more theory to be able to better control their results?

4. What kind of knowledge are we testing for when we test a learner? How can the learner best be supported by “automatically” being provided with information that is based upon their interactions with the material(s)?

Development:
Under the broad goal of designing and producing compelling, highly interactive, multisensory learning modules, the Academy experiments with a full palette of current and emerging technologies from QuickTime Virtual Reality (qtvr) exploratory environments to 3d worlds, from highly interactive animations to programs that generate sounds “on the fly” in response to user changes in a circuit design. Development pushes current technologies to their edge and beyond, creating new tools for existing multimedia authoring programs, and unique applications of existing programs. Development sets a high priority on cost-effectiveness in both the means needed for production and in consideration of practical realities of the resources of the end-users in schools or on the Web. The Academy relies on the intellectual capital and high levels of
Creativity among team members ahead of dependency on high-end equipment to get the job done. One form of cost-effectiveness is to design tools to eliminate “non-value-added” activities, such as the grading of tests by teachers, thus freeing their time for more student contact, their own learning, and/or curriculum development. A “playspace mentality” in the lab encourages invention of increasingly imaginative interactive simulations and fluid ad-hoc collaborations. Rapid feedback from users, even prior to formal testing and evaluation, allows changes—adding and discarding, implementing an idea from a learner or teacher. The Academy is vitally interested in developing applications that not only stimulate the desire to learn but that respond in a sophisticated manner to the user’s behavior, recognizing increased interest (entries in electronic notepads, questions posed, time spent in an area, types of experimentation, quality of designs) by offering opportunities to access more advanced materials. Recognizing student difficulties (by testing, skimming, non-use) is of equal importance, and a responsive module can provide earlier, more fundamental materials on an easier gradient to remedy the difficulty.

Deployment:

The broad goal of this area is to provide cost-effective technology to enhance the access of learners to these new materials, and to “teach the teachers” new methods to enable them to integrate the new technologies into their current curricula and practice. One major project is the development of a new web architecture for use by educators to structure their own sets of modules tailored to their curriculum. Courses are being taught to math and science high school teachers in the design, development, and utilization of interactive multimedia materials. Discussion, involving several schools at Rensselaer, is underway about the creation of graduate programs in instructional technology. The audiences for current module production include a high school AP calculus class; undergraduate studio classes in Electronics and Instrumentation, Circuits, and Signals and Systems; a simulation of the cycle of product design for corporate training at Boeing; and skills training modules for teaching electronics manufacturing.
BENEFITS

The Academy involves interdisciplinary collaborative efforts that bring together faculty/staff members from four (out of the five) schools at Rensselaer, as well as researchers from other organizations already involved in aspects of studying and developing electronic media and computer based learning. These associates represent engineering, science, humanities and social science, and management who concentrate on electronic arts, literature, distance learning, virtual education, web design, human-computer interface design, multimedia design and development, computer-mediated communication and philosophy. The Academy fosters the opportunity for them to share breakthroughs and innovations in a very rich collaborative environment.

The Academy significantly extends Rensselaer's capacity to serve as a national resource and leader in the field, offering cognitive research, guidance, training, and tools, over the World Wide Web and through education and dissemination, to partners in K-12 schools, other universities, and corporations. Our vision and hope is that the Academy will significantly accelerate the understanding and modeling of cognition and its assistance by technology with the result of enriching and improving learning for the greater good. Finally, the Academy is responsible for envisioning and growing the best, most responsible self-sustaining future for learning technologies in concrete terms—and invests resources towards making that vision a reality.

Specific benefits of the Academy's current work include:

- effective interactive learning modules that can be used in a variety of modes: in classrooms at all levels, in individual student study, in corporate training, and as independent knowledge updates for lifelong learners
- development templates for the creation of content by other producers
- publishing partnerships for broad distribution of materials and financial support of ongoing Academy research
- courses and degree programs to train the educators of current and future generations growing up in a technology-dominated world
- contributions to cognitive research in learning from the embodiment of new theory in multimedia materials and their evaluation in real-life learning environments.
CURRENT ACTIVITIES

The Academy’s modules are intended to be used in courses as well as corporate training programs and are designed expressly for deployment in multiple venues—internet deployment for anyone anywhere via the www, intranet deployments (as in studio classrooms and corporate networks), and special audience screening via cd-rom or other portable method. Many different types of multimedia modules have already been completed which can be used to create interactive learning environments. Some examples of these include:

- Interactive design tools and tutorial units: Modules for functional and physical design of electronic circuits/circuit boards along with those pertaining to the layout and planning of electronics manufacturing activities are integrated with handbooks and libraries to provide the necessary background to understand the technical and managerial issues associated with the development of electronic products.

555 Timing IC Introduction Module screen example
(where the user plays with the wiper delay)

Common-Emitter Amplifier Design Module
(where the user can view the impact of design choices)
Interactive simulation modules: Integrated simulation takes special advantage of the multimedia environment and involves the user in the decision-making and design processes. Simulation modules use real life examples to demonstrate principles and practices in Electronics Engineering. For instance, the Academy uses music (a universal language) as a contextual wrapper (virtual guitar) and historical innovators (Les Paul) as launch pads to draw students into further explorations of the content. Using innovative templates in designing courseware, simulations allow students to discover laws and principles as they “experiment.” At the Academy, modules are utilized to foster a new model in which learners are guided toward the discovery of laws and principles.

“Twanger” Module sample screen
(where the user can study and play a virtual guitar)
Multimedia case studies: Case studies of dual-use product development, management, and manufacturing are being developed to explain and analyze the principles which affect decisions for combined defense and civilian manufacturing. An electronics manufacturing line is designed to bring the factory to the user which incorporates principles of design, fabrication, assembly, joining and quality testing. Video of a real factory is combined with simulation and animation to study the choice of manufacturing systems and the scheduling of production activities. An extensive simulation-based game highlights the challenges faced by the Cybertronics Corporation, a fictional company, which is developing products for commercial applications based on its defense-related technologies.

Virtual reality environments that immerse the learner in the spaces (e.g. clean room facilities) and allow actual handling of equipment to learn hands-on skills such as electronics board manufacture. In the traditional learning model, the learner is given the rules as pronouncements at the center.

Modular multimedia structures that can be re-purposed for utilization in multiple courses, in differing curricula and by a variety of organizations (e.g. k-12, academia and industry).
A new web-based architecture specifically designed for multimedia deployment that can be used by educators to configure, assemble, and efficiently deliver a series of modules which address specific course requirements.

The Academy’s multimedia deployment architecture
(introductory screen example)

Sample filters content playing in the Academy’s architecture
(showing the high-level view of how electronic filters operate)

Proprietary software development: Extras, engines, etc... the permutations in analytical tools for microelectronics simulation. Our modules are designed for specific purposes from analytical engines and cad code libraries we have developed over a period of several years.
“WaveChooser” Sound Generation Module
(permits the user to create and hear waveforms)

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