Consider a snapshot from 1996: A bright young woman has just earned a degree from a prestigious art college, majoring in computer animation (a program her school started four years ago). She is looking for her first job. An excellent student artist, top in her class, she does not know how to program. She is being courted by all the major West Coast studios and has retained an attorney to get her the best possible deal (among other things, a starting salary in the $60,000 range).

Cut back to 1990, just six years earlier: A recent graduate is trying to find a job. He studied computer graphics as an art student and created some respectable short animations. He took a class in general programming but not graphics programming. He is not even looking at the big companies in Hollywood because they seek only experienced people. Instead, he sends out resumes to and visits small “boutique” production companies in the Southeast or Midwest—any place that will let him get a foot in the door.

Cut back further, to 1986: A student has just graduated with a Master’s degree in computer science. He has always been interested in art, but never thought of it as a way to make a living. He did his graduate project work in NSF-funded simulation techniques. He attends Siggraph 1986 in Dallas, resume in hand. He lands a job programming for a newly formed small production company, hoping to make it big doing computer-generated imagery (CGI) for the film industry.

Finally, cut back to 1975: A talented, creative computer science student wants to explore computer graphics’ animation potential. His thesis, funded by the DOD, describes a way to render images on the computer with something called a “z-buffer.” His school approaches a large animation company about an exchange program that brings a student to the company to learn the industry and a company animator to the school to learn new technology. The company’s animation division isn’t interested in computer animation and the exchange does not work out. The graduate student—Ed Catmull—goes on to found a premier computer animation company.1

A bit of history

The above scenarios illustrate actual examples of people trying to get computer graphics jobs in the entertainment industry. You may recognize yourself among them, depending on when you started in computer graphics. Barely three decades old, the computer graphics field has been through enormous changes. Possibilities and experimentation have evolved into commonly used and widely accepted tools to create effects, images, and characters for films. The education needed to succeed in the digital entertainment industry has also changed. The early emphasis on technical skills, especially computer science, has broadened to include a strong focus on art and animation skills. The reasons for this necessitate looking at the industry and education over the last twenty or so years.

While this article primarily addresses the entertainment film industry, that industry offered few digital production jobs before 1992. We must therefore consider the role that television commercials (and those ubiquitous “flying logos”) played in the development and adoption of digital technology in the film industry. In addition to theatrical motion pictures, the fast-growing digital film industry now produces a wide variety of film-based entertainment, from ride simulators to large-format special-venue theaters such as OmniMax and Imax.

Industry: 1975

In 1975, computer graphics had been around little more than a decade. Because the field was so new, it did take a rocket scientist to do the work required for computer graphics. Few basic tools existed, and computer graphics specialists invented the tools they needed from the technical and mathematical ground up. Only those who could write the code could tell the machine what to do artistically.

Hollywood knew little about this fledgling area. The
biggest advances involved 2D graphics, and in the 1970s the few movies that employed CGI used either on-screen graphics (simulating what would be seen on a computer terminal or screen readout in a spaceship, for example) or 2D computer imagery. By 1975 CGI had been used in only two major films. In 1973, *Westworld* featured scenes that showed audiences the world viewed by the eye circuitry of a synthetic human (played by a very real Yul Brenner) in a future Western theme park. This effect was achieved with 2D computer graphics tools mostly derived from image processing techniques. The 1974 sequel to *Westworld*, *Futureworld*, used 3D CGI.

Using 3D CGI extensively in films remained a dream. Few in the movie industry believed in CGI, but academic researchers around the country sought to create viable tools. Because no one knew what could be done with CGI, it was considered extremely risky, and also very expensive. Making a film was already an expensive endeavor; using budding CGI technology could significantly increase the overall cost, even if it did manage to get done on time and not delay the film’s release date.

In the meantime, television embraced the fledgling computer graphics industry. CGI examples tended to be quite short because the technology was highly technical and tedious, with long rendering times needed to get good-looking images. Short formats, however, worked well for TV with its 30-second commercials and program openers. Also, rendering for broadcast required considerably less resolution than film—about one-tenth the number of pixels per frame—and therefore less time as well.

Then as now, commercials had to grab the audience’s attention before they launched the sales pitch. Computer graphics offered a new, glitzy way to do just that, and the advertising industry had the money to spend on it. The digital film industry owes a great deal to advertising’s need for something new to captivate audiences. Companies doing primarily TV commercial work proliferated in the late 1970s and early 1980s.

These companies had relatively few artists on staff, however. They needed technically versed workers to write new code and manipulate technology into doing things it hadn’t done before. The commercials’ artistic design generally came from the CGI company’s contracting agency—usually a prestigious ad agency that could afford CGI’s high price. Most companies thus had one or, more likely, no artists on staff. Among the few exceptions, Triple-I (Information International, Inc.) had three: Richard Taylor, Art Durinski, and John Whitney, Jr.

**Industry: 1986**

By 1986, thanks to all the work done for commercials, digital technology had made inroads in the film industry—but the work force hadn’t changed much. The chances were still high that whatever was needed for a particular shot had never been done and required new code. This called for programmers, not artists. If a company did hire an artist, it was typically as an art director, working alongside the programmers to help them understand and translate an artistic vision into code. Few people could claim to be both scientists and artists at this time (although some schools were starting to train well-rounded people who would play pivotal roles in the digital film industry’s future).

During this decade, the quality of images generated by CGI rose substantially. In addition, people who worked on traditional effects (optical and physical) began working in the digital realm. As CGI infiltrated the film community, commercial CGI creators also learned more about the way films were made.

Looking back, 1981 was a milestone year for digital film, with 3D computer graphics in two major films. In Michael Crichton’s film *Looker*, Susan Dey’s character needed to obtain physical perfection as embodied by a computer program’s ideal 3D representation of her. Based on their work for *Futureworld*, Triple-I won the task of creating this 3D figure. Though not a box office success, *Looker* showed the new medium’s potential.

Also released in 1981 (and also not a box office success), *Tron* used 3D computer graphics extensively in both concept and actuality. Although traditional optical effects created the characters’ look, the film used the most CGI to date—it took four major CGI companies to achieve it all. The light cycles were done by Magi, the solar sailor ship by Triple-I, the *Tron* title logo and wireframe world by Robert Abel and Associates, and the bit character and *Tron* opener by Digital Effects.

The next landmark was *The Last Starfighter* (1985). Digital Productions created an astounding 27 minutes of CGI for this film. Unfortunately, the film’s success did not translate into success for the company; Digital Productions closed in 1986.

Besides generating original imagery, CGI began to make inroads into another traditional effects mainstay, optical compositing, or the layering of foreground and background elements within a single scene using analog film equipment called optical printers. Digital compositing had its start in the early 1980s. It had been tried...
early on in the movie Flash Gordon at an optical printing house run by Frank Vander Veer. Both the early Digital Scene Simulation system and the Pixar Image Processing Computer (developed in 1982 by the Lucasfilm Computer Division) further developed the technology for digital compositing, and slowly the idea took hold in Hollywood. Digital compositing offered many benefits, chief among them a simplified production pipeline that did not involve shooting, processing, and aligning many layers of filmstock.

In the late 1980s, illusion—once the domain of highly skilled artists creating matte paintings or constructing miniatures, and skilled film industry specialists putting the elements together with optical printers—became the domain of physicists, mathematicians, computer scientists, and electrical engineers. About two-thirds of the key people in the digital effects industry in the 1980s came from these disciplines.

Unfortunately, the decade that saw the meteoric rise of so many CGI companies also witnessed their demise. Within a fairly short period of time, four of the largest CGI houses—Abel, Cranston/Csuri Productions, Omnibus, and Digital Productions—closed their doors. Their high overhead and the rapid pace of innovation made it impossible for them to survive. (Digital Productions’ Cray computer reportedly cost $250,000 per month in upkeep.) The entertainment industry was not willing to pay exorbitant capitalization expenses or research and development costs. Work moved to smaller companies that could operate on more traditional budgets.

Despite its successes, producers and directors still did not trust CGI. A Siggraph 88 panel, “The Reality of Computer Graphics in the Motion Picture Industry,” considered various directions CGI might take. Several participants urged exploring it more for its storyboarding capabilities than its potential for generating original images.

In preparation for this panel, Richard Hollander, owner of a company that produced on-screen visuals and video displays for the movie industry, informally surveyed movie people in person and by phone on the state of the industry. The good news was that everyone knew what CGI was. The bad news was they repeatedly commented on the great expense and that CGI had a unique look appropriate for a limited range of film styles. The industry decision-makers did not see beyond CGI’s existing uses, and many remembered the high cost and box office failures of movies that relied too heavily on CGI.

Alex Singer, a veteran Hollywood director and currently a director on Star Trek Voyager, has followed technology’s progress and potential for some time. In a phone conversation, he remarked about this period in Hollywood:

Everybody was learning. The artists and programmers were learning how to create things that had never been seen before. The producers and directors were learning that this new thing was out there, even if they didn’t trust it at all. Even the audiences were learning—much like Citizen Kane was not a commercial success when it came out (for 10 years) because the audience was not sophisticated enough to know what it was looking at. Tron was a failure, not only because of a bad story, but in a contributory way because the audience was not tuned into the subject matter.

We could call the 1980s the startup decade for CGI in the film. It enhanced such commercial successes as Star Wars: Return of the Jedi (the death star hologram), Star Trek: Wrath of Khan (the Genesis effect), and Young Sherlock Holmes (the stained-glass man). The Abyss typified the decade’s end, offering a prime example of a major director (James Cameron) taking a chance, but not too big a chance. Had the CGI effects for the pseudopod water face scene not worked out, it would not have affected the movie’s schedule or success. The fact that it did work convinced Cameron that this tool, if used well, could deliver.

Industry: 1990

The early 1990s saw major growth for CGI in films. The Abyss’ success convinced Cameron that he could successfully undertake a new film that relied heavily on digital effects and, in fact, could not be made without them. The 1992 film Terminator 2 proved to be not only a box office smash but also the turning point that convinced the film industry that CGI was indeed a reliable tool.

In his keynote address to the 1991 Society of Motion Picture and Television Engineers tutorial “Issues in Advanced Motion Imaging,” James Cameron talked about CGI achieving respectability after many years of “hard work.” He also discussed his experiences with The Abyss and Terminator 2. What surprised him about The Abyss was that each company vying for the job proposed very different techniques to create the effect. Happy with the work Industrial Light and Magic did, Cameron described himself as “intoxicated” with the technology’s possibilities, prompting him to take the big step with Terminator 2. But he also said this about the practitioners of the digital arts:

You (digital) effects guys know too much. You’re getting like doctors—too much knowledge and not enough bedside manner.

CGI made significant inroads in film as awareness and demand grew. Many films in the early 1990s used large amounts of CGI technology, including Batman Returns, Alien 3, Jurassic Park, The Lawnmower Man, Death Becomes Her, Toys, In the Line of Fire, The Mask, and Forrest Gump. Companies specializing in CGI were finally in demand and had to find more talent to keep up with the new and hectic pace. And, just maybe, they were starting to develop some bedside manners.

Industry: 1996

By 1996 CGI, by most accounts, had come of age. Moving beyond just usefulness, CGI had become an essential film industry tool for simulating dangerous or costly effects and for the final digital compositing of all separate elements.

Besides effects and compositing, CGI’s role in entertainment also grew with the resurgence of the animated feature film. While some companies tried early on to make
animation cheaper to produce with CGI, innovations by Disney's Feature Animation Division in the 1980s and 1990s enabled CGI to enrich the look of animation in ways not necessarily cheaper, but better. One involved achieving an unlimited number of layers in the digital multi-planing technique (prohibitively expensive in its traditional form and limited by the buildup of density of the numerous cel layers when stacked). Another involved replicating single character elements, essentially animated once, into flocks, herds, and crowds. Animated features' new popularity may stem in part from the new richness computer graphics techniques bring to animation.

In 1995, an entirely computer-animated feature film, *Toy Story*, marked a major digital milestone. Created jointly by Pixar and Walt Disney Feature Animation, this film's success took many by surprise. For many years the Pixar group had been creating cutting-edge short computer films such as *Tin Toy* and *Luxo, Jr.* Later they delved into commercial work, focusing on character animation. The Pixar team, widely acknowledged as the world's best CGI character animators, seemed well suited to step up to a feature-length film. *Toy Story*'s success motivated more than one Hollywood company to start developing in-house CGI animated features.

This growth, and the entertainment industry's confidence in mature CGI, spurred intense demand for talent to fill the growing ranks of CGI companies between 1994 and 1996. Top students were often pulled from schools before they completed their education; others were hired immediately upon graduation. Companies searched the world to find the talent they needed. In fact, the only area that grew as fast during these years was the human resource departments tasked with all the recruiting and hiring.

But it has been quite difficult to find the talent the industry needs, even though in sheer numbers more students are looking for work than there are jobs. While hundreds of schools now offer CGI programs or courses, a disparity exists between a graduating student's knowledge and what employers desire. We can further explore some of the many reasons for this disparity by examining what was going on in the academic world in the same years we examined for industry.

**Academia: 1975**

In the 1970s, few schools offered formal study in computer graphics for the entertainment industry. Those that did typically offered a course or two in their computer science or electrical engineering departments, usually at a graduate level. Few art departments had funding or equipment for computer graphics classes. Graduate students lucky enough to find funding for computer graphics research often worked on Department of Defense computer simulation projects, the primary application for this new field. The other major source of funding in the 1970s was the National Science Foundation. Both groups funded pure research projects and typically let students select the topic and direction they wished to pursue. Since computer graphics was such a young field, it provided many challenging problems for student researchers.

The rare entertainment company wanting to use some form of CGI did not hire off the street; it looked to the schools engaged in CGI research. Among the most prominent in the 1970s were the New York Institute of Technology (paint and 2D animation systems), Ohio State University (animation), the University of Utah (real-time graphics, 3D modeling and viewing, human animation, and frame buffers), and Cornell University (color and rendering). The entertainment industry sometimes collaborated with students and researchers to address key industry problems. An example of such collaboration was the rendering program Utah researcher Frank Crow wrote for Triple-I.

In the 1970s, then, the CGI "jobs" in the entertainment industry existed mainly under the academic umbrella. Most decision makers in entertainment saw CGI as "interesting stuff, but not for us right now." Few other than students and researchers were willing to risk their reputations creating a whole new technology whose destiny they could not foresee.

**Academia: 1986**

By the mid-1980s, several schools had started fusion programs aimed at teaching basic artistic and technical concepts. Sheridan College in Ontario, Canada, had developed a successful computer animation program. The University of Illinois at Chicago's Electronic Visualization MFA program, started in 1980, balanced technical and artistic training in a joint effort between engineering, computer science, and art and design departments. Ohio State University's computer graphics program offered perhaps the best example of how to prepare students for the entertainment world. In conjunction with Cranston/Csuri Productions (C/CP), this art education program provided ideal training for many current entertainment industry leaders. Why did it work so well? The answer lies in a balanced combination of art, education, computer science, and production experience.

Students in the Ohio State program were mostly art education majors working in the Computer Graphics Research Group (CGRG), which had been active for more than a decade. This group included computer science, art, and education majors, all expected to understand how to program and use the custom-written software constantly being revised by group members. Most thesis work focused on ways to teach computer graphics. Not surprisingly, many of today's best computer graphics educators are graduates of this program.

C/CP, a full-fledged CGI production company cofounded by Ohio State professor Charles Csuri, offered students hands-on learning in a production environment. This complemented classwork by allowing them to apply CGI concepts to real-world problems. It also gave them invaluable experience working with directors, budgets, and schedules to develop production skills demanded by the industry but seldom if ever taught in school.
Besides attending OSU or another key "fusion" school, two basic options existed for someone wanting to go into CGI. Many took the "learn it on your own" path—begging for computer time after hours in production facilities or taking any entry-level position just to be near the technology and learn. Others majored in either art or computer science, to the exclusion of the other, hoping to get a foot in the door with the basic degree and pick up other skills on the job. Computer science remained the best option, since most companies still needed workers adept at handling unfriendly and constantly changing production software.

By the mid-1980s, many educators agreed on the need for interdisciplinary studies in computer graphics. At Siggraph 84, more than 200 people attended a two-day course, "Interdisciplinary Issues in Art and Design." Vibeke Sorensen, a long-time computer graphics teacher and one of the course organizers, listed 31 schools "leading the way" in CGI in 1984, making no distinction between CS and art schools. This made sense in light of the session's goal to find ways to merge the art and science of computer graphics into one harmonious course of study.

This course resurfaced at Siggraph 87 as a one-day Educators' Workshop on "Teaching Computer Graphics: An Interdisciplinary Approach." For teachers trying to establish or improve their computer graphics programs, this course represented the best of CG education. It featured detailed descriptions of programs and courses, syllabi and sample curricula, and lists of resources such as books, magazines, and journals. It included articles like "Why Artists Should Learn to Program" by University of Oregon art professor Craig Hickman and information on where graduates were getting work—many at Hollywood's main entertainment companies.

The Siggraph Education Committee emerged in the 1980s as well. Siggraph's mission has always been to educate, but many practitioners found themselves going into teaching with few resources. To bring computer graphics educators in all disciplines together and share ideas and resources, Siggraph members Steve Cunningham and Judy Brown (themselves teachers) founded the Education Committee. This committee has documented schools providing computer graphics training for the past 13 years. A 1989 Siggraph Computer Graphics special issue on careers in computer graphics listed 145 schools teaching computer concepts and systems (most in computer science departments) and 154 teaching computer graphics in arts, architecture, design, or communications programs. This doubled the number of schools listed in a 1984 committee study.

This special issue also included job profiles, two of the 13 in entertainment: technical director and director of special projects for a CGI house. This fairly represented the percentage of entertainment jobs within CG in 1989 (other listings ranged from independent consultant to aerospace scientist to system software professional). This detailed information proved invaluable not only to students seeking work but also to teachers, and helped spark the creation of even more new academic computer graphics programs.

**Academia: 1990**

By the 1990s, hundreds of schools had some sort of computer graphics program, many targeting entertainment as their students' professional destination. Students especially were drawn to this glamorous new area, having seen exciting CGI effects in popular films. Studios began to provide limited, highly competitive internships almost certain to lead to permanent jobs for students with the appropriate talent and personality. While most film industry jobs still advertised for people with three to five years of experience, any student determined and talented enough could hope to end up with a job somewhere in the industry eventually. Most entry-level jobs, however, were at small boutique production companies around the country where students could gain the experience needed for Hollywood.

In the early 1990s, many technical and vocational schools focused on bringing students up to speed quickly. Spurred by students' demands to get into this industry fast, and their willingness to pay, these schools provided programs ranging from six months to two years. High tuition permitted these places to offer newer equipment and industry-level software that many colleges could not. However, they also emphasized training on specific commercial software. Studios buried in work sought students who had logged many hours on an up-to-date system. Some companies advertised for jobs such as "Wavefront Operator"—many postings listed specific hardware or software—and students took classes to become just that. If studios couldn't get what they really wanted, they could at least hire someone who knew the software.

In this atmosphere, university teachers had difficulty convincing students to spend additional years learning subjects that did not seem pertinent. Often, students settled for a university over a trade school only because of the cost difference. Fueling students' impatience was what I call the "software vendor trap"; as a panelist at the Siggraph 97 Education Panel put it, "If you get an outfit, you can be a cowboy too" (after a humorous Smothers Brothers song). Some students felt that knowing one software package made them ready for work, without understanding that they possessed only a small part of the knowledge and skills required. A student in my program at Ringling School of Art and Design was convinced by a software salesman (from a company no longer in business) to take his next year's tuition and buy their system—it was all he needed to start his own business. The student did so but was back at the school's door within the year, having learned the hard way that he did not have the training he needed.
**Academia: 1996**

By 1996, anyone with talent and some software skills could get hired somewhere, with exceptionally talented graduates often the target of bidding wars. Some companies, recognizing that the schools that consistently turned out well-trained students, started recruiting them well before graduation, sometimes hiring students who still had two years to finish. Some students thus started looking for work as soon as they had something on their demo reels. Many, reading about animators’ incredible salaries, hired attorneys to negotiate the best deal, even seeking signing bonuses.

All this has prompted even more schools to jump on the bandwagon in the last two years and start programs focusing on computer graphics for entertainment. In California, hit hard by the lack of talent to fuel the industry’s rapid expansion, nearly a dozen new programs have sprung up this past year alone. The State of California encourages schools and studios trying to generate workers for the industry by initiating discussions, meetings, and funding programs.

**Today**

The picture has changed dramatically over just the last year. Studios have reached the expansion targets they set in the last few years. The hiring has, with few exceptions, slowed to a trickle; companies are laying off workers and even closing their doors. Graduating students are amazed to find no jobs when they go looking. While a studio may still hire a graduate whose work shows real star quality, this often comes at the expense of someone hired in the last several years who is not making the grade (remember those kids who only knew one software package?). We are seeing a shakedown in the industry both in the quality of digital artists a studio wants to keep and in the number of CGI facilities able to stay in business.

Where does this put us in terms of the education needed to work in this ever-changing but essentially mature industry? We must examine current job categories and requisite skills, how studios work with entry-level artists, and how education and industry can better prepare the next generation of digital film workers.

**Types of jobs available**

CGI jobs in the late 1990s tend toward increasing specialization, with many different job titles. These jobs do still require some cross-over, however, and students would benefit from a thorough understanding of the whole production process. A survey of job titles and categories from major studios’ recent recruiting brochures yields the following examples:

- technical directors for motion, modeling, and lighting
- effects and character animators
- digital artists such as 3D texture painters, concept artists, compositors, and rotoscope, matte, and inferno artists
- software developers for 2D and 3D production tools and software to maintain studio infrastructure
- systems workers including networking specialists and system administrators
- entry-level positions such as I/O positions, scanning, data wranglers, and output

As an example, let’s consider what today’s ideal entry-level digital artist—say, an animator—would look like. He or she would possess a range of skills and qualities; I’ve listed the most important, distilled from studio recruitment brochures, personal experience, and industry publications. Desired artistic skills include

- a solid foundation of art training
- excellent draftsman/illustration skills
- intuitive understanding of movement and emotional nuances
- understanding of animation principles

Desired technical skills include

- demonstrable experience with major software packages (preferably more than one)
- good working knowledge of Unix
- thorough grounding in CGI concepts
- ability to write scripts
- mathematical skills and ability to write mathematical expressions

Underlying these technical and artistic skills are social and success skills critical for all jobs in the digital film industry’s team-based production structure, such as

- excellent written and verbal communication skills
- teamwork
- ability to take direction and criticism
- understanding of the production process and how this job fits within it
- keen critical thinking and aesthetic skills
- flexibility, adaptability, and a desire to learn and grow

**The rise of studio training programs**

It would be great if graduating students actually matched the description above, but few do. Not only do the studios recognize this, students themselves often find out as soon as they start interviewing.

An article written by two recent graduates for the *IEEE Computer Graphics and Applications* in 1996 discussed the lack of standardization among CGI programs. They stated, “This lack of standardization makes many graduates feel that everything they never had is all they need.” Traditionally, studio training for new hires occurred on the job. New employees were typically given a basic orientation and then, if they were lucky, put under the tutelage of a more experienced worker. Far more often, new hires had to find things out on their own, befriending a sympathetic colleague (or two or three) who could guide them through the company’s working procedures. However, as the ratio of...
Academic programs need to produce better trained students. This requires committed cooperation between academia and industry.

However, long ramp-up times have their own problems. A company must keep a new employee around long enough to recoup their sizable investment. This has impacted the traditional film model of studios hiring freelancers when work is heavy and laying them off when it slows—CGI people are brought in to stay, for the most part. Beyond the differences in production software and procedures, most companies have discovered that new hires (and even some experienced ones) just do not know all they should. Because senior people often must explain basic concepts to team members, most CGI companies have instituted substantial internal training programs to bring people up to speed.

Disney, one of the first to develop such in-house training, started an animation internship in the 1980s. In this program, about as long as a typical semester, Disney trained young art students in traditional animation. There was no guarantee of a job at the end, but top interns might be offered entry-level openings. In 1994, when Disney realized it must find a way to hire good computer animators and technical directors, it hired me to create an intensive three-month training program. This program differed from the traditional internship in that the trainees, as they were called, were actually under contract—the demand for good students was high. Also, in addition to learning computer techniques, trainees undertook a traditional animation regimen including weekly life drawing classes. Each trainee had a CGI mentor who was an established artist in the trainee’s discipline. One or two traditional animation mentors were also assigned to the group, as very few schools provided traditional animation training in their computer programs.

Other studios have followed suit, setting up entry-level training programs. These not only teach software and specific production techniques but also provide regular or specially scheduled “enrichment” classes such as life drawing, acting and movement classes, sculpture classes, and lectures or workshops.

Lectures and special classes help address what I see as a lack of related competencies needed to fully understand CGI and its role in the film industry. These include basic computer graphics concepts, from modeling methods to rendering techniques; few people come in with the whole CGI picture. Other competencies include knowledge of film, lighting, and color concepts, and of the physics and math behind effects and natural phenomena. For example, a technical director writing Renderman shaders also needs to comprehend the artistry of lighting, that is, how lights work within a scene to achieve the desired effect, and how to specify colors in a precise yet aesthetically pleasing way.

Getting that first job
Not everyone can get into the limited access studio training programs. But most young hopefuls seeking a job still do not have all the skills they need. What can they do?

Commercial training facilities might provide part of the answer. Once established to help production artists gain and update skills, these companies now must choose whether to become “finishing schools” for graduating students who need more information to be hirable. Many are establishing concept-based classes in response to studios’ concerns about the lack of basic conceptual knowledge. Students may not recognize that they need this and pay money for it until they have spent some time unsuccessfully searching for jobs.

Some students can, and should, go on to graduate school; many more students are hired out of graduate programs than undergraduates. Young artists can also look at successful undergraduate programs, see what classes they might not have had, and try to enroll in them. In addition, especially in California, some universities offer digital film-specific extension classes. Professional society memberships are extremely important and provide valuable knowledge and resources often not available in formal academic programs. Finally, industry hopefuls must realize that they may need to start at the bottom, much like the kids who took work as janitors in the 1980s.

For the future
Of course, in the long run, academic programs need to produce better trained students. This requires more committed cooperation between academia and industry—some schools have consistently produced better trained individuals because of successful relationships with industry.

Part of this relationship has involved curricular advice. Not all schools can pick up the phone and have a major studio answer all their questions, but they do need advice on relevant curricula. Available resources include trainers at production houses and training facilities, many of whom started out as educators in the academic world. In 1996, these trainers, managers, and directors of training formed a loose organization, the Alliance of Digital Effects Production Trainers (ADEPT), that meets regularly to share ideas, problems, and resources. This group plans to serve as an information clearing house and help with curricula, lectures, or student placement—it can help match students with internships and serve as teachers’ primary contact within industry. ADEPT will also work on educational issues within governmental agencies, working with the Siggraph Education Committee through its new Entertainment Liaison representative (me).

For educational programs to improve, the digital film
companies must become more involved with and supportive of them. In addition to providing more internships for students, they could also provide several faculty sabbaticals per year. Few teachers have had working experience in a production company, and a sabbatical at a studio could make them more informed and better educators.

Industry could also sponsor more collaborative research and dialog with graduate schools. There are really two types of “entertainment” talent essential for today’s industry, and only one ends up directly in Hollywood. The other does the applied research at academic labs around the world, thus creating the industry’s new tools. Increased dialog will mutually benefit both groups.

Interdisciplinary: More than a word

The digital film industry needs more fusion artists—those who combine artistic and technical skills in equal amounts. The 1980s to the 1990s saw a shift from hiring programmers to hiring artists in an attempt to bring more artistry to digital effects. But this did not solve all the problems. Even with constant software advances, artists find they are called upon to create scripts or write expressions, use unfriendly in-house software tools, or rely on a technical director to do things for them. Programmers, on the other hand, find they need to really understand the art behind what they are coding.

But today’s educational systems will never produce enough fusion artists unless interdisciplinary becomes more than a word. The separated disciplines cannot viably train students for real-world expectations. Fewer than a dozen truly interdisciplinary programs currently train for the entertainment market. Most mentioned earlier still produce good graduates, and some interesting new ones, such as the BS program at Concordia University in Montreal, requires equal credits in computer science and art classes.7

The introduction of the interrelationships among disciplines needs to start in the early grades and continue through high school and on into higher education. Many groups, including Siggraph, have been attacking this problem for some years now with limited success. A key factor in bringing about this change may be to stop “preaching to the choir” (the students and teachers) and start working on the administrators, principals, college presidents, and governments, where the decisions and funding come from. Fundamental shifts such as this could achieve success more quickly with this top-level support. The digital film industry’s economic importance can be the motivating rationale for these decision-makers to become involved.

But part of this change also involves how we teach. Teachers must be mentors. They need to recognize that they cannot do it all or know it all—the rapid advances in technology preclude this. A new kind of partnering between students and teachers will provide a better model for future training, not only in entertainment but in many industries. Teachers should also teach students basic, unchanging concepts. And because students will be doing it all their lives, teachers must help students learn how to continually learn, and enjoy doing it. A love of learning is the greatest gift a teacher can provide.

We also need to make sure students understand the cyclic nature of the film industry and businesses in general. We need to instill in students that a craft will take a long time to master—that learning software alone, or just what they need for today, is never enough. We need to encourage breadth, love of learning, and problem-solving and critical thinking skills—all the things that a liberal arts education should do. And finally, we need to encourage students to permit themselves the time to travel down those unfamiliar paths that just may lead to that next significant breakthrough—personal, technical, or artistic.

References

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