available credit hours for students, and increased team-teaching options.

To avoid hodgepodge programs, educators should be careful about how they set up their units. A systematic analysis of goals, available materials, teacher knowledge, and student outcomes should be used as the foundation of an integrated curriculum. Teachers can help their teams by making more efficient use of their common planning time.

As the teachers become more experienced and creative in developing their integrated curriculum, the achievement levels of the students should rise. As more empirical research is completed, the link between an integrated curriculum and achievement will be apparent. The interdisciplinary curriculum is a new teaching delivery method. Instead of disjointed activities throughout the school year, the curriculum makes the activities link schools and careers. These school-to-work competencies should be the driving force of American high schools. The interdisciplinary curriculum is not a perfect system. Many decisions entail tradeoffs, but it does seem to provide a way for students to develop the higher order thinking and learning skills they will need to survive in the 21st century.

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3. Environmentally Sound and Competitive Processes in the Graphic Communications Industry

by Ute Sartorius

At a time when global competition is fierce, the graphic communications and printing industry is undergoing significant changes as a result of new environmental regulations. Awareness of the precarious ecological situation of our planet has imposed exigencies to reduce waste and contaminants derived from paper making and printing. However, new technology continuously responds to these restrictions by offering environmentally friendly solutions geared towards a reduction in the use of hazardous materials and waste production.

Every year, the United States consumes more than 67 million tons of paper products (Ortbal, Lange, & Carroll, 1996). According to Weiss (1996), 50 to 70% of all printed material is never used, and this figure is only slightly alleviated by recycling. In fact, paper represents about 40% of all solid waste in the United States (Ortbal et al., 1996). In addition, the printing industry has a considerable effect on the environment through the use of hazardous material. Undoubtedly, the graphics industry is seen as a principal culprit in the current environmental conditions.

However, in recent years, a combination of governmental regulations and an increased social awareness has created a demand for environmentally friendly alternatives, such as recycled paper and soy-based inks. Graphic designers and graphic artists share the responsibility to question the environmental impact of a product at all possible stages of its production, from concept development through printing and production. The process thus entails

assessing usefulness, reusability, recyclability, and overall design. In order to assure an environmentally friendly production, Ortbal et al. (1996) have suggested the following actions:

1. Using fewer materials to reduce waste right at the source.
2. Specifying reused materials and making the final product reusable.
3. Specifying recycled materials and making the final product recyclable.
4. Reducing the amount of energy required for production.
5. Reducing the pollution and/or toxic waste originated by production.

ELECTRONIC PRE-PRESS

In terms of pre-press production, new graphics technology constantly evolves towards a more environmentally friendly production system. Electronic output to film, for example, has simplified prepress work, reducing time and unnecessary use of material. Current computer graphics applications such as PageMaker, Quark Xpress, Freehand, Illustrator, and Photoshop allow for optimal screen performance, accurate color specification and separation, imposition, trapping, and screening. Combining these applications with high resolution output makes it possible to go directly from the screen to high contrast lith film, bringing more control and flexibility to the designer's desktop. Moreover, the all-digital computer-to-plate (CTP) work flow eliminates the use of film, avoiding pollution through silver nitrates, chemical developers, fixers, isopropyl alcohol, and gum arabics. Although most CTP platemakers use thermal plates processed with environmentally safe aqueous chemistry, developer-free plates using "dry toner transfer" technology are now available from manufacturers such as TechNova Imaging Systems. The implementation of CTP technology has experienced a considerable growth during the past three years, advancing from 40 installed platemakers in 1994 to approximately 600 in 1997, as estimated by Vantage Strategic Marketing, a firm in the United Kingdom that monitors the industry (Dennis, 1996). Not only is the production process of DTP technology faster and less expensive than the traditional method involving compositing, masking, and stripping of multiple generations of film, but it also yields higher image quality. In terms of environmental impact, elimination of chemical processes as well as minimization of production materials and use of energy are highly desirable steps towards a more environmentally responsible graphic arts production process. Other emerging environmentally sensitive procedures include the usage of recycled paper, the adoption of alternative inks, and the choice of printing and finishing processes.

RECYCLED PAPER

According to the American Forest and Paper Association (AFPA), paper recovery in the United States has been on the rise for several years (Streuteville, 1996). Nevertheless, the use of virgin fiber is still preferred, arguably because of its price advantage (Kraner, 1996). Qualitatively, recycled paper standards equal virgin pulp and, with modern deinking technology, even post-consumer waste produces white, fleck-free writing and printing papers with extremely high performance levels ("Recycling Paper," 1993). In December 1994, the Clinton administration issued an executive order calling for a minimum content standard of 20% post-consumer waste for most office papers used by the federal government. The order stipulates that this standard be increased to 30% beginning on December 31, 1998 (Evans, 1997). Currently, manufacturers such as Mohawk, Cross Pointe, Monadnock, and Crane offer competitive paper grades composed entirely of post-consumer waste. In addition, tree-free paper can be made from kenaf (a hibiscus plant of African origin), hemp, fabric, banana fiber, and algae (Evans, 1997; Imhoff, 1994, 1997).

ALTERNATIVE INKS

Due to the emission of volatile organic compounds (VOCs) released from conventional inks in which pigments are suspended in petroleum, environmentally friendly soy-based and vegetable-based inks are becoming increasingly popular. These inks, comparable in quality and price to conventional inks, break down more readily in the landfill as well as in the deinking and repulping processes (Evans, 1997). According to Abramowitz (1996), the consumption of soy-based printing inks has been increasing at an annual average of more than 300%. In fact, the majority of newspapers in the United States use soy-based ink for its better mileage, faster start-up, and good print image. Vegetable inks, on the other hand, which can be made from corn, walnut, and coconut oils, are a viable alternative to conventional inks because of their improved lithographic performance and enhanced color reproduction (Rooney, 1993).

PRINTING AND FINISHING PROCESSES

In printing processes, flexography is generally considered environmentally friendly for its water-based inks. However, water-based inks can create problems for paper recovery in pulp mills that use flotation deinking systems designed to separate oil and water. Waterless or dry printing—also called dryography—is another widely accepted option (Evans, 1997; Ortbal et al., 1996). Waterless printing eliminates fountain solution, replacing solid vibrator rollers with hollow rollers containing a cooling solution that assures even color quality on the press by controlling the ink's temperature. Some advantages of waterless plates are high resolution attained by allowing more dots per inch and better control of dot integrity (Ortbal et al., 1996). Embossing, which creates an impression of an image by molding paper around a die, is one of the most environmentally sound processes, because it does not employ chemicals or inks (Evans, 1997). Thermography and foil stamping, on the other hand, are not recommendable because their use of resins render paper virtually unrecyclable. In terms of varnishes, press-applied formulations are easier to remove from paper in the deinking process than aqueous varnish, and ultraviolet-cured varnish—the glossiest and most durable finish of all varnishes—produces the most severe environmental impact, making paper absolutely undeinkable.

FUTURE PERSPECTIVES

On a completely revolutionary level, scientists are working on a technologically advanced alternative that may completely eliminate the use of paper. Joe Jacobson, at the Massachusetts Institute of Technology, is developing an electronic display as thin and versatile

as paper but infinitely reusable (Platt, 1997). Jacobson is considering the production of a "prime sheet of paper with millions of tiny, two-toned particles" (Platt, 1997, p. 165). The so-called "paper" is coated with a grid made up of thousands of lines of flexible, transparent, conductive ink. Text and images come into focus by applying controlled electronic charges. However, Jacobson does not expect the paper-thin electronic display to replace conventional paper within the next 20 years.

In Europe, a prototype for a new ink that will not harm the environment is being tested (Imhoff, 1996). The ink is polymerically encapsulated and held in place with a bonding agent that comes off the paper at 130 degrees Fahrenheit. According to Imhoff (1996), the dye never touches the paper, and when an item is no longer needed, the ink goes back into a solution to be shipped back to the printer so it can be reused. Moreover, paper treated with this ink will be 12 to 13 times more recyclable because there is no breaking up of the fiber by chemical bleaching.

In many fields of the graphics industry, emerging technologies offer new solutions that safeguard the environment. Universities and schools, where tomorrow's printers and graphic communicators are being educated, have the compelling task of fostering an environmentally conscious attitude among their students in order to ensure responsible graphic production decisions for the future. Vice President Al Gore highlighted the need for environmental education saying: "The most dangerous threat to our global environment may not be the strategic threats themselves but rather our perception of them, for most people do not yet accept the fact that this crisis is extremely grave" (Ortbal et al., 1996, p. XVIII). The educational aspect should not be limited to creating awareness about possible pollution through printing processes, use of hazardous materials, and the impact of paper production and consumption on existing ecosystems. More importantly, environmental education includes making ecologically sound and economically viable options available and known to students and professionals. In the graphics industry, environmental awareness combined with state-of-the-art technological know-how is no longer a matter of choice; it is rather a strategic necessity to stay competitive in an increasingly global market.

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4. A Customer Feedback Information System

by Ke Wang, Ping Liu, and Mahyar Izadi

In the competitive global economy, every organization needs to continuously improve the quality of its products and services to meet the needs of ever more sophisticated customers. Prompt response to customer feedback is a critical step toward achieving world class quality. Today, consumers demand high quality and reliability in goods and services at a fair price. The quality of products and services can no longer be taken for granted. Even industries that once enjoyed a monopoly over domestic products now face competition from foreign products. More than ever industrial companies realize that quality is vital to their survival, and industrial technology faculty and graduates can play a significant role in quality improvement and customer satisfaction.

All activities for quality improvement must be performed with customers in the principal position. Both manufacturing and customer service divisions should focus on fulfilling the needs and expectations of customers. Processes including design, manufacturing, and service begin with customer needs and expectations and end with what the customer sees and believes concerning the quality of the product. Managers must continuously understand customers' needs and provide