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The Print Medium In Distance Education

By

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THE PRINT MEDIUM IN DISTANCE EDUCATION

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A Brief History of Print

Recently, I stood amid the ruins at Jarash, Jordan reading Greek letters scored in monoliths by Alexander the Great's masons in 330 BC. Two days earlier I had viewed the Magna Carta which reposes in the British Museum and, in the days following, picked my way down a steep hillside at Clearwater Bay in Hong Kong Territory to touch 13th century Sung Dynasty inscriptions. Each experience assured me that the written word is an uncommonly persistent human device, and that print has become its durable medium.

The Egyptians used simple hieroglyphics from early in the 4th millenium and from 3000 BC drew them on papyrus. The Sumerians are credited with the first writing. As early as 3700 BC these ancient Persians used wedge-shaped (cuneiform) letters well-suited to pressing into clay. The first known library, consisting of clay tablets, dates back to Babylon in 2000 BC. Late in the 2nd millenium, the North Semitic alphabet was invented in the Syria-Palestine region and gave rise not only to classical Hebrew and Aramaic and, indirectly, to Arabic, but also to the alphabets of South and South-East Asia, the angular Devangari and Sanskrit, and the rounded Burmese. It also travelled to the West, brought first to Greece by the Phoenicians. A variety of media were used to transport writing: the Assyrians wrote on hollow clay cylinders and the Romans on wax tablets, while the message of Buddhism was spread in part by the inscriptions of Ashokan pillars. The Chinese are credited with inventing paper in 100 AD and are known to have printed on it with ideograms carved from wood and soft stone.

The modern era of print is usually held to have begun in 1456 with the release in Mainz, Germany, of Johann Gutenberg's Latin bible. However, the first moveable metal type appears to have been produced in the Royal Type Foundry of Korea in 1403 and a book was printed in 1409. During the 400 years from 1400 to 1790, there were few changes in printing. Essentially, a mixture of molten lead-tin was poured into a mold formed by punching an engraved steel character into a piece of copper.
Individual letters were hand set into page forms, the letters inked and a single sheet of paper printed in a hand press. Through the late 18th and the 19th centuries several refinements were made to this basic process. Didot invented duplicate printing plates (stereotypes) from set type in 1790, Senfelder of Munich invented lithography in 1796 and, in 1816, Konig and Bauer built the first perfecting press, capable of printing both sides of a sheet of paper. An American, David Bruce, patented the first commercially successful typecasting machine in 1838; it produced 100 characters an hour. In 1885, printing reached its mechanical, industrial era zenith with Mergenthaler's invention of linotype, a keyboard-operated machine capable of casting an entire line of alpha-numeric type from molten metal. Eventually, linotype machines could compose six lines of type per minute and were still in use by 1970. Older printers in distance education institutions began their careers setting hot metal.

**INSERT TABLE 1 ABOUT HERE**

Two 20th century technologies were to exert a profound influence on printing. Phototypesetting was under experimentation in the 1940's although not then commercially viable. It was an entirely new process in which letters and characters in each type style are stored on film or tape-recorded. Both positive and negative images are available and typeface can be quickly enlarged or reduced with lenses. When the printing industry began to adopt photo-optic technology in the 1960's there occurred major strife on the shop floor. In Runquist's (1985) words:

"Skilled craftsmen were now forced to bridge the gap between the tangible reality of metalcraft and the abstract process of computerised typesetting. The tools, the skills and the working environment were all changing. Typesetting was no longer the exclusive domain of ink and metal craftsmen who laboured in industrial factories as it had been for 500 years. Instead, a reborn industry was emerging - one that was cleaner, more cerebral, and soon to be dominated by a preponderance of women workers."
Computers bring to printing the power of voluminous information storage and its extremely fast retrieval. However, it is important to remember that even as recently as 1980, the year that the IBM Personal Computer went to market, digital typesetting machines were still used mainly in the newspaper industry where large volume turnover justified their high cost. Since 1980 there has been intense competition among manufacturers to deliver fast, cost-effective page make-up and integrated text processing systems. The events of the past twenty years, including the emergence of distance education as a technology for moving information in new ways, mark the transition from the industrial to the post-industrial era, from mechanical to digital technology. The advent of digital typesetting may prove to be as momentous as the invention of moveable metal type.

The intent of this paper is to place recent developments in the technology of print preparation into focus for distance education practitioners, to outline current trends and to discuss human resource requirements in preparing printed course materials. As alluring as technology may be, human skills and creativity will continue to determine whether technological gadgets are employed efficiently in carrying out our primary task - the education of distant learners.

**Evolution of the Print Medium in Distance Education**

Taking the establishment of the British Open University as its beginning, modern distance education is just now approaching twenty years of age. Print development systems have passed through several stages in this short time, evolving so quickly that information on the topic is often out date in two or three years. The situation is also complicated by the emergence of new styles of distance teaching institutions, for example, single-mode operations with no resident faculty, such as Universitas Terbuka, Al-Quds Open University and the Open Learning Institute. In these cases, where perpetually new pools of
course writers are employed under contract, the burden of training them in both institutional methodologies and the use of new technologies has been particularly heavy. And whether course writers work for dual or single-mode institutions, with or without faculty, and with mechanical or digital technology, they bring to bear their own choices for new technology and fresh ideas about how to use it. So, too, equipment manufacturers seem always prepared to demonstrate and sell indispensible new equipment and software. How then do we bring order to and analyse recent transformations in the process of print preparation?

In suggesting three distinct phases in the evolution of print development systems over a horizon of two decades, I am leaning on my own experience at the Open Learning Institute and at Asian distance education institutions where OLI has been engaged in training and development projects. Some of the world’s older institutions have seen a complete transformation from mechanical to digital technology in their print development systems, from typewriters and hot lead to word processors and laser printers. OLI is less than ten years of age; accordingly, we began with intermediate technology — typewriters, phototypesetting and impact printing. The major intrusion of new technology has been felt at the "front end" of our system. However, the traditional print shop is now also coming under pressure as new devices such as laser printers and raster image processors (Barrett and Reistroffer, 1987; Flower, 1987) permit images generated on a microcomputer to be printed at extremely high resolution.
Phase I: Mechanical Script Preparation

When I began designing science courses at OLI in 1980, course writers usually sent me typewritten manuscripts. These were either edited and retyped on an IBM Selectric typewriter or sent directly to the production unit heavily marked up with a red pencil, the decision dictated by the perceived tolerance and deciphering ability of staff in production. A keyboard specialist then rekeyed the entire manuscript, including lengthy and complex typesetting codes, into a Wang typesetter to produce a good quality, albeit expensive, galley proof. Because codes had to be inserted into the manuscript, the operator was not able to "see" the manuscript on the video display terminal. As a result, complicated mathematics and scientific manuscripts often had to be rekeyed several times before an accurate final galley emerged. To complete a print-ready manuscript, a paste-up artist amalgamated snippets of galley paper and hand-drawn illustrations provided by a graphic artist. Finally, two-page flats were sent to the print shop for camera work and printing. Our cameras, paper and presses were incapable of maintaining the quality of the galley proofs despite the best efforts of the print shop staff.

There were two major flaws in this system of mechanical script preparation. With each editorial iteration a new manuscript had to be keyed, or one lived with a lower quality, marked up script. As well, the system produced high quality and expensive intermediate stage manuscripts, only to lose the quality at final production stage. This type of system and its frustrations are well known to distance education print practitioners. It has been described in greater detail (Timmers, 1983, 1985a) and in other forms (Flower, 1987). Figure 1 summarises the system.
Phase II: Partially Integrated Front End

We opted in 1984 to change the print development system at the Open Learning Institute in two fundamental ways. This transformation has been described earlier (Mugridge, 1985; Bottomley, 1986a,b; Timmers and Mugridge, 1986), but can be summarised here. First, each course designer/editor worked on a computer terminal which gave access to powerful word processing software installed on the Institute's central minicomputers and to relatively fast storage and retrieval of manuscripts. Second, a new page make-up system, Xerox's "Star", was installed. The computer information systems staff of the Institute developed integrative software to permit our central computers to move manuscripts bi-directionally between editors and page make-up technicians in the production unit as shown in figure 2.

This new system had an immediate impact on the way manuscripts were treated. Once words are digitally "captured", in this case by initially keying a manuscript into the system, the manuscript can move electronically through the printing stage (see also Cowper and Thompson, 1982; Lafrere, 1984). This is especially possible where all required graphics can be created on a page make-up terminal, a laser printer provides a final page of sufficient quality, and where the production run is of small size. However, in the present OLI print development system, it is common for some of the graphics to be hand-drawn, to use a paste-up specialist to amalgamate mechanical and digital elements of the script, and to print large runs on the mechanical printing presses.
Phase III: Integrated Electronic Print Development

The partially integrated print development system depicted in figure 2 not only suggests the way of the future, it also poses significant problems. Its greatest shortcoming is a lack of integration between the word processing environment, represented by the initial input terminal and the designer/editor's terminal, and page make-up environment. The present debate at OLI centers on the perceived need for common software to serve the domains of course writer, course designer/editor and page make-up artists and technicians, whether or not the process is mediated by a central computer. The value of such commonality is suggested by the experimental, microcomputer-based network between course writer and course designer established at OLI in 1983 (Timmers, 1984b, 1986b). This experimental system, also subsequently used to train course writers and developers in Malaysia and Indonesia, was successful in helping writers adhere to form and style guidelines, and in increasing the speed with which courses could be developed.

A well designed system for print development should achieve the following goals: 1) flexible hardware and software made available to front end workers such as writers, designers and page make-up technicians should allow practitioners in each domain to make maximum contributions to print development while providing necessary controls to prevent divergence from house style guidelines and other critically important standards; 2) the system must be cost-effective and allow for upgrading; 3) the system should if possible interface with adjunct technological devices, for example front end optical scanners, high resolution graphics terminals, laser printers and communications ports, in order to offer increased flexibility; and 4) the system must ensure that valuable traditional skills like the graphic arts and lay-out are offered points of entry.
Much information is now appearing on the phenomenon of desktop publishing (for example Alsop, 1987; Burns and Venit, 1987a,b,c; Holmes, 1987; Rosenthal, 1987; Seybold, 1987; Seybold Report on Desktop Publishing, 1986). Some recent developments in this area, notably typesetter emulation and page layout software, will find their way into distance education print preparation systems. However, caution is urged. Helliwell (1986) offers a lucid treatment of current myths surrounding the marketing term "desktop publishing." He asserts, for example: "Current page layout programs are still primitive compared to what can be accomplished by a moderately skilled layout artist with an Exacto knife, a ruler, and a waxer."

No matter which print development configuration is chosen, distance education practitioners must contend with several overriding trends. These will continue as we approach the next decade and will affect our decisions about the human resources we require. Not only will traditional typesetting continue to be decentralised, but also the origination of both structure and content of distance education course materials will be more widely dispersed. Digital language will increasingly integrate the various components of print development systems and reproduction of multiple copies will steadily move away from traditional impact printing devices. Course writers and others who have available databases that can be used for teaching will become more skilled in the use of digital technologies. As this happens, we should expect the roles of course designers, editors, artists and print technicians to move steadily toward the managerial and consultative.

Training Requirements for Print Medium Practitioners

A discussion of training requirements in print production systems focuses attention on several issues within distance education institutions. Institutions evolve variously, encompass different
attitudes about and capacities for new technology, operate in a compartmentalized fashion and give training and staff development low priority.

1. Institutions vary widely in their course development systems. Print development is usually depicted as a linear process (see for example Dodd, 1981a,b; Mason and Goodenough, 1987; Holmberg, 1983) although the scope of various tasks and the relative importance placed on staff who do the tasks differs. At Universiti Sains Malaysia, for example, on-campus academics were trained to write distance teaching materials either by offshore trainers or a very few off-campus administrators. Clerical staff keyed in manuscripts (initially on typewriters, later on word processors) and designed them by following a basic model. Artwork was rare and materials were printed at the university's central printery. Recently, a semi-permanent group of off-campus coursewriters has been trained to act in the role of instructional designer (Bottomley, 1986c; Timmers 1984a, 1985b, 1986a, 1987; Timmers et al., 1987). Universitas Terbuka in Indonesia uses contract writers who undergo cursory course development training and follow a rudimentary blueprint while writing. Their manuscripts are word processed at UT, checked for stylistic adherence by an in-house group of editors and printed commercially in large volumes (Sandhu, 1987). At OLI, course designers train writers and manage the front end of print development. The majority of print materials are produced at the Institute. As you can see, course development means something different in each institution.

2. Institutions are marked by different attitudes toward print production technology and have varying capacities to purchase it. The purchase of a print production system requires a major institutional commitment. Decisions taken reflect not only the capacity to purchase, but also an awareness of what equipment is currently available or anticipated. Institutions can find themselves locked into technology that actually defines the entire teaching approach long after anyone recalls who made the original decision to purchase and on what grounds it was made. (For
example, OLI tends to produce print-based courses, 33% of which have an audio cassette component, because in earlier years decisions were taken to install production technology for these media.) New digital technology for print preparation should reduce some of the burden of choosing a system as it is more portable, more productive and will continue to decrease in cost.

3. Instructional design and media production tend to be compartmentalized in distance education institutions. Unfortunately, the term "course development" has been made synonymous with assisting academics to generate pedagogically sound, print-based course material while keeping an eye tuned to institutional standards. Neither print production processes nor technology has been adequately addressed by those who write about course development (Jonassen, 1982; Duffy and Waller, 1985; Jenkins, 1985; Rowntree, 1986). New digital technologies provide an escape from traditional academic vs technical battles by decentralising technical tasks.

4. Different levels of training are required. Training for print production might refer on one hand to undertaking doctoral studies in instructional design and on the other to sitting in on a one-day workshop. Print production technicians can spend several years in trade school or spend a week in another institution's print shop. It is important for administrators to realize that distance education is developing new methodologies and, therefore, formal training does not always adequately address applied technology in print production.

In the following sections of this paper, I have attempted to sort all the usual tasks involved in preparing printed distance education course materials into three discrete blocks. The categories pre-production, production and post-production are artificial; however, my intention is simply to highlight those functions most affected by new technologies and those which will play increasingly important roles in the future.
Pre-production

The tasks associated with course development have traditionally involved training the course writer and associated academic consultants in distance education methodologies and institutional print development requirements. This has been done in larger course teams or simply between an author and a designer/editor. The writer must know clearly our publishing standards, copyright requirements and systems for developing audio, video or digital media. The designer/editor may also take the role of course development manager and be required to lay out contractual terms, including schedules and deadlines for writing. Finally, the writer and designer/editor must develop a content plan (blueprint), and test comprehension and working style by creating prototype segments and assembling a mutually satisfactory submission-edit-revision procedure.

Success or failure in developing an individual course invariably resides within the pre-production stage. Course writing is fraught with human variables and is the least predictable part of print development. In the future, designer/editors will continue to require planning, teaching, design and motivational skills. As new page design and typesetting software enforces the decentralisation of these production tasks, the designer/editor will not only be required to train writers in their use, but also will play a greater role in controlling the quality of a remote author's work. Our experiments indicate that template construction and course modelling skills will play greater roles in the integrated electronic print development systems of the future.
Production

Management skills are especially important to production units in distance education institutions where course turnaround may be expected in as little as three months. The pressure is greatest in new distance education institutions as course production must keep pace with student consumption. Course revision is invariably sacrificed and students suffer flawed course material. There is usually a crisis by the third year of operation when revisions can no longer be ignored and the development of new material continues unabated. Production managers require good communication skills in maintaining liaison with pre-production staff, and scheduling and management skills for their own shop. As print development systems become more integrated, it is to be expected that managers will require skills in computer-based scheduling and critical path analysis.

While art schools tend to teach traditional skills, the graphic design industry is evolving at high speed. Graphic artists will increasingly turn their attention to computer-generated art or, at least, work more closely in conjunction with electronic page layout specialists. Page development and layout software has had a major impact on design. While most agree that new, easy-to-use and entertaining software permits neophyte designers to experiment, the traditional skills of the artist and designer will continue to be in heavy demand in the foreseeable future. Proofreading is another traditional craft often ignored or undervalued in emerging distance education systems. Where proofreaders are available we can anticipate that their role will evolve with systems. Traditionally, proofreaders ensure that each iteration of a manuscript is accurate in terms of its precursor and that house style and language conventions are adhered to. Captured keystrokes reduce variability in new drafts of manuscripts, but modern technology does not reduce the requirement to use language properly and consistently.
All indications suggest that high speed non-impact printing, for example laser, electro-erosion and xereographic, will continue to infiltrate the traditional print shop. As electro-digital text and graphic input to the production unit increases, more importance will begin to fall on the front end of the production system. Non-impact printing is already upon us. It is now possible to circumvent the production unit altogether and, for small enrolment courses, this has occurred on a number of occasions at the Open Learning Institute. Distance education system administrators must now address serious issues about the cost-effectiveness of traditional print tasks, and of how to retain valuable employees who have been displaced by emerging technologies.

Post-Production

Speed and operating efficiency are the hallmarks of today's single station finishing operation. Even a medium-sized Bourg collator run by an experienced operator can produce up to 1500 sets of finished material per hour. In the past, my institution printed its units as individual booklets. Today entire courses are produced as single pages, collated, three-hole punched and shrink wrapped. There are significant savings in paper, labour, handling and warehousing space.

Warehouse management and course handling have changed as software has been developed to integrate student records and the warehousing operations. These developments have been described in detail in earlier papers (Bottomley, 1986 a,b; Timmers and Mugridge, 1986). Post-production functions will evolve to reflect changes in production technology. Two scenarios of the future are worth mentioning. In the first, a single student registers in a course, and the course is produced on demand and mailed. In the second, courses are delivered electronically and either read on students' terminals or printed on their home printers. In both instances, traditional printing and
warehousing functions are circumvented. Neither scenario is drawn from science fiction - both options are available today. Once again, distance education system administrators are required to deal with both emerging technologies and their human impact.

Conclusion

Printed course materials form the backbone of today's distance education institutions and can be expected to do so for the foreseeable future (Daniel and Marquis, 1979; Pittman, 1987). Those who deny their centrality fail to accommodate the persistent traditions of writing and print - flexibility, transportability and moderate cost. Not only are students comfortable with the print medium, traditional and distance educators are, too.

This paper addresses some of the many variables affecting our methods of print preparation. Over the past twenty years, we have seen the emergence of new models for distance education institutions. At the same time, technological change has been intense, occasionally demonstrating its power to define, limit or extend our educational systems, always demanding retraining so that valuable traditional skills are not lost. Finally, the expansion of distance teaching programmes continues unabated on a global scale and has produced acute shortages of trained personnel.

We have demonstrated that print production methods and technology are transferable (Jenkins, 1987; Timmers, 1987), but we must work hard to accomplish effective exchange. Experience suggests that there is considerable value in simply sharing our expertise in methodology and technology; we often ask trainees at OLI to undertake an extensive comparative analysis of distance education institutions in order to focus their attention on why things are done a certain way. Our
experience also tells us that once we have attracted staff who have adequate basic training in print production management, the language arts, design and graphic arts, we must train them to apply these skills within our distance education system. Finally, we require training at all levels in new digital technologies - word processing systems, page layout and typesetting software and hardware, laser printing and optical scanning - and in developing or applying integrative software to make systems run smoothly. New communications technologies are providing opportunities for joint course development, course sharing and off-shore teaching. Training is required in the use of communications software, facsimile transmission devices, conferencing and management of computer-based telecommunications.

Print development is only one of many areas where distance educators must make informed decisions about implementing and utilizing new technology, and must be prepared to deal with staff dislocation caused by technological turnover. Every indication suggests that we are becoming more critical when shopping for institutional models, technology, training programmes and consulting services. We should welcome this trend as it reflects our collective experience in establishing and refining distance education systems.
References


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Table 1  **Chronology of events during the evolution of print**

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<td>Neolithic Art</td>
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<tr>
<td>6,000</td>
<td>Cuneiform writing</td>
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<td>4,000</td>
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<td>3,000</td>
<td>alphabet invented</td>
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<td>2,000</td>
<td>first paper</td>
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<tr>
<td>600</td>
<td>earliest moveable metal type</td>
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<td>digital typesetting appears; first open university</td>
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Figure 1  Mechanical Script Preparation
Figure 2  Partially Integrated Front End
common
word-processing/page make-up
environments

Figure 3  Integrated Electronic Print Development
Table 2  **Pre-production activities**

- assemble course teams
- explain terms of contracts
- explain copyright procedures
- train course writers and academic consultants
- establish schedules and deadlines
- plan courses and develop blueprints
- write prototypical units
- establish submission/edit/manuscript revision procedures
- integrate resources from other media
- edit manuscripts
- liaison with production unit
Table 3 **Production activities**

- liaison with pre-production
- schedule and manage production tasks
- design and produce graphics
- page make-up and layout
- typeset manuscripts
- proofread manuscripts
- paste-up
- camera work and plate preparation
- printing and photocopying
Table 4  **Post-production activities**

- finishing, including collating, trimming and binding
- wrapping
- warehousing
- course package assembly
- delivery