

Graphic Arts Education and Training in the Twenty-first Century

By

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My intention was not to write an article about Cal Poly. However, I cannot help but present a case study of success in preparing the future human resources of the graphic arts and for re-educating those already actively part of the printing, publishing, and related graphic communication profession.

With a focus on hands-on practical education and training, Cal Poly has deployed a methodology that has bred an outpouring of accolades from the graphic arts industry that resulted in a substantially industry-funded institute for the purpose of developing and delivering education and training services to the profession.

Founded in 1946, Cal Poly's Graphic Communication department today maintains an enrollment of 300 unusually bright and focused students drawn from the top 10 percent to 15 percent of their high school and community college graduating classes. Approximately two-thirds of the qualified applicants to Cal Poly's Graphic Communication program are turned away and many of those who are accepted have attained high school grade point averages of over 4.0 (honor students) and some have achieved combined SAT scores of over 1400 (1600 is maximum). In operation for over 55 years, the department has over 3,000 alumni, many of whom have reached high levels of responsibility and authority in the graphic arts profession. Most have been educated in the Graphic Communication department's 33,000 feet of laboratories that have been kept modern through yearly outpourings of equipment and financial gifts from industry. As one of the largest and known programs of its kind in the nation, the department boasts 100 percent placement for students wanting to enter the industry upon graduation. Indeed, most receive multiple offers by the largest and most prestigious companies in the industry that recruit on the Cal Poly Campus. Part of this success comes from an internationally known faculty of professors, scholars, researchers, authors, and consultants. However, most of the success comes from Cal Poly's long-standing philosophy of "learn-by-doing."

When I first arrived on the scene at Cal Poly in 1983, I was skeptical about this philosophy and thought that it was just a cute and catchy cliché that the university used to attract students with technical interests who were not particularly academically oriented. I learned quickly that this was a far cry from the truth. In fact, Cal Poly attracts, and has for

years, some of the most academically oriented, critical thinking, and creative student bodies that I have ever encountered. In fact, in 2001, it was a Cal Poly Graphic Communication student who won the coveted Outstanding Student of the Year award for Academic Excellence. This is the highest student award give out each year by the university.

At Cal Poly, classroom lectures represent the under girding of the students' education. However, it is the laboratory that is their home and where the real learning takes place. It is in the laboratory where experimentation, testing, and trial and error takes place, and it is where the students are able to apply their creative thinking in coming up with new ways to solve old problems. What is unique about these laboratories is that they resemble industry departments equipped with some of the most modern and sophisticated equipment available. This approach has been so successful on the undergraduate level that we now employ the same "learn-by-doing" philosophy in the growing number of training programs that we are called upon to conduct for industry. The new Graphic Communication Institute at Cal Poly will epitomize this philosophy and is being further developed into a premier resource for industry to participate in research, testing, and product evaluations, as well as training, seminars, workshops, and conferences.

Philosophical Premises Underlying Successful Education and Training In the Graphic Arts

Central to Cal Poly's Graphic Communication department philosophy are a number of premises that apply equally to education and training in the graphic arts industry of the twenty-first century. They are:

- Education does not take place in a block of time.

Whatever it takes at the university; four, five, six years or even more could represent the boundaries within which a block of education takes place. The time involved depends heavily on the individual being educated, the education or skills being developed, and the complexity of the subject matter under investigation. The four-year metaphor for a Bachelor's degree, for example, has fallen and continuing education of individuals already in industry is just that, "continuous." If a career is to remain viable, vital, and productive, ongoing training and re-training has to be defined and expected for nearly every position in the graphic arts on the management and production levels.

- The university is the last bastion of idealism.

It is the laboratory and its ability to create situations simulating industry that provides students with a window on their professional future. That future includes the expectation that they will propose and simulate ways to improve the industry by drawing on their university experiences. It is through tests, and trial and error, that students develop a practical understanding of what works and what does not work in achieving desired outcomes. A university providing the opportunity for students to experience ideal conditions, or conditions that are as close to ideal as possible, graduates people who bring

some of that idealism to industry when they graduate and, hence, improve industry. They bring new ways to solve old problems and with each generation entering field, industry benefits from continuing improvement. The Graphic Communication Institute at Cal Poly and the laboratories included are designed to provide those already in industry with opportunities to experience some of the same idealism in a practical setting that is part of our regular academic program.

- Education is more than a Bachelor's degree that prepares one for an occupation.

Reading, writing, speaking, and overall communication skills are as important as technical skills in the graphic arts industry of the twenty-first century. Education and training in the graphic arts must address these issues on all levels. "Human" skills are increasingly what drive companies to success. More specifically, marketing, sales, customer service, and related training are as important, or even more important, than training to operate a piece of equipment. Equipment increasingly requires less human intervention and is run by microprocessors and other electronic devices. Hence, the training needs in industry are moving more to preparing people to develop those business skills needed to generate business and to keep equipment running.

- Education is a service that must address the needs of undergraduates and industry professionals.

At Cal Poly we have structured our Graphic Communication program to address the needs of our regular students and also industry professionals who rely on us for continuing education and training. Our labs are equipped with the type of technology used by industry, thus providing opportunities to simulate real business and production conditions. From prepress to press to post press, the same equipment is used by our regular students and by industry professionals alike.

- A viable educational program, such as a successful business, must have a well thought-out and flexible strategic plan.

At Cal Poly our Graphic Communication department has a strategic plan addressing forecasts for curriculum reform, laboratory development, faculty and staff development, and related topics. We attempt to project six years ahead and such thinking is the basis for educating our students and training industry professionals on what they will need to know in the future. The six years comes from the opportunity to reform curriculum every two years and then assuming that at least some students will graduate in four years, though many take longer.

New Skill Sets for the Graphic Arts Industry

So, in projecting six year ahead, what do we really prepare students with and what do we really train industry professionals for? From the philosophical premises previously noted

come two categories of training needed to develop skill sets for employees of the graphic arts in the twenty-first century. They are mental or cognitive skills and physical skills.

Mental or Cognitive Skills

- Accepting change as a rule.

Traditionally, change was the exception in the graphic arts. However, it is now the rule. For example, it was about 430 years between the time Gutenberg invented the process of duplicating movable type and the invention of the linotype machine. It was another 56 years between the invention of the linotype and the practical application of phototypesetting. Hence, little happened to further the process of placing words on paper between these lengthy periods. Expecting to enter, continue, and complete a career doing the same thing (as was possible for linotype operators and then strippers) is unrealistic. Today, technological change can occur daily and be unanticipated. The expectation of change must be addressed in education and training, and employees must adopt the notion that if they expect the unexpected, there will be not surprises. Expecting change requires a mind set that must often be developed. Resisting change is a natural tendency. But doing so inhibits professional growth in technologically dynamic field such as the graphic arts.

- Analytical thinking and understanding systems.

Systems concepts, file management, and workflow analysis has become the skill set required for aspiring managers in the graphic arts. For example, systems concepts involves standardizing and quantifying operations whenever possible to help insure consistent results regardless if one person is working on a particular assignment or if 100 people are working on it. Being able to measure quality and measure results are all part of the outcome of systems concepts. This differs from the craft orientation of the graphic arts in past decades where each individual in the production flow used her or his on personal skill abilities in producing a job. This is what led to great variability in quality, time taken to complete a task, and other variations that are just not acceptable by today's standards and customer demands. Analytical thinking requires training as does understanding systems. Both are vital components of training in the modern graphic arts industry.

- Understanding the relationship between people and technology.

It seems that there is a certain mystique or special esoteric skill development necessary before one can run application software to achieve computer results or to assess problems on computers. This was not so with traditional equipment. For example, nearly any person with any level of training can get into a car and drive it from point A to point B. In past years, before the introduction of microprocessors to printing presses, nearly any press operator with some basic training could turn on a printing press and get it to work. However, today I know some extremely bright and highly educated people who do not know how to navigate application software or figure out the basic procedural

manipulations necessary to achieve certain computer results with such software. This is in spite of the fact that they have tried. While nearly any person can walk into any car and make it do what it's supposed to, not any person can get on a computer and operate it efficiently or even know how to operate it. Until such a time that running a computer application is as simple as driving a car, there will be a substantial amount of training necessary for operators in the graphic arts to use computers efficiently and profitably.

The range of time and training required in developing an understanding of computers and application software varies tremendously from individual to individual. In the graphic arts, knowing how to select people with the mind set attuned to operating computers efficiently, to understanding navigational procedures, to achieving desired results, and to solving problems efficiently is critical. It seems in the electronic arena, it is the ongoing "communication" between people and technology that helps to determine when a person has internalized procedural requirements and when a system is ready to cooperate in performing desired functions.

- Understanding contingency management.

Contingency management is the fourth of the management style evolution that has evolved from the days of authoritarian management of the early part of the twentieth century. It was then that when effective management was considered to be achieved through one-way communication where those in authority dictated terms and employees simply followed them. Authoritarian management gave way to human relations management in the late post WWII 1940s that really took root in the 1960s. Studies of that era showed that operational efficiency was improved when employees were permitted to participate in decisions related to how they did their jobs. This was followed by the socio-technical management style of the 1970s and early 1980s. This was the era in which the impact that computers and other electronic devices would have on the workplace became clear. This management style suggested that in effectively run companies, management would have to delegate responsibility and authority to electronically savvy employees who knew more about technology and production than did their supervisors—a first in the history of the graphic arts. This gave way to contingency management of today.

Contingency management means that there is no one management style best suited for running a company all of the time. For a company to exist, survive, and grow, the applied management style must vary with changing times and particularly as they relate to changing economic conditions. In other words, when times are good and cash flow is plentiful, one style of management works best. Typically this is a time where there is great latitude in providing professional development opportunities for employees, on-the-job latitude for trials and experiments, flexible working hours, and a general loose and open air of management. On the other hand, during difficult economic times, as is facing some of the "high-tech" and "dot com" companies of the graphic arts industry today, management styles must be tightened and become more rigorous. With diminishing cash flow comes diminishing freedoms on the job and fewer professional development opportunities, and employees must be trained to expect this. They may not be permitted

to attend seminars and conferences that they were permitted to attend in better times, and they may not have as much say in their working hours and conditions as they used to. That this become an expectation of the job and not a disappointment of the job necessitates training that is quite different from technical training.

- Creative cognitive skills as opposed to physical craft skills.

Physical mechanical skills are easily taught though becoming a diminishing requirement in the graphic arts. Presses virtually run themselves and imaging takes place from computer monitors directly to the printing plate or to the printing press cylinder. These are merely a couple of examples of where physical human skills have been replaced by technology. Imaging film and film processes are no longer an important part of the printing process whereas in the past it was the nucleus or core of the process. I visited a printing plant producing a major national daily newspaper in full color where I observed the press operators sitting besides the press reading books while the press was running at over 30,000 impressions per hour. Basically, the press was being driven and controlled by microprocessors. Whereas in the past, the press operators, and many more than are required for presses controlled by computers, would be all over the press while it was running to control ink feed, fountain solution, ink-water balance, register, density, and so on. Such physical skills have been replaced with the need for cognitive skills including workflow analysis, file management, preventive quality control, statistical process control, total quality management, and so on. Being able to analyze and anticipate the most efficient, productive, and profitable workflow from the time a job comes in the front door of a company to the time it is delivered to the customer has become the fundamental skill set needed by employees in an effectively run graphic arts company. This includes the “micro workflow” that takes place in each department of the company involved in producing a job.

- Organizational communication skills.

When I speak to prospective employees of my students I often ask them what they look for most in the people they consider for employment. Invariably they point to communication skills. This involves not only reading, writing, and speaking skills, but also being sensitive to what is effective and appropriate upward, downward, and lateral communication skill. This applies to employees communicating to those above them, supervisors or management staff communicating to those below them in the organizational chain of command, and to people on the same level communicating to each other. However, when I conduct communication audits of companies, I find that this is where the major breakdowns occur leading to costly problems such as downtime, waste, misinterpreted instructions, and even animosity among employees that leads to insufficient communication required to get the job done properly. Organizational communication training is becoming increasingly essential in the graphic arts as technology dictates that no one person can complete a job by her or himself and that teamwork is a required component of organizational efficiency. Effective and focused communication is the main ingredient for effective teamwork and is only learned through training.

- Marketing, sales, and customer service skills.

Again, technology has driven the need to enhance marketing, sales, and customer service skills. The graphic arts industry has been transformed to one in which labor intensity has moved from the “backend” to the “front end” of operations as a result of technology. For example, prior to the introduction of microprocessors and other electronic devices to printing presses, it took four to six people to run a four-color printing press of 38 inches or larger. There would be one person loading and watching the feeder of the press, one person between each of the printing units controlling ink keys, ink-water balance, and performing other tasks, and one person, usually the lead press operator, monitoring the delivery of the press and inspecting printed sheets for register, density consistency, color match to a proof, and so on. Today, the same press with built-in electronic controls can be run by one person though two are typically used for safety purposes. Not only do the newer presses require fewer operators but they also produce at three times or more the speed of the non-computerized traditional presses. What this does is create an over capacity that must be sold or else the press begins losing money for the company. Hence, when more is being produced with fewer people in the “backend” there must be more people trained in the “front end” to market and sell this over capacity. Therefore, in the graphic arts company of the twenty-first century, there is the need for more trained marketing staff, sales people, estimators, and customer service representatives than ever in the history of the graphic arts. On the other hand, there is the need for fewer machine operators than ever before and this trend is expected to continue.

- Skills in practicing professional ethics.

Ethics in the graphic arts has recently taken on an entirely new meaning and the issue will be in the forefront of defining business dealings for printers, publishers, customers, and vendors in the twenty-first century. This issue must now be part of training directed to employees at all levels of the graphic arts company.

Printing industry ethics traditionally focused on matters of keeping promises to customers on deadlines, deliveries, and providing fair pricing. In other words, the matter of ethics had to do primarily with relationships between the printer and their customers. Today, however, printing has evolved from a provincial industry of thousands of small companies unlinked by any universal codes or standards of behavior. It has become a highly sophisticated and modern industry. Companies in the industry must now have the management savvy to deal with and define issues not typically associated with the printing industry. Some relate to employee loyalty, placing company interest above personal interests, dealings with competition, a wide range of customer services, democracy and equality in the work place, behavior of management and company executives, harassment, activities that are defined by local, state, and federal laws, and measures to prevent unethical behavior. Others include balancing business priorities with personal and community values, accurate record keeping, abiding by company and industry standards, trust and shared responsibilities, relationships with vendors, the work environment as it relates to health and safety, the highly visible issues associated with

handling intellectual property, computers and Internet access, and the entire realm of freedom and access being provided by modern technology.

Unauthorized use of the Internet, photocopiers, company equipment, telephones, company mail including express mail, and taking home copier paper, pens, and related items, varies from company to company. However, such practices are clearly contrary to good ethical behavior but often difficult to track. Some companies take great efforts to track such behaviors, while others do not care if employees telecommute or work odd hours as long as the job gets done and goals are met. Clearly, a uniform standard of ethics for doing business in the graphic arts for the twenty-first century has not been established. Companies set their own rules, guidelines, and codes; some stringently and some loosely. Whatever the company policy is, it is prudent to include it as an essential part of employee orientation and training.

- Understanding laws and policies concerning intellectual property.

One of the most controversial and unresolved areas of new technology has to do with copyrighted material and related intellectual property in print and electronic form. The latest developments in copyright law are a direct response to changing innovative technologies. New technology allows digital conversion of images and text, creation of multimedia, and transmission of data to remote locations. These activities are often central to innovative and effective business dealings and critical to doing business in a highly electronic world. Where more materials are farther from the reach of those who need them, their availability will increasingly be subject to payment of a license fee.

As the graphic arts becomes more reliant on networking and electronic communication, the mistreatment of intellectual property in most cases can lead to very serious consequences. One major supplier to the industry has been known to terminate an employee on the mere notion of disclosure or abuse of intellectual property. It is becoming increasingly common in the graphic arts for employees to sign an oath of secrecy which is taken very seriously. This has been common in certain printing industry segments for many years, such as in the financial and legal printing, and is now becoming common for all industry segments in which employees have access to intellectual property. Employee knowledge of the legal requirements and company policies regarding the use of intellectual property is an important component of graphic arts training today.

- Overall communication skills.

This requirement cannot be overstated and is worthy of some closing notations under the category of Mental or Cognitive skills. Again, communication training means training people to “communicate” with technology and “training” technology to “communicate” with people, e.g., making sure that technical components are of the type that people feel comfortable with and are not intimidated by. It also means training people to communicate with people at all levels of the organization and “training” technology to “communicate” with technology, e.g., making sure that the components, connectors, and software needed for machines to “communicate” with machines are of the proper type

and are properly configured. Perhaps most important it means training employees at all levels of the organization to communicate properly and effectively with the company's external constituencies including prospective and current customers, equipment and supply vendors, service personnel brought in from the outside to help solve problems and to perform maintenance that cannot be performed internally. Feeling that one is being communicated to with respect, dignity, and sensitivity is the key to achieving goals expeditiously and with expected outcomes. Such communication capabilities are not innate. They often must be taught.

Physical Skills

While the emphasis on training is clearly moving to the mental and cognitive facets of the graphic communication profession, there are still essential physical skills that must be addressed. However, they are quite different from those requiring focus in years past. Here are some.

- The ability to minimize waste.

Waste continues to cause major variability in printing profitability. And in spite of attempts to control it and anticipate it since the days of Gutenberg, it continues to be the main element often making the difference between a profit and loss on a printing job. The key contributor to this situation is paper waste which has become exacerbated in recent years by the rising cost of this most expensive disposable commodity used in printing. Paper accounts for between 30 percent and 50 percent of the cost of printed products. With faster printing presses, paper gets wasted faster (probably three times faster on electronically-controlled presses) than on the previous mechanical presses. Additionally, some of the newer digital presses also encounter extreme waste due to the newness of the technology and all aspects of control are not yet known by users. In spite of predictions of a society using less paper, the trend is in the opposite direction with more paper being used than ever before. More paper used equates to more paper wasted. More paper wasted accounts for less profitability of printing jobs which is a major problem of business survival in the highly competitive commercial printing industry. Training in anticipating, controlling, and preventing waste is key to business success in the graphic arts.

- The ability to improve and maintain quality.

Products of the graphic arts industry continue to be viewed as a "necessary evil" for the most part by those purchasing such products. Printing, for example, and now digital non-print images purchased for advertising and marketing purposes represent expenses that buyers prefer not incurring. However, they have to in order to survive in a very competitive marketplace. When a product is considered a "necessary evil," those buying it want it at the lowest possible price, as quickly as possible, and at the highest possible quality. Here in is part of the dilemma that commercial printers have faced for centuries in trying to earn a decent profit. Hence, the question is: What type of training is required to instill in employees of the graphic arts the knowledge and skills needed to accomplish

this difficult feat of providing low prices, fast delivery, and high quality? The answer is knowing how to negotiate supply purchasing arrangements, in understanding workflow management, in knowing how to monitor production systems, in knowing how to perform quality monitoring and how to control systems, in knowing how to manage inventory, in knowing how to estimate jobs that may be used for multimedia, and in knowing how to put delivery mechanisms in place. The goal is to learn how to avoid backward movement caused by errors, learning how to assure quality consistency, learning how to meet all customer's expectations, and learning how to predict and control waste.

- The control of electronic devices.

Training in the control of electronic devices is essential in nearly every facet of the graphic arts including prepress, press, post press, as well as in the production of non-print media such as Internet publishing, Web authoring, CD-ROM production, and so on. This differs greatly from the control of mechanical devices with their focus on manual dexterity and manipulations in some cases, and in maintenance (knowing how to fix mechanical items) in others. The control of electronic devices encompasses microprocessor and circuitry analysis; being able to navigate through software applications; knowing how to create PDFs (Portable Document Formats); knowing how to compress files to expedite transmission; knowing how to move files from one application to another; knowing how to manipulate image resolution, contrast, brightness, and size; knowing how to do RGB/CMYK (Red, Green, Blue/Cyan, Magenta, Yellow, Black) conversions; knowing how to cross-platform electronic files; and so on. Training in these areas is substantially different from mechanical training and has become a vital component of education and training in the graphic arts.

- Knowledge of computer management and workflow systems.

Training in computer management and workflow systems involves learning about networking and how computers are interconnected with other technology in creating completely digital and seamless workflows. For example, it is not unusual for graphic art companies to have departments with multiple computers, each of which are networked through a central server. This allows each computer to “talk” to each other and enables the easy movement of files from one workstation to another. Additionally, it has become common for computers, through servers, to drive prepress, press, and post press equipment such as computer-to-plate systems, digital on-demand and variable imaging printing presses, and even some finishing technology such as ink jet addressing systems. How these facets of the production workflow are interconnected or networked, from where and to where data flows, and how to capture data within the workflow to make changes and corrections, are vital parts of graphic arts training in the twenty-first century.

- Knowing how to “repurpose” for multimedia.

“Repurposing” is one of the newest words in the graphic arts vocabulary. It refers to creating or capturing an electronic image and manipulating it so it is suitable for

multimedia applications. For example, an electronic image created for distribution over the World Wide Web has different requirements than an electronic image created for reproduction on a web printing press. Copy range (difference between highlight and shadow density), sizing, resolution, and other physical properties of the image must vary for optimal results in both media. Preparing electronic images for “burning” onto a CD-ROM has yet other requirements, and preparing images for proofing on ink jet or laser printers have yet others. Knowing how to repurpose images for these applications and others requires substantial training in understanding electronic image construction, differences between ppi (pixels per inch), spi (spots per inch), dpi (dots per inch), and related structural components of electronic images.

- The ability to improve job handling practices and productivity.

It seems that as smooth as graphic arts production may appear, there is always room for an upward spiral of improvement. Intelligent graphic arts management today includes ongoing assessments of efficiency including how a job is handled in every cost center or production department of a graphic arts company. Being able to make such an assessment requires an in depth knowledge of job handling requirements and options in each production department. This used to be a fairly simple matter prior to digital workflows and performing production through software applications. One trained in mechanical production routines would easily be able to spot inefficiencies by merely walking through a department and observing manual routines. However, digital technology and software applications have made invisible those routines that influence production efficiency. It takes a special type of training in software and digital workflow analysis to become sensitized to areas in which efficiency can be improved.