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ABSTRACT

A rationale for the design and maintenance of a multi-media instructional system is presented in this topical paper. Implications, such as developing instructional packages and behavioral objectives, that are important in designing a multi-media instructional program are also discussed. Once the idea of designing such a program has been accepted, planning in terms of what media and equipment to use, what facilities and personnel are available, and how to finance and maintain the program are important considerations. Another factor in constructing a multi-media program is the writing of the lessons. The fourth section of this paper includes case studies of existing multi-media programs in shorthand and typing, mathematics, biology, and English. The author makes brief analyses of these programs in comparison to their traditional counterparts. The final chapter in this paper brings out certain questions concerning the development of multi-media programs that need to be answered before undertaking such a project. (RC)

CASE STUDIES IN MULTI-MEDIA INSTRUCTION

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TOPICAL PAPERS

1. A Developmental Research Plan for Junior College Remedial Education, July 1968. Out of print.
2. A Developmental Research Plan for Junior College Remedial Education; Number 2: Attitude Assessment, November 1968
3. Student Activism and the Junior College Administrator: Judicial Guidelines, December 1968
4. Students as Teachers, January 1969
5. Is Anyone Learning to Write? February 1969
6. Is It Really a Better Technique? March 1969. Out of print.
7. A Developmental Research Plan for Junior College Remedial Education; Number 3: Concept Formation, August 1969
8. The Junior College in International Perspective, January 1970
9. Identifying the Effective Instructor, January 1970
10. Financing Higher Education: A Proposal, February 1970
11. The Person: A Conceptual Synthesis, March 1970
12. The Position Papers of Black Student Activists, September 1970
13. Case Studies in Multi-Media Instruction, October 1970

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Foreword

Most reports that deal with technology in education refer to the potential uses of various forms of hardware and software. Sweeping statements are made praising the flexibility of reproducible media or blaming them for failing to live up to their promises. More rarely do we find case studies describing the introduction and use of the various techniques that together form a technology in education.

This Topical Paper, No. 13 in a series, reviews some rather significant details about multi-media instruction--a generic term for patterns that combine various media forms into single instructional sequences. The author reports the problems associated with the introduction and maintenance of multi-media systems in some junior colleges that have attained a considerable amount of experience in their use. The paper also includes some particularly helpful caveats.

At the time he wrote the paper, Richard Banister was Dean of Academic Instruction at Mt. San Jacinto College (California). Our sincere thanks to him for this contribution to the literature of the field.

Arthur M. Cohen
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Chapter I

A Rationale for Multi-Media Instructional Systems

As we enter the 1970's, American education should be prepared for drastic change. The 1960's witnessed a growing concern for education on all fronts. Parents demanded better schools; taxpayers demanded more economical schools; educational leaders and classroom instructors demanded changes in the whole education process. Last, but certainly not least, in our universities, community colleges, and high schools, students demonstrated for changes in the educational program.

Although the manufacturers of both hardware and software for multi-media systems have tried to increase their sales to the "knowledge industry," their efforts have been frustrated. Their expectations were dashed by the billions of dollars spent on the Vietnam war effort instead of on the educational effort at home. With the passage of the Elementary-Secondary Education Act of 1965, the Higher Education Act, the Vocational Education Act of 1963, and other large-scale federal education projects, the manufacturers' hopes were raised. Although these programs did not blossom to the extent they had hoped, they still see a vast potential market for their products and have carried on a campaign to affect the attitudes and values of both the educational world and the public.

Publications Related to Multi-Media Use

Many new books, journal articles, and other publications, subsidized by the manufacturers, are aimed at creating an environment receptive to change. With articles about computer-assisted instruction, multi-media systems, educational TV, and other innovations, the manufacturers hope to create a need for these novel devices. A few examples are: Educational Television and Educational Media, with a controlled,

complimentary circulation; Education Age, published by 3M and distributed nationwide to educators at all levels; and College Management and College and University Business, directed to those who control the purse strings.

Professional organizations and independent publishing enterprises have also encouraged change with such periodicals as the NSPI Journal of the National Society for Programmed Instruction, and Educational Technology. Some current concepts of multi-media systems are usable; others are misleading. We here explore some of these concepts.

The manufacturers of hardware for multi-media instructional systems have been concerned primarily with developing and marketing novel mechanical and electronic devices. As most of these devices have been designed in the manufacturers' engineering departments, not in the classroom, they are not only too expensive to use on a large scale, but also require software unsuitable for an educational setting. As a result of hard-sell tactics, millions of dollars worth of equipment is sitting in closets in our educational institutions, most of it purchased without sufficient evaluation.

In most cases, the manufacturers of software have no sound concept of multi-media instructional systems either, usually specializing in production of paper or cardboard, film, filmstrip, or tape. They expect their product to be sold in limited quantities and used for group viewing, thus keeping the price too high. When the producers of software realize their sales could increase one or two thousand per cent through lower prices, they will have a real impact on the educational system.

Publishers and editors of professional books and journals are fascinated with multi-media instruction as a novelty that creates reader interest, but, because so few schools are using it, most of the articles are either utopian proposals of manufacturers or innovators in the ivory tower or reports of limited experimental programs in certain districts or colleges.

There are few articles by experienced practitioners, except on instructional television.

Educational administrators often view multi-media systems with enthusiasm, visualizing machines grinding out information, students grinding out answers, teachers busily coordinating the program, and taxpayers smiling. They view the possession of hardware not only as a status symbol but also as good public relations, for the public has been told that, if education used the products of modern technology, it would save the taxpayers money.

In many cases instructors are the lost men. Although they will determine the success or failure of the new technology, they are often the last ones to be consulted. If they fail to comprehend the potential of the new technology and fail to use it fully, it will never be widely adopted.

Definitions Needed

The general concept of multi-media instruction in the minds of manufacturers and educators is limited. The term "multi-media instructional system" is defined as a pre-planned system of instruction using many means, ranging through lectures, discussions, field trips, experiments, and other teaching and learning activities. The author has found many educators and manufacturers unable to comprehend even this obvious definition and its implications.

Implications

An important implication of a multi-media instructional system is the necessity for program design. This idea is foreign to most classroom instructors and administrators--as well as to manufacturers of hardware and software, for they have rarely had an opportunity to design total programs. They have designed textbooks, workbooks, films, filmstrips, and other teaching aids, but have seldom designed the total system for a particular course, especially at the college

level. Even for educational television, the manufacturers could not control the design of the entire system because they cannot control its use in the classroom.

Administrators and instructors have had no chance to design programs, largely because of lack of money and time for research and development. Instructors are used to organizing their classroom topics and activities, and they design limited instructional programs by selecting the activities and materials. Those who intend to develop multi-media materials and who see the potential of program design, must realize that they will affect not only the media and methods, but also the content of their courses. Once an instructor breaks through the various limitations of the past, he can become a creative educator, capable of designing many kinds of instructional systems to solve many teaching problems.

A second implication for multi-media systems is the concept of instructional packages. If a teacher is allowed to, he can design an entire instructional package from pre-test to post-test, bringing his own structure to it.

A third implication is teaching by objectives. The person who designs a new system must work with objectives to produce an effective system. Without terminal behavior objectives, the system will tend to wander and the students will lose interest in the program. A lecturer can sense whether his class understands what he is saying, but when his lecture is put in a semi-programed format for an automated tutorial system, he must make sure in advance that the presentation is interesting and directed toward some terminal goal. The identification of terminal behaviors is difficult for some instructors and will be discussed in detail in later chapters.

A fourth implication is that of instructor options. In the typical classroom, the instructor talks to the students, who listen and take notes. This pattern varies somewhat in a laboratory, in a discussion group, or in a debate. Multi-

media use can change all this, however, for the teacher lecturing in front of the large group is not common in such programs. He will spend his time mainly in small-group seminars, where personal interaction is possible.

The instructor planning a multi-media program has many teacher-learner situations open to him. These cover automated learning, large-group lectures, motion-picture viewing in large groups, closed-circuit television, seminars, panel discussions, debates, field trips, laboratory experiences, and many others. In a well-developed system, the student also has options, which will vary with the program and allow him to learn by the methods that suit him best--whether by reading, by listening, or by seeing.

A fifth implication is that performance will become more important, and time less important. The customary fifty-minute period will, with the use of varied media, become less important than the ability to achieve predetermined goals.

Instructional Patterns Used Today

A brief review here of the instructional patterns in typical junior colleges should allow the reader to compare them with the multi-media instructional systems.

Instructional space in junior colleges usually consists of classrooms, large lecture halls, laboratories, library and study centers, and an occasional small seminar room. Students attend classes with over twenty-five students, have daily lectures, and pursue parallel activities. Classrooms are rarely designed so that separate groups of students can carry out different activities at the same time.

In traditional institutions, time is also rigidly structured into repetitive daily and weekly patterns. Few schools are truly flexible in their scheduling, even at the college level, although multi-media systems make it possible to use large-group instruction, small-group seminars, and

student-scheduled study periods. Also, one instructor or one team of instructors can be responsible for all students enrolled in a particular course. Scheduling possibilities in a multi-media program will be described later.

The personnel in the traditional program includes instructors, students, and an occasional aide or assistant to the instructor. The size of the group, whether twenty-five or several hundred, makes little difference in the instruction or in the ability of students to grasp the information.

In traditionally organized programs, the students have little chance to interact with one another or with the instructor, to ask questions, or to be questioned. At some junior colleges, seminars are used as oral quiz sessions, but many of them have more than fifteen students, thus hampering conversation and communication within the group.

Instructional equipment and materials are usually in short supply except in the science laboratory. Audio-visual equipment is used mainly as an aid to instruction rather than as an integral part of it. It is also used largely for group viewing, since traditional classrooms are not designed for best use of audio-visual materials. Until recently, facilities for individual use of these materials have been almost non-existent, although many libraries now have them. Even when the hardware exists, the software is often scant, and the facility cannot be used effectively.

The Integrated Instructional Package

Although the concept of an integrated instructional system using various media has been discussed for forty years or more, it is not often found in today's educational institutions. Heinich points out that audio-visual materials were conceived as aids rather than as self-contained teaching devices. He further points out that

> This attitude prevailed even when audio-visual materials were conceived during the curriculum planning and development stage. . . . In public education, the concept of materials as "aids" was even more rigid because materials of instruction were more afterthoughts of curriculum planning than results of the curriculum development process. Audio-visual materials usually entered the instructional process at the classroom application level either when the teacher was casting about for materials that might "aid" instruction, or when the audio-visual director instituted a search of catalogs for appropriate materials (6:3).

With the evolution of multi-media systems, a system integrated and designed for a specific program has become a necessary concept. Few teachers, however, have had any experience in program design, and even fewer in developing audio-visual materials and other teaching techniques for a specific program; they see themselves mainly as users of ready-made instructional materials, their responsibility being merely to implement their use in the classroom. The new systems allow instructors to develop programs from the ground up. Later in this paper, we shall discuss several case studies of programs developed by junior college instructors.

A teacher developing instructional systems must accomplish several important tasks in the process. The first is to identify terminal behavior objectives in measurable terms, for which most teachers will require some training. The next task is to determine the content needed to meet the objectives, for he must be aware of content structure before he can write multi-media program materials. A third task is to decide what can best be taught by automated tutorial systems, what by large-group lectures, what by laboratory experience, and what by small-group seminars or other instructional techniques. The fourth task is the actual development of the instructional materials and techniques.

The necessary months of creation, testing, and investigating novel, unfamiliar teaching techniques will give the instructor a rare opportunity. (The few who successfully construct instructional systems will have received a liberal education in both their subject matter and their teaching techniques.)

The Realities--Four Alternatives

The present economic burden forces personnel in higher education to select from among certain alternatives. One has been used in the past and is being used today--closing the doors of higher education. Another alternative is "jamming the system"--placing four to six hundred students in large lecture halls.

A third is complete automation of the system. When we think of automation, we picture individual students sitting in front of computer terminals, receiving information, being asked questions, responding to them, and being reinforced. In practice, it generally means an auto-tutorial system that only a few students use or relatively inexpensive programmed textbooks.

A fourth alternative is the development of a multi-media instructional system that can handle increased enrollments with limited funding and still be a humanistic program, relevant to the students' needs. This is the system advocated in this paper.

To create such a system, maximum cooperation is needed between faculty and staff. Under the present organizational structure of education, certain limitations are apparent:

1. The instructors have freedom to do what they want within set limits.

2. The instructors are protected by this system while students suffer from inadequate or obsolete instructional programs.

3. The administrators, protected by not having to support disturbing and costly experimental programs, have

their tasks greatly simplified.

4. Because of the administration's non-involvement in details of the instructional program and because of its inability or unwillingness to change the instructors, the latter often display more loyalty to their disciplines than to the institution and students.

5. Most institutions do not function as work groups because of their inability or unwillingness to agree on the institution's most important problems.

The organizational structure and the lack of adequate support for innovations using audio-visual and other devices have limited the use of multi-media material. As Heinich points out (6), it has been viewed as only an aid even in such well-supported programs as military training. As long as so few instructors make full use of audio-visual systems, administrators will be reluctant to provide the needed funds. The concept of audio-visual devices as mere aids to instruction must be changed; they must be seen as integral parts of the instructional program.

Chapter II

Planning for Multi-Media Instructional System

Planning, though the most important, is probably the most neglected phase in the development of multi-media systems. It is neglected because so many hours are required for preliminary research. This chapter will discuss the procedures of planning.

Multi-media systems vary greatly in cost. Sophisticated systems using closed-circuit television and videotape recorders run into hundreds of thousands of dollars. Software, whether purchased directly from the manufacturers or developed by the institution, costs thousands of dollars. Because of the cost, therefore, it is logical that sufficient planning be done before an institution embarks on such a program.

We will explore five necessary aspects of planning: (1) campuswide, (2) production, (3) curricula, (4) distribution and maintenance, and (5) inter-institutional.

1. CAMPUSWIDE PLANNING

Campuswide planning involves curriculum, instruction, equipment, facilities, personnel, supplies, financing, and strategies for change, if a multi-media system is to be effective. A number of junior colleges have elaborate dial-access systems capable of playing both audiotapes and videotapes. If these were purchased without any curricular or instructional planning and are viewed only as aids to instruction--optional and available to instructors if they want them--they are probably used poorly or not at all. The investment will not be sound.

How extensively will the multi-media be used? The amount of use will determine the type and amount of equipment needed. Multi-media systems used in a biology laboratory, such as the one described by Postlethwait (8), will require a different system from one employed campuswide and/or for many courses.

A multi-media system for one department can be operated effectively, since the department can be in charge of its production, with the help of only a technician. Although this is probably the simplest system to initiate, it will not be attractive to some colleges because it serves so few instructors and students.

A multi-media system to be used by several departments will require more efficient systems of communication, supply, maintenance, and management. Extreme care must be taken in planning a campuswide system to make sure that, before the initial purchase of hardware is made, the system can handle the student load. Dial-access systems, for example, have several limitations not always obvious to prospective users, the worst being their inability to handle large numbers of students and a wide variety of programs.

What is the mix of multi-media? Which parts of a program will be presented by electronic media, by live instructors, and by other methods (laboratory experiences, field trips, or group discussions)?

In the initial stages, planners often put all the instructional experiences on an automated tutorial system, believing that, if they can present one lesson in this way, they can present them all. However, the mix of learning experiences is critical and must be carefully planned. It would be embarrassing (and financially disastrous) to create a program that the students will not use.

What media are available for instructional purposes? It is advisable not to make hasty selections, since each medium has its advantages and disadvantages. At first look, instructional television appears to be most useful, even with certain disadvantages besides the high cost. On the other hand, filmstrips do not appear the most exciting way to teach or learn, but they have advantages other than low cost. Group discussions and large groups also have a place, each with its virtues and faults. Laboratories where large groups of students work side by side on the same experiment have been quite

common for many years. Postlethwait's laboratory (8) overcomes some of the limitations in this type of instruction, but it, too, has its problems, one being the amount of planning and set-up time required to run it. Planners should search the audio-visual literature carefully and might even find it worthwhile to employ a consultant and a learning theorist before investing too much money in equipment and program development.

What equipment is most feasible? One way of approaching the equipment problem is to establish a communication system and use it for various programs; the other is to design the instructional program and then to acquire a system that will handle it. This could apply to any department wishing to establish its own multi-media laboratory or learning center--for reading-study skills, mathematics, or any other subject-centered program.

If the entire institution and many different departments are going to use the system, it is then necessary to consider a central system with decentralized laboratories to house the audio-visual equipment. This may call for some standardization, e.g., deciding that the whole college will use filmstrips instead of 2-by-2 slides. Planning for a campuswide program is much more complex than for a departmental program. It also means that any necessary updating of the system will be more expensive and more difficult. Perhaps a large junior college should use a number of multi-media systems instead of a single one.

What facilities are needed to house the system? As the right facilities are essential if the program is to work well, the instructional program and the system to handle it must be designed before the facilities. If the system is to use filmstrip projectors in a centralized location, occasional large-group sessions, and numerous seminars, the college must provide the necessary facilities; otherwise the program will be difficult to implement. In planning for instructional facilities, the curriculum planners must know approximately

the mix of the programs to be presented so that the architect will know the ratio among small rooms, large rooms, and viewing areas.

What personnel is required for multi-media? Often the values held by professional people are contrary to those demanded by multi-media systems, and an institution staffed by tradition-oriented instructors has little chance of implementing a program so radically different. Areas of possible conflict are discussed below.

The setting of goals is one conflict likely to arise early. Learning events that are presented by electronic and audio-visual equipment rely on the identification of behavioral outcomes, and, if these outcomes are not defined, the students will soon lose interest. The instructor must be willing to identify his objectives, state them clearly, and let every student know what is expected of him. Instructors who are not willing to set these goals court disaster in a multi-media system.

Time is another factor to consider. If instruction is measured in time units instead of the achievement of objectives, and if simple routines are important to instructors--such as having the same class fall at the same hour on the same days--they will resist multi-media. If instructors feel that they must go over verbally everything to be learned and be sure that every student is listening, they will find multi-media disturbing. Because the instructor will not be with the students during much of the instruction, he must place a great deal of trust in them.

Numerous personnel factors enter the multi-media picture. New and growing institutions have a golden opportunity to recruit and hire the right kind of people. Older institutions may have to rely on changing the people they now have, a topic that will be discussed in terms of strategies for change.

What supplies and maintenance are needed for a multi-media system? Any system will require many supplies not used in traditional educational programs (i.e., projector bulbs,

tape-recorder parts, etc.), and will likely require an increased consumption of paper, as many instructions and objectives must be written down for the students.

The various projectors and recorders require constant maintenance, which can be provided either by dependable private service or by college maintenance people. Whoever is used must keep an inventory of the spare parts, for a breakdown of any sort could be a major disaster.

Traditionally, educators have over-protected audio-visual software such as tape, film, and videotape. It is more important, instead, to design a system where the cost of films, tapes, etc., can be reduced to an expendable level than to spend thousands of dollars on a system that conserves software. With the increased use of multi-media systems, less value will be placed on software items. Librarians and instructors will be willing to let students handle them just as they do library books.

How is a multi-media program financed? Although these systems are not primarily designed to save money, an institution that develops or purchases one that can be used for several years by thousands of students will save money in the long run.

From the author's point of view, the primary contribution of multi-media instruction is not in the money saved, but in the variety of teaching-learning experience provided. Institutions will still have to provide for small-group sessions where interchange between students and teachers can take place, and if the educators load discussion groups with thirty or forty students, they will destroy any possible benefit by removing the opportunity for this interaction.

Many educational institutions have no financial reserves for program development. They will have to seek funds from such other sources as foundations and state and federal offices. Multi-media development can be considered a project to bring about change in education; and if the system is economical (e.g., a filmstrip-tape system), institutions

should be able to maintain it from their own finances once it has been installed.

The amount of money needed depends on the size and complexity of the system. Use of occasional filmstrip projectors and tapes in a self-contained department will require little money, while an institution-wide program using videotape will call for much more. The planners must know the institution's needs and available funds.

What strategies of change should be used? No forward-looking administrator can suddenly institute a multi-media system, since people with established values and feelings are involved. A careful study must be made to determine the best strategies for change. If the institution is new and has adequate finances available for development, a massive assault on the multi-media problem would probably be most beneficial. This would mean that multi-media systems could be designed into the educational and architectural plans, with administrators and faculty being hired specifically to work in this area.

In existing institutions, where most of the faculty members have tenure and tend to be set in their ways, other strategies must be used. The broken-front approach is most likely to succeed. It requires the administrators to search out faculty members who appear receptive to change, encourage them to attempt something different, and protect them from the jealousies and objections of fellow faculty members.

New instructors may have to be hired to implement the system effectively, even though they face possible rejection by the tenured instructors. All these problems fall under strategies for change and administrators are advised to choose the one that will cause the least confusion and frustration.

2. PRODUCTION PLANNING

Adoption of multi-media systems will create new problems for most institutions of higher education. The production of

multi-media materials requires an organization much like that of an effective manufacturing plant. In other words, someone must be responsible for supervising all the people involved--the photographers, artists, sound technicians, typists, and the like. Educational institutions have usually survived with relatively simple management techniques, being involved mainly with providing instructional areas, teaching personnel, and a steady supply of materials. Multi-media development, however, requires something more sophisticated. Many people, whose skills vary greatly, must perform their duties appropriately. Some may find it difficult to work in a closely supervised situation, meeting deadlines and working as a team.

Furthermore, people must know how to communicate with fellow workers to do the job effectively. The manager must be in tune with all personnel in the organization, the instructors with the artists and photographers, the sound technicians with the narrators, and the narrators with the students.

The design of production facilities and equipment is of paramount importance because they will be in daily use. They must be suited to the work to be done and located so that the manager can effectively supervise the personnel. In an existing college, the necessary facilities are not always nearby, and an institution beginning on a low budget may find that photo labs, classrooms, and other facilities are makeshift and have to be shared with classroom teachers.

Hiring production personnel is another problem. Student help may be effective on some campuses, but trained professional people are less expensive in the long run.

Another element in production planning is scheduling. The production manager must schedule the activities of all members of the team so that everyone is busy and production moves smoothly. Flow charts, needed when making long-range plans, must be converted into day-to-day operations. Deadlines must be set and employees motivated to meet them.

Innovations. One of the greatest problems facing junior college administrators is how to interest their faculty members

in curricular and instructional innovations. Although the solution is not easy, administrators should persevere, for faculty inertia can be overcome.

New colleges have an opportunity for change that older, established institutions do not. In junior colleges still in the planning stage, administrators can design the facilities to encourage and accommodate innovation. Careful research will determine the ratio of the various instructional areas needed for the programs the colleges would like to implement. Colleges interested in new approaches should advertise their available positions and stipulate instructors willing and able to try these innovations. They should discourage instructors looking for a soft berth and a high degree of security by stressing the challenge of joining a new organization seeking new answers for old problems. This kind of approach and an aggressive nationwide recruitment campaign should attract people who can do the job.

For administrators working in established institutions with tenured faculty (most of whom have difficulty accepting new ideas), the problem requires any of several different approaches. Certain cautions must be heeded.

The administrator in charge of instruction should always be looking for faculty members who show signs of interest in innovation. Frequently instructors get tired of doing the same thing year after year and may welcome a change in their day-to-day activities. In 1968, the author published a case study in which a dean of vocational education discovered that an engineering instructor was bored with teaching electronics and had no interest in improving the program. One otherwise unproductive day, the dean asked him what he would really like to be doing. The instructor, an experienced pilot, replied that he would really like to fly. At that time, a course in aviation was needed at the college and the instructor developed and implemented an A. A. degree program in aeronautics. This isolated incident illustrates the point:

a perceptive dean was able to identify a specific problem of one of his instructors and, by capitalizing on it, was able to acquire a program the college needed.

It cannot be stressed too often that administrators must know their instructors well. They need to isolate problems and determine why individual instructors act and believe as they do. In this way, they can find instructors on the staff who are able to move ahead with innovative programs. Of two kinds of hiring practices, one screens out undesirables; the other screens in those who appear able to do a specific job. The screening-out process is commonly used in large school districts, especially for elementary and secondary teachers. Most junior colleges, however, use the screening-in process, so that they can know exactly the individual most likely to succeed in a particular assignment.

The new faculty member must still be encouraged to experiment and innovate, safe from faculty members in high-status positions who might destroy him to protect their own security. A team consisting of a tenured faculty member interested in trying new ideas and a new faculty member provides the greatest chance of success.

Changing the existing procedures. Before any strategies of change are put into operation, the administration must examine with detachment the possible reactions of the faculty to the new proposals. An administrator who is highly motivated to bring about change must evaluate strategies objectively, however difficult that may be, or he will meet with early defeat.

Before trying an experimental program, the administrator must be sure the instructors know as much as possible about it. Whether a new program is brought in from the outside or is developed on campus, much groundwork must be done to inform the instructors. Just because an instructor says he is interested in experimentation does not necessarily mean that he will be successful at it. Most approaches to instruction depend on a firm understanding of their rationale by the instructors who will use them. In-service training is the answer to this problem.

3. PLANNING MULTI-MEDIA CURRICULA

Decisions must be made on who will design and develop multi-media systems. Should all instructors who will be using them or only the one or two who appear particularly interested be involved in the development?

It is not practical to have each instructor who will use the system help with its development. A good system can be used for years, and new teachers recruited may not like using the system as they find it without having had any say in its development. Much money is invested in the development of any multi-media system, and any changes are costly. Each multi-media course must have a system to handle the flow of materials and adequate space, equipment, and personnel.

In a small college or department, it may be possible to involve all instructors in system development, but in a large institution it is more feasible to have only one or two instructors assigned to it. They can work on it part-time or full-time, as appropriate.

If instructors are hired to develop systems for multi-media instruction, their salaries should be charged to program development and not to instruction. If an institution makes these charges against the operating budget for classroom instruction, it might have financial difficulties. Until the last five years, expenditures in education for research and development hovered near the one-per-cent mark. Even now, with federal aid for R&D programs in regional laboratories and centers, junior colleges have not received enough of it.

Not all instructors are capable of or interested in developing multi-media materials. Many practitioners can implement programs already developed, but are not interested in spending the time to plan, write, and test multi-media systems. The system planner and writer must be able to specify what the job is and develop a program to accomplish it. Administrators still have to sell the new program to

the other staff members. They should therefore be kept posted on the development (and give feedback to the developers) so that, when the program is ready to be implemented, they can anticipate some of the reactions of the staff.

How will instructional activities be scheduled? In the traditional program, the fifty-minute time-block for the same period on certain days is most frequently used. Although this arrangement is common, it is neither the only nor the best one. One of the first new approaches to the use of time was presented by Trump and Baynham (10). Trump's proposal centered mainly around team teaching, with scheduling a secondary consideration, but it opened up new avenues to scheduling.

The scheduling of college courses can be even more flexible than Trump's proposal, as multi-media systems will show. With their development, it will be possible for teams of instructors to develop a particular course using large-group sessions, motion pictures, lectures, small seminar groups, laboratory periods, and auto-tutorial sessions scheduled for specific time blocks or for individual students at their convenience.

The planner must consider various options and proposals before he decides on the final schedule. As instructors gain experience in the use of multi-media systems, they will probably want to change the scheduling pattern from semester to semester; the institution must be flexible enough to permit it.

Facilities. Scheduling different teaching-learning activities using various media necessitates an assortment of facilities, and the ratio of one to another will depend on the system and its design. Courses using multi-media systems will probably require facilities for large and small groups, laboratory facilities, and stations for individual learners. All will require audio-visual equipment.

Planners must determine the mix of the programs before designing facilities, although at that time it is difficult to make even an estimate. Flexibility in building design is

one way to overcome this problem, e.g., movable room dividers to break standard-sized classrooms into seminar rooms and furniture that can be converted to carrels.

Planning the course. How long it takes to develop a course will naturally depend on how much auto-tutorial material it will use and how much restructuring of course content is necessary. If the instructor intends to change the content of the course as well as the method of presenting it, he has two problems to solve.

Changing a course completely from the traditional approach to the use of lectures, seminars, and auto-tutorial sessions requires a full year to complete. Several weeks are needed for gross planning of the course content, behavioral objectives, and instructional methods and six months or more for the development of auto-tutorial systems--depending on the number, length, and complexity of the lessons. Each lesson should also be tested with small groups of students (and large groups, if possible) to discover its faults. In many cases, the first semester's presentation is a field test, revealing major and minor errors and ambiguities. Even after a year's use, the instructor may spend several months refining the program.

Although it is difficult to state exactly how long it will take the instructor(s) to perfect a multi-media system, the administrator should allow them sufficient time and money to assure success.

4. PLANNING FOR DISTRIBUTION AND MAINTENANCE

Another phase of planning for multi-media instructional systems involves the distribution of materials and the maintenance of software and hardware. (1) Where will multi-media materials be stored or located? (2) Who will make, store, distribute, take inventory, and reorder? (3) Who will decide when to revise or replace them?

The planner must decide whether or not the materials will be used mainly in a centralized location (a learning

center or library), in several decentralized locations, or in a combination of these two. If the institution is small, it may be feasible to locate most of them in one place where students can use them in a special facility. In a larger institution, however, the advantages of centralization diminish, and decentralization may be more efficient.

Typical centralized multi-media systems can be found in the college library, with its study booths containing tape recorders, projectors, TV screens, and other audio-visual equipment, and nearby supplies of software. A dial-access system will generally be located close by or in the same building.

Decentralized facilities vary in complexity. In shorthand and typing classes, the instructor will probably check out tapes to students. In small centers, the students may check their own materials in and out. In larger, decentralized systems, a clerk or technician will likely maintain equipment and check out software to students. Each of many possible procedures has its advantages and disadvantages. Planners must consider them all, since they will affect the communication and supply systems.

Who will be responsible for storing, distributing, taking inventory, and reordering multi-media software? If a centralized system like a library is used, the librarian will handle this material along with books and other library items. In small, decentralized distributing systems in classrooms, such as a foreign language or business machines laboratory, it may be better for the instructor to take charge of them. In a larger decentralized location, such as a departmental learning laboratory, a clerk can take care of them.

Who will decide when multi-media software needs to be revised? Only the instructors who use it can determine if it has become obsolete and needs to be replaced. The whole department may have to consider the obsolescence of the materials and set priorities for revision or replacement.

5. INTER-INSTITUTIONAL PLANNING

The development of multi-media systems is not easy. A good system requires the expenditure of much money and many hours of instructor and technician time. The size of the task and the uncertainty of its outcome make many institutions unwilling to risk the development capital. This is one reason institutions should be encouraged to cooperate, for programs developed by one of them can often be used by others.

The development of multi-media instructional systems is a suitable task for a consortium or an association of junior colleges. Although the concept of a consortium developing a program for all its members is not new, it has not yet been explored extensively. Such associations as the California Association of Junior Colleges or the American Association of Junior Colleges could certainly sponsor the development of multi-media instructional systems in various fields. Institutions could pool their financial resources or make joint application for federal or foundation funding to develop these packages. A large consortium might even establish a center on the campus of one participating institution. The center could help instructors there who are designing and developing programs and select its staff from the interested faculty members. So far, consortiums and associations have dealt with the sharing of information and the establishment of in-service programs for faculty members; it is now time for them to look for more far-reaching tasks.

Most multi-media systems designed to date have been created in a particular institution for its own use--not an efficient or economical use of human or financial resources. It is no more logical for each instructor to develop his own program than for each driver to build his own automobile. Business and industry long ago proved the advantages of the division of labor and the use of specialists. There is no reason for higher education to be tied to a "cottage industry" level of program development.

The many decisions needed before an institution can successfully implement multi-media instructional systems must be made as early as possible, for, although good planning can prevent many costly mistakes, even the best will not insure perfection.

Chapter III

Writing and Illustrating Multi-Media Lessons

School administrators often assume that teachers can use various instructional methods but would not be interested in developing them--just as they do not expect teachers to write textbooks but simply to use them, forgetting that many were developed by teachers or former teachers.

Teachers may not be creative enough to design and develop instructional materials, but they may also lack the time, training, and money. This writer has found, however, that many teachers can not only create materials for multi-media systems, but can also design a total system. Mt. San Jacinto College employs about forty full-time instructors. Among them, they have developed behavioral objectives, multi-media lessons, and a multi-media system for a whole college course. Many can design courses from the ground up and develop the accompanying instructional materials. The teachers at Mt. San Jacinto, for example, have produced isolated, supplementary auto-tutorial lessons for complete instructional programs, including syllabi, behavioral objectives, auto-tutorial lessons, seminar guides, and evaluation devices. Several of these will be discussed in the next chapter.

Administrators interested in causing changes in instructional methods should be aware that the instructor who is to develop a system will need a great deal of time to think through the various problems step by step, analyzing the subject matter, and identifying valid behavioral objectives for his students. He must place these in appropriate hierarchies and distinguish between general and specific goals. He must state them in behavioral terms and communicate them effectively to his students. He must also draw up a master plan for the program, laying out the course on a semester calendar to accommodate both long-range and specific day-to-day objectives.

A multi-media instructional system can use many types of learning events. The designer must examine each one and decide which will best present the content to meet the objectives. This takes considerable thought, research, and experimentation, for, after trying the system once or twice, the instructor may find that it must be redesigned or altered to accommodate corrections.

The next step is to work on each learning event--for instance, the outline and script for a large-group lecture or a small-group seminar, or determining what problems to present to each daily seminar. Writing scripts, doing rough illustrations for auto-tutorial lessons, taping lectures to be heard in the library, and developing on-going evaluation and reinforcement devices to keep the students interested and apprised of their progress must also be done at this stage.

Next, the instructor must integrate all the instructional events into a total program and present it to his students to see if flaws appear when they use it.

Examples. When Robert Schley, health science instructor at Mt. San Jacinto College, first presented his multi-media course, he allowed the students to attend small-group seminars voluntarily. This affected the entire course, for those who did not attend could not participate in discussions, causing many of the seminars to go flat. The program was revised and students required to attend all but two of the small-group sessions. To get into these sessions, they had to turn in the response sheet accompanying the lesson they took in the library and take a three-item quiz. These controls made sure the students attended, were prepared, and passed a test to get a satisfactory grade. By building in these control devices, Mr. Schley improved the attendance in his course and made all students responsible for full participation. They can no longer skip class and still expect a passing grade.

Blair Ceniceros and Jerry LaMattery, both English composition instructors at Mt. San Jacinto College, spent twelve months developing a multi-media instructional system for

freshman composition and reading. After eighteen months' use, they discovered that it was not giving the students enough reinforcement for them to gauge their success, thus creating anxieties and doubts and causing many of them to drop or fail the course. After this discovery, the two instructors developed a complete set of behavioral objectives that would let the student know what he was to do each week, what his instructor was to do, and how to determine his degree of success.

These two illustrations show that, however carefully designed, the program must be tested to discover problems and to make any necessary changes. Instructors must be willing to discard the program if it fails so completely that it cannot be corrected.

Facilities and Time Needed

The successful development of multi-media instructional systems will depend not only on the designers but also on the facilities and the time available to them. Ideally they would have a quiet, isolated area with plenty of time to think through problems, to confer with each other, and to exchange ideas. Every instructor designing a program should have a private office, isolated from students pressing for advice and counsel, and uninterrupted periods of time. When instructors tried working part-time during the regular school year and full-time during the summer, they found the summer months the most worthwhile investment of time. It might also be economically sound to assign a teacher to program development for a semester or a full year, depending on the requirements. It is not reasonable to expect teachers to develop multi-media instructional systems on their own time during evening hours or weekends. Although some teachers have done so, it is not generally effective, and, with today's teacher militancy and strong teacher organization, it would be politically hazardous for administrators to expect it.

Steps in the Design and Development of Multi-Media Instructional Systems

The eight steps in the design and development of multi-media instructional systems are: (1) development of terminal behavioral objectives; (2) selection of content to be presented; (3) sequencing of content and learning events; (4) determining the mix and balance of media to be used; (5) deciding on the media for each learning event; (6) establishing a schedule for the system; (7) designing learning events; (8) designing an evaluation and reward system.

1. Developing Objectives. The development of behavioral objectives for college courses has become popular at universities where junior college instructors are trained, and even at progressive junior colleges. In spite of the trend, some objectives written for use in college courses are still stated in traditional rather than behavioral terms. Behavioral objectives stated in behavioral terms become a student's guide to learning instead of a teacher's guide for teaching.

Instructors need in-service training if they are to write behavioral objectives successfully. Consultants are available from colleges and universities to work with them on this problem. Robert F. Mager has written the "bible" for formulating instructional objectives (7). His book takes the reader step by step through the requirements for writing them. Bloom (1) should also be helpful--especially for devising items to test the objectives.

2. Selecting Content. After the terminal behavioral objectives have been defined, the writer must determine what content or topics will best achieve them. If the designer has written valid ones, he may find that the content to be presented in the program differs greatly from the content traditionally presented in the course. The process of writing behavioral objectives gives the instructor an opportunity to look carefully at his course to see if it has been taught to

satisfy tradition or because it is worthwhile. Courses that can not survive a test of this type should probably be eliminated.

At Mt. San Jacinto College, when several English instructors began to analyze the objectives of the freshman composition and reading course, they discovered that many topics, not taught in the past, should be taught. From a careful examination of the objectives, they discovered that freshman English students should be able to read, use the library effectively, write clearly, and produce a research paper. These became the overall objectives for the course, and its content was changed to meet them.

The health science instructor at Mt. San Jacinto, in working on the design and development of the course, carefully analyzed the objectives. On discovering that, in most health science courses, the objectives are poorly stated (if at all) and that the content is little more than a hodgepodge of facts, he resolved to design his course in such a way as to change the students' behavior and their attitudes toward health practices. In developing a set of behavioral objectives to accomplish this, he found they in turn affected the content of the course. Analysis and evaluation of objectives and course content, by revealing weak practices that have been carried on for decades, allow the instructor to alter the content to meet them. This kind of activity makes course design and development a challenging and interesting experience.

3. Sequencing. The next problem is the sequencing of learning events, defined as the events that cause the learner to change his behavior. They may involve many media; they may be for short or long periods of time; they may take place in large groups, small groups, or individual learning situations; or they may involve listening, reading, audio-visual presentation, experimenting, or doing a research paper. (The program designer must, of course, select the learning events best for

his particular course before he begins to sequence them. If he doesn't make a thorough survey of the available learning events, his program will be too limited in scope.) Robert M. Gagné (5) presents the theoretical principles of course development. Briggs, Campeau, Gagné, and May (3) discuss in detail the theory, design, and development of multi-media systems.

In developing individual learning events, particularly the auto-tutorial, the instructor must learn how to program the content to be presented. There are many books on programming techniques. Dale M. Brethower (2) and David Cram (4) are good sources for a basic understanding of programming. Teachers who wish to program more sophisticated lessons should refer to Thomas et al. (9), who give valuable information on the sequencing of facts in program lessons, especially the internal consistency of each programmed lesson.

4. The Mix and Balance. Once the instructor has reviewed and evaluated all the learning events at his disposal, he must then decide on their mix and balance. Most college courses today use large-group lectures, while science courses generally use laboratories as media of instruction. In some colleges, instructors have broken away from these two traditional media to use individualized study, auto-tutorial instruction, small-group seminars, and the field trip. The media should be effective for their particular teaching mission. For example, certain instructors have found that an auto-tutorial system using tapes, filmstrips, and student response sheets is effective for teaching facts. They have also discovered that small-group discussions following the multi-media presentation give students an opportunity to apply the facts they have learned from it. The two media complement and reinforce each other. This balance gives the student a variety of learning events and contact with his fellow students and teachers, thereby assuring that the program will remain humanized as well as individualized.

5. Choosing the Media. In designing the mix of their programs, instructors have discovered that large-group sessions are effective for certain types of learning events such as showing films, giving examinations, or presenting lectures. One instructor is currently developing, as a substitute for the class field trip, a field trip for individuals or small groups. Instead of taking a busload or carloads of students, he uses a taped guide that individuals or small groups can take with them on the trips. The taped guide directs them where to go and what to watch for along the way. The instructor feels that field trips for large groups are ineffective, because communication is difficult, and because students cannot always see the objects they are supposed to observe.

6. Scheduling. Another task in the design and development stage is the establishment of a schedule for the system, as it differs somewhat from the traditional. For instance, American history is usually taught as a three-hour-a-week course, meeting at a given hour on certain days. At Mt. San Jacinto, however, all students taking the course meet (usually during the noon hour) in the auditorium once a week for a large-group lecture and in small-group seminars for two additional hours during the week. These seminars are scheduled for various times so that the students, when they register, can choose the time slots best for them.

The health science course has occasional large-group sessions for showing films. (These are also open to the public.) Health science students must attend 50 per cent of the showings to pass the course. When they attend, they get a ticket, to be turned in at the next small-group session. They take one hour of the program in the library on an auto-tutorial system and meet weekly in small-group seminars, where the facts presented in the auto-tutorial lesson are discussed, debated, and applied.

Freshman composition and reading has a unique schedule. The occasional large-group sessions are scheduled for a noon hour, and small-group seminars are staggered throughout the week. Each week, the students have a two-hour writing lab and must schedule themselves for an auto-tutorial lesson in the library. Although it is evident that multi-media instructional systems require flexible scheduling, schedules for the whole school need not be changed, since the auto-tutorial classes are taken in the library or elsewhere, without interrupting regular classes.

7. Design of Learning Events. When educators think of multi-media instructional systems, they often limit themselves to considering automated teaching devices and programmed instruction, instead of all the instructional media. The following paragraphs will explore some of the media and their use in different learning events.

Large Groups. Large groups have been the most common organizational structure and no doubt have remained popular because of their low cost per student and because of faculty unwillingness to innovate. Large groups can be used for learning events other than lectures, however, such as motion pictures, slide and filmstrip showings, social dramas, guest speakers, panel discussions, debates, field trips, and mid-term or final examinations.

The large group is an economical way to teach, but the quality of instruction is doubtful. An instructor can talk informally to a small group of students, asking and answering questions, allowing an exchange between himself and the group, an exchange that cannot take place with a large group. Even in a large group, however, he can communicate effectively, if he has suitable audio-visual equipment and lighting.

Communication problems in large groups have been a challenge to the engineers of audio-visual equipment and have led to the development of quite sophisticated lecture halls in our more modern institutions. Some incorporate closed-circuit

television, tape-slide presentations, rear-view screens, student-response systems, and public address systems. To work effectively in this environment, the instructor must plan his lesson carefully and must have technical personnel to set up the hall for him. With suitable ancillary equipment, he can handle many students each day and can communicate many complex ideas.

Instructors of large groups can present a variety of learning situations related to the subject, e.g., in the sciences and social sciences, where considerable use can be made of audio-visual aids. For effective communication, the presentation should be carefully timed so that the learning event moves rapidly and holds the students' attention. The instructor can select appropriate audio-visual presentations for the group, or he can develop his own to meet the special needs of his course. When social dramas and the like are scheduled, someone will have to be responsible for putting on the production. If guest speakers are scheduled, the question of fees must be settled in advance. If panel discussions are used, appropriate topics must be arranged. Field trips require careful arrangements for vehicles, eating and restroom facilities, parking areas, and first aid, besides the educational events.

Small Groups. Examples of small-group learning events are quiz sessions, discussion groups, student task groups, student reports, social dramas, and t-groups. Being less formal than large groups, they permit more interchange between instructor and students, and can even be broken down further into subgroups of four to six students for work on specific problems. This arrangement allows each student to contribute and requires only regular-sized rooms.

The dynamics of this learning event was apparent in math classes at Mt. San Jacinto College, where students were presented with behavioral objectives to be achieved before they could progress in the course. When students were allowed

to work in small groups of two to four when solving math problems, they talked to each other and learned from each other. The groups were task oriented and self-motivated--noisy, but productive.

The health science instructors at the same college have designed a health education program for small-group sessions. At first, discussion is hindered because the group meets only once a week, but, as the semester progresses and the students get better acquainted, they communicate and interact more with each other and the instructors. This interchange provides a healthy learning situation, much more effective than the large lecture hall. This writer has observed interesting discussions in some of the subgroups, particularly when middle-aged and teen-aged students talk about such topics as the new sex morality, drug abuse, and birth control. Each student participates and can have a truly personal experience not possible in a large lecture hall.

The t-group has been used at Mt. San Jacinto in such courses as "Marriage and the Family," offered in the evening program to prisoners and their wives at a nearby facility. Open discussions work effectively for marriage and family problems, and the courses are well received.

Individualized programs. Individualized learning events are another important part of any multi-media system. Instructors intending to use them must plan their presentations carefully, setting specific behavioral objectives, so that the student can understand and achieve them. The next task is to write a script, the style of which will depend on the nature of the medium; i.e., a videotape or an audiotape. Mt. San Jacinto uses audiotapes and audiotape-filmstrips for individualized instruction in many classes. The scripts must be written to capitalize on the structure of the content, especially important when the presentation consists of both filmstrips and tapes. Content structures can often be visualized on the filmstrip. Such techniques as outlines, diagrams, cartoons, photographs, etc., if well done, are very effective.

Solving this type of instructional problem increases the teacher's awareness of the structure of his content, for if he cannot find the structure, he cannot communicate it by tapes and filmstrips. The tape-filmstrip presentation is not alive, as is the instructor in front of the classroom, and unless the lesson can stand on its own--without depending on the instructor's personality--it is doomed to failure.

Some areas of content are easier and less expensive to put on an auto-tutorial system than others. Mathematics is probably the easiest subject to put on tape-filmstrip, being easily illustrated and narrated. History, on the other hand, is at the other end of the continuum, and the cost of developing an effective history program is significantly higher than for a math program. Mt. San Jacinto has developed numerous history lessons for multi-media presentation and has also purchased commercially produced history lessons. The latter are of higher quality and communicate more effectively. Research will determine which subjects are or are not appropriate for automated systems.

Once the script is written and programmed, it must be augmented with appropriate graphs, charts, illustrations, cartoons, or photographs. If an instructor can not do his own artwork, he must have the help of a skilled illustrator. After these visuals have been selected, the instructor should write a response sheet, defining the objectives of the lesson and requiring the students to participate actively in the lesson.

As instructors become more proficient in program design and development, and as institutions are able to use more audio-visual devices, we will see a development of instructional techniques that use not only filmstrip and tape but also loop films, videotape recorders, and other equipment.

8. Evaluation. A last step in the design and development of programs is the evaluation system. This means developing a

bank of test items as well as norms or acceptable minimum performance levels. With sound behavioral objectives and test items to measure their achievement, it is possible to develop a test bank--a collection of test items for a specific subject--stored according to units of content. The bank can be either closed or open, a closed one being most likely stored on a computer, thus permitting the instructor to request printouts of certain content areas. Such a system is used at the Marine Corps Recruit Depot in San Diego at the Communications-Electronics School, because so many trainees go through the depot each month. Since classes are continually being started and graduated, and frequent testing is necessary, a test bank seemed best for the storage of test items. On short notice, a computer can select and print out random items from the bank for the construction of tests for a pre-determined unit of work. The computer can generate an almost infinite number of test forms at a moment's notice. It also prevents students from cheating or telling the next class about the examination. The Marine Corps computer can also correct the completed tests, scoring, grading, and producing an item analysis for the instructor.

Another approach is to publish the test bank and give or sell it to the students. The open test bank then becomes a study guide and the student knows all the possible test items for any exam he might have to take. Some instructors may find this objectionable, as it is contrary to the traditional practice of hiding the test items from the students. With the use of terminal behavioral objectives and test items to measure achievement, however, the open test bank is logical. The educational system of tomorrow will open the system so that all students will know what is expected of them. The game of cat-and-mouse that we have played with students for many generations is passé. Students no longer want to play games, and instructors should want to develop honest teaching-learning situations, not keep students ignorant about course objectives.

An effective evaluation system for a multi-media instructional system will have pre-tests as well as post-tests. Indeed, if a student has all the correct answers on the pre-test, he should be given credit for the course, thereby saving him the time and agony of taking a course he does not need.

After developing a system using a variety of learning events, the instructor should test it on a small scale. Although lack of time and money may make this difficult, it is possible to pre-field-test various individualized lessons by having small groups or individual students take them to see if they can understand them and can achieve the minimum learning level. The pre-field-test can be achieved with a rough tape, rough illustrations, and dittoed student-response sheets. (It may be more difficult and expensive if the program uses videotape or other media.)

If the pre-field-test is successful, if students can follow the logic of the lesson and learn from it, the next step is field-testing the entire program in any of various ways. Some institutions prefer a two-by-two slide presentation with a large group of students to see if they can follow the lesson and learn the concepts presented. If the test works in large groups, where students must depend solely on the presentation and not on questioning the instructor, it will probably work on an individual basis. After going through the program once or twice, getting feedback from the students, and making any necessary alterations, the instructor should be ready to place it on filmstrip and tape.

Continuous evaluation and feedback from the consumers of the product are mandatory. They provide the only proof that the instructor has designed and developed an effective instructional package.

Chapter IV

Case Studies in the Development of Multi-Media Instructional Systems

In higher education, especially at the junior college level, multi-media instructional systems are comparatively rare. Of these few, four will be described in this chapter.

The first system to be described teaches shorthand and typing at Mt. San Jacinto College; the second system teaches pre-college level mathematics courses at Fullerton Junior College. The third and fourth, at Golden West College at Huntington Beach, are designed to teach biology and a pre-freshman English composition course. All three colleges are in California.

The four systems have several characteristics in common. They were designed by instructors interested in using a multi-media approach to instruction to improve the efficiency and effectiveness of learning. Each uses behavioral objectives and has a built-in evaluation program. The designers have explored new and infrequently used modes of instruction, such as tapes, filmstrips, slide presentations, small-group seminars, and motivating lectures.

1. SHORTHAND AND TYPING

For the past three years, teachers of business education at Mt. San Jacinto College have used multi-media instruction for typing and shorthand, relying on taped lessons, textbooks, workbooks, and a course syllabus. An individualized approach to instruction allows each student to progress at his own pace. Teachers become consultants, instead of directing the entire class at one time.

Marianne Icenogle developed three semesters each of the typing and shorthand instruction systems. The taped lessons replace the instructor in his or her role as direction-giver, dictator, and timer. Tapes instruct the student which lesson in the textbook he should type and also give dictation.

The classes can be a mixture of beginning, intermediate, and advanced students all at the same time, thus simplifying scheduling problems. Taped lessons also allow more students to be taught at the same time in the same room. As each student has his own earphones for his own lesson, the noise level in the room is minimized and teachers need not shout over the noise of the typewriters. To communicate with a student, the instructor need only walk to the student's desk. He spends most of his time consulting on typing or shorthand techniques or giving dictation to individual students. Each day's lesson in the syllabus is numbered to correspond with a lesson number in the textbook. The student consults his syllabus for the day's lesson, secures that particular tape, and takes it to use at his station.

The instructor's voice on the tape tells the student specifically what to do. For dictation, the voice dictates the lesson to be typed or taken down in shorthand; if a typing lesson requires the use of the textbook, music is played while the student types; if it is a timed test, music will be played until the instructor's voice tells the student to stop typing and correct his errors.

Behavioral objectives indicate the minimum level of performance for each lesson. It is the student's goal to meet it. A videotape recorder can be brought into the classroom and used by an individual student to monitor and evaluate his typing techniques.

The instructional system used in typing and shorthand is perhaps the simplest to use, but not the simplest to construct. The teacher had to develop many hours of instruction by tape, for the student listens to a tape through most of the course.

Currently, the business education instructors are developing systems to use for other office occupations, office machines, and for individual students interested in learning specific skills. These systems have been used successfully

not only by the initial developer, but also by new instructors with only a minimum amount of in-service training. The ease with which new instructors move into these systems is one of their strong points. The teachers' major adjustment seems to be in changing their role from group director to consultant.

2. MATHEMATICS

At Fullerton Junior College some of the pre-calculus courses are taught by a multi-media instructional system designed and developed by six instructors who felt that the traditional approach was inefficient and ineffective. Students with a variety of problems, needing to move at various speeds and at different levels, were all locked into one group. Lectures were the basic means of instruction, and students were deprived of the individual attention they needed.

The instructors worked in teams to write various math courses at the pre-calculus level. One person wrote the script while another illustrated it; they would then review each other's work. Through this refinement process, over a period of a year, the courses began to take shape. A combination of filmstrips, tapes, worksheets, seminars, and quiz sessions was used, with illustrations done by the teachers themselves. The school photographer shot the illustrations and produced a filmstrip for each lesson. The instructors did their own taping on recorders hooked in series so that one master could have fifteen or so slave recorders copying from it.

During the past year, several instructors have worked together to develop a textbook-tape combination for two math courses.*

The multi-media instructional materials are located in

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*These textbooks, published by Charles E. Merrill Publishing Company, are currently on the market. The textbook-tape combinations are similar in format to the filmstrip-worksheet-tape combination, except that the frames that originally appeared on the filmstrip now appear on the top half of the textbook pages.

the mathematics department and in the college library. In the math laboratory, a full-time technician maintains the hardware and distributes the software. All other illustrations and printed materials are purchased by the student along with his textbook.

The courses currently being offered by the multi-media system are elementary algebra, intermediate algebra, trigonometry, and the slide rule. Approximately 35 auto-tutorial lessons have been developed for each course. Students spend three hours a week in class and about two hours in the laboratory, where new concepts and topics are presented. Ten mathematics teachers use the lab, which accommodates half the approximately 800 students in all math sections. To handle them, the lab's hours are free and unscheduled, and students use it on a first-come-first-served basis.

Instructors are discouraged from doing any lecturing during the class periods, for fear of diminishing the students' incentive to concentrate on the multi-media instruction. The program uses a modified self-pacing system in that, although students spend as much time as necessary to complete a unit, they must take each quiz and test on a prescribed day. Class meetings have three purposes: (1) to review the assigned unit and answer students' questions; (2) to give a short motivational introduction to the next unit; and (3) to administer a quiz or a test on the completed unit.

To evaluate the instruction, a 26-question attitude survey was made of the 125 students in the program during its second year. From the survey, the following generalizations were made:

a. Many students enrolled in elementary algebra tend to fear and dislike mathematics, have little self-confidence in their ability, and prefer to avoid all mathematics courses.

b. Many auto-tutorial students tend to increase in

self-confidence and are willing to take another auto-tutorial math course (83%), but not a traditional one (34%).

c. When asked to compare auto-tutorial with traditional presentation, many felt that the auto-tutorial was less monotonous (67%) and easier to understand (47%) than the traditional lecture methods.

d. Students felt that the most beneficial features of the auto-tutorial method were: the ability to stop and repeat tapes and film lectures, opportunity to enter the lab at their own convenience, periodic self-mastery tests, and small-group discussion sessions.

e. A large percentage of students (74%) liked the auto-tutorial method from the beginning and continued to like it as the semester progressed; 20% liked it by the end of the semester; only 6% continued to dislike it. From the point of view of student attitudes and evaluation, the auto-tutorial laboratory was apparently highly successful.

When the auto-tutorial system was compared with the traditional system, it did not demonstrate the superiority of either method clearly, but, when a difference was detected, it was in favor of the auto-tutorial. Results of the research were sufficiently encouraging and, taken along with the favorable reception by students, with the demonstrated usefulness of these materials for review and independent study by students in more advanced classes, and with the apparent drop in the attrition rate, they clearly warrant the expansion of the auto-tutorial approach and further study of its merits.

3. BIOLOGY

The Total Receptor Access Independent Learning System (TRAILS) in the biology department at Golden West College (California) has received nationwide attention. Patterned

along the lines established by Postlethwait at Purdue in 1962, TRAILS incorporates several features not found in his system. It contains behavioral objectives as well as learning evaluation and scheduling systems. The entire program depends on behavioral objectives similar to the ones proposed by Mager (7).

The learning system uses general assembly sessions, accommodating nearly 400 students. Several of these sessions are needed every Monday to accommodate all the students signed up for TRAILS. Through trial and error, it has been discovered that the sessions can be used for several purposes including final examinations, guest speakers, motion pictures, and motivational lectures. After students have attended the general assembly session, they schedule themselves into an auto-tutorial lab, which is open 37 hours a week.

Instructors at Golden West College have identified several advantages of the auto-tutorial lab: (1) the students are free to use it whenever they wish; (2) they can work at their own pace; (3) they have ready access to a tutor who can give individual attention without interfering with other students; (4) they can make up missed lab work or can review extensively; (5) they can make up their work if they have been absent; (6) it offers a means of documenting instruction effectiveness and course content for accreditation teams and sister institutions.

Small assembly sessions are held once a week to quiz the students on the material presented during the previous five days. During an hour session, the students answer the quiz, have it corrected, graded, and returned for review and discussion. Those who fall below the 75% level on quizzes must attend a special session at the end of the week to find out what went wrong, write the correct answers, and clarify any misunderstandings and misconceptions before the end of another week.

The evaluation system of TRAILS is tied closely to the

objectives, to test-scoring machines, and to the college's computer center. Weekly test items are drawn from the behavioral objectives for that week and coded so that students will know which behavioral objective they come from. The test items are scored rapidly on machines located near the classrooms and the students can thus quickly see and discuss their errors.

In addition to the weekly quizzes, a one-hour examination is scheduled every four or five weeks. A statistical analysis of the exams provides data on the following: (1) the degree of difficulty of each test item; (2) the discrimination of each test item, based on a comparative count of the number of correct responses given by students whose raw scores place them in the upper or lower 27% range of the entire group; (3) non-distracting, incorrect responses, based on the identification of incorrect responses given by 2% or less of the group; (4) median score; (5) mean score; and (6) standard deviation. The statistical analysis also detects items that do not pertain to the behavioral objectives, for students are quick to protest any ambiguity or lack of relevance in test questions.

A time clock in the auto-tutorial lab enables students to punch in and out. A card records the students' attendance periods, showing how many hours they spend in the lab. Instructors who find that students spend too much time in the lab may be asking more than the course credit justifies and they can lessen the course load.

The TRAILS program personnel consists of the anchor man (who is team leader, master designer, and developer), four to five instructors who follow him, and several paraprofessionals and lab assistants. He writes the behavioral objectives, the quizzes, final examinations, and the auto-tutorial program in the laboratory. The students hear his voice on the tapes as well as in the lecture forum. He also supervises the other instructors on the team.

Two full-time paraprofessionals, with degrees in the biological sciences, set up the auto-tutorial lab each week, maintain it, and work with students. The lab has thirty hours a week of student help. These students assist in the stock room, supplying and setting up equipment and materials under the direction of the paraprofessionals. As one instructor has pointed out, this many students, taught in a traditional program, would require two and two-fifths more teachers.

The TRAILS program uses a variety of learning equipment, facilities, and material--the lecture forum, small assembly sessions, motion pictures, slides, videotape, and other audio-visual devices. Aside from the regular equipment used in a biology laboratory, it has many tape recorders, projectors, and loop film and filmstrip projectors. The stations do not duplicate each other but vary by type of equipment and material. Each student has his own auto-tutorial station, but can move around the room to observe various displays and experiments.

4. ENGLISH A

Instructors in the English department at Golden West College have found that 60 to 70 per cent of entering junior college freshmen require remedial work in English before they can succeed in the freshman composition course. This causes staffing problems, and is further complicated because too few English instructors are interested in, or prepared to teach, remedial English. Golden West has found that, of the 80 per cent of entering freshmen who express interest in transferring to a four-year college, only about one-fourth to one-third actually do so. English skills--mainly reading and writing--are essential to success in college, and many students who drop out are undoubtedly inefficient readers and writers.

Another problem is that many English instructors prefer to teach literature, rather than composition, grammar, and

linguistics. The freshman composition course at the junior college level must parallel the courses offered at four-year colleges. For these reasons, it was decided to have only one or two highly motivated instructors teach all those needing remedial English. It was felt that their enthusiasm and effectiveness could offset the disadvantages of large-group instruction. The remedial program is designed to prepare students for freshman English and is organized around two nine-week courses--English A and English B.

English A meets four hours a week for large-group lectures, where the students watch transparencies on an overhead projector. Frequent tests are given to evaluate the course, which consists of spelling, grammar, punctuation, and sentence structure.

English B deals primarily with paragraph writing and is given during the second nine weeks of the semester in a different instructional pattern. Only students who receive at least a C in English A are allowed to proceed to English B, while students who receive an A or B in English A are allowed to skip it. In addition, students are encouraged to "challenge" English B by writing a paragraph, under supervision, on an assigned topic. The English instructors read the paragraphs and, if they reach a consensus, they can excuse any student from English B. Approximately half those who challenge English B pass the exam. Instead of using the large lecture hall as the medium of instruction, English B uses smaller groups (30 students) in a laboratory, where the teacher can supervise their paragraph writing.

As the English A program has evolved, more slides, tape, and worksheet lessons are used. Behavioral objectives direct the students in their learning process, and they are asked to respond to questions as they take their lessons. Later, in English B or freshman English, students are taught how to apply the theory they have learned.

The team leader conducts the general assembly session,

which is used to present lectures, pre-tests, motivational activities, and final examinations. Experience has shown that new content should not be presented, except in a superficial way, at the general assemblies; it is presented most effectively at the auto-tutorial lab sessions. The Friday meetings of the small assembly groups are short quiz sessions to evaluate each student on his week's work.

A paraprofessional with a B. A. degree runs the laboratory. He loads the machines each week, labels the rows of machines with numbers designating the available lessons, and, as the students advance through the lessons, he inserts new programs.

Instructors at Golden West College feel that the program has effectively done the work it was designed for. They have discovered that students taking English A are more apt to succeed and usually get better grades than those who do not. This finding tends to substantiate the theory that students can be taught principles and concepts of spelling, grammar, punctuation, and sentence structure to be applied to subsequent writing situations. However, neither the instructor nor the student can be sure that the carry-over is inevitable or automatic; students must be taught how to edit what they write and how to separate the editing function of writing from the organizational function.

Chapter V

A Few Last Questions

Previous chapters have presented the rationale for multimedia instructional systems, steps to take in designing and developing them, and descriptions of existing systems. In this chapter several probing questions will, we hope, encourage readers to give these systems serious thought.

Question 1: Can instructors become system designers or are they destined only to be instructional technicians?

The role most instructors play, as instructional catalyst, is really that of technician. Most instructors in our community colleges have not designed (and probably never will design) an instructional system. Instead they have adopted the instructional patterns they observed as students in grade school, high school, and college. The typical pattern involves the teacher at the front of the classroom with 30 or more students seated before him. Typical activities are the lecture and the question-and-answer session. The pattern varies somewhat in the sciences requiring laboratories, but even there the teacher does not usually create an instructional system; instead, he adopts a lab workbook and follows the outline set by its author.

Most community college instructors, like those at the secondary and higher education levels, spend much time on subject matter and little on teaching techniques. It is paradoxical that many instructors, expert in fields that have made rapid strides in the past ten or twenty years, are still using teaching techniques that were used hundreds and even thousands of years ago. It is even stranger that they lack any desire to find new ways of teaching. They rely automatically on the lecture as the sole means of transmitting knowledge from one generation to the next. Rare exceptions, such as Postlethwait and a few others, are mentioned in this paper.

The key question still remains: Can enough community college instructors become program designers and developers to lead the way in the restructuring of the community college?

Question 2: Can community colleges accommodate the various system configurations that innovative instructors might create?

If instructors do design and develop numerous multimedia instructional systems for the community college, how much diversity of configuration in these programs can the typical college tolerate? Diversity of instructional systems will create problems in finance, plant use, staff use, student load, and scheduling. Some systems are more expensive to operate and some more expensive to develop than others, and will call for a different allocation of funds.

Facility use is another consideration. Some systems call for expensive equipment; others may require taking students off campus to use the community as a learning laboratory. If instructional systems are to be implemented, those who schedule the facilities must be willing to accommodate them. If building planners do not consult with the instructional system designers before designing the building, the buildings will not likely accommodate the programs.

Instead of the usual one teacher per classroom of 30 or 40 students, the instructional staff needed for different systems will vary. Under some systems, a master instructor may be required, heading a team of other instructors or even paraprofessionals. Other systems will need an entirely different personnel pattern. This variety of staffing needs will create problems of status for various individuals on the instructional team. The personnel planning will be complex, for it will involve not merely the allocation of a teacher to a specific classroom, but the design of a whole instructional team for each system.

The scheduling of classes and instructional activities

will have to be flexible. If institutions have trouble scheduling traditional activities, their difficulties will multiply when they have to schedule multi-media instructional systems.

Philosophy is another difficult area. Under diverse multi-media instructional systems, neighboring departments may operate under dif erent philosophies of instruction or education. As systems are developed and become visible, the educational philosophy of the people using them will also become more evident. System designers favoring reinforcement as a method of instruction will show up when compared with those using a "discovery" or a "Gestalt" approach to instruction. The faculty and the administration will have to accommodate visible and conflicting philosophies of education on the campus.

Question 3: Can community colleges become program manufacturers or are they destined to be consumers only?

For many years, community colleges, like other educational institutions, have perpetuated the myth that instruction is controlled by the instructors and administration. This has really not been true, for most teachers teach traditional courses by traditional methods with traditional materials in traditional surroundings. For many generations, instructors have felt that they controlled their own destiny and, to some extent within the classroom, they could make a few minor decisions. Now, however, with the development of instructional systems, the areas where they can make instructional decisions is not so limited. Still to be answered is whether many instructors can really become system designers; or if community college instructors, like those elsewhere, must remain consumers of programs developed by the few instructors who write textbooks and by a few conservative publishing houses.

Question 4: Can systems be transported from one classroom to another and from one college to another, or must each instructor and each college rediscover the wheel?

At numerous workshops, curriculum and instructional leaders in the community college field have stimulated some instructors to attempt to design and implement new programs in their classrooms. Only a few have been successful. Must all develop their own programs and systems; or can a program designed in one college be transported to another; or can a program designed by one instructor be adopted in the same department by other instructors? It is probably not feasible even for each community college to have one instructor in each department design a new program, for development costs run high and the time needed to develop first-rate systems is more than most colleges have to invest.

The one hope for this problem is the transportability of programs between classrooms and between institutions. If one institution designs a workable system, other institutions should be able to buy it for use on their own campus. One myth about systems is that, if a program is taped or filmed, the instructor using the program should be the one heard or seen. If this were so, we might as well forget instructional systems, for they would be only novelty programs. Only when the market provides competing systems will they have any significant impact on the programs of our community colleges.

The mathematics systems at Fullerton Junior College have been produced in textbook-tape format and can be bought by any community college that wants them and has the necessary tape recorders and study areas to accommodate them. Mt. San Jacinto College is selling a number of its programs to colleges interested in adopting either all or part of the system. If the systems do not prove adequate, the colleges can adapt them without spending the many man hours of labor and thousands of dollars needed for initial development.

Question 5: Can new instructors be assimilated into existing systems or will the systems last only as long as their creators remain on the job?

If an instructor creates and implements a dynamic multi-media system, does this guarantee that other instructors will be able to use it? If the creator should resign, retire, or die, will his successors have to abandon the system through ignorance of its use or disagreement with its philosophy? If the systems exist only as long as their creators use them, they are not worth the effort to develop. If, however, an in-service program can initiate new staff members to the systems, they will likely live for many years.

The textbook, if it can be called a system at all, is relatively simple and readily adapted by new instructors. Multi-media instructional systems, however, require a more sophisticated approach to training new instructors in their use, for they control much more of the teaching-learning process than does the textbook. Instructors unwilling to learn to use the system will fail miserably. It is almost impossible for an instructor to teach by a new system until he has gone through it himself to find out exactly how it is put together and what it attempts to do. Those requesting funds to develop multi-media instructional systems should keep this in mind, for the transfer of the systems to others as the years go by is important if they are to be widely used.

Question 6: Will these new instructional systems improve the management systems in community colleges, or will the inadequacy of the management systems limit the development of instructional systems?

The management system in most colleges is relatively simple because the problems are simple. Resource allocations, schedules, and even personnel use are traditionally determined on a year-to-year basis. All this will change, however, with the use of new instructional systems; for the variables inherent in multi-media systems will be so great that present

management will not be able to handle the decisions. If it cannot, the instructional systems will never get off the ground; only chaos and confusion will result.

Question 7: Who will hold the copyright?

A small, but important, problem if instructors develop multi-media instructional systems will be the question of copyright. Any system developed for use in an institution should be copyrighted, and the problem of who will own the copyright must be resolved. If the institution hires the instructor(s) specifically to develop the program, the institution will doubtless own the copyright. On the other hand, if individual instructors volunteer their time and efforts to develop programs on their own, they will probably expect to own the copyright. Perhaps, through various motivational schemes, institutions and instructors will share the copyright. In certain cases the institution may allow the instructor to take the program with him if he leaves. Although these may seem minor matters to an instructor or institution that has not yet been involved in this kind of program development, they become important as soon as either begins to plan for it. Policies should be formulated and adopted by the governing board before any work is started, for, once instructors have invested their time, it may be too late to adopt regulations on copyright ownership. This would result in a poor relationship between the administration and the instructors and in low morale of the instructional staff.

Question 8: Who owns the systems?

Although the copyright problem may be resolved through certain policies, it does not necessarily mean that they will determine the ownership of the system. If an instructor uses his own camera and film and develops the program on his own, he will probably own not only the copyright, but also the materials. On the other hand, he may use school film or

materials, but his own time. Who then owns the instructional materials--the school or the instructor? These problems should also be covered in school policy. It has often been the practice of colleges unable or unwilling to spend money for program development to allow teachers to spend their own time and money to develop programs. Under these conditions, there should be no question about who owns the material. Even if the school is willing to go half way with a teacher (e.g., the school provides the materials and the teacher the labor), some question will probably still arise on ownership of the program. Before such agreements are made between instructor and institution, policies should clarify the ownership of the materials, so that, if an instructor leaves, both he and the institution will know what he can take with him.

Question 9: Can systems teach better than traditional approaches?

This will be a frequent question from instructors who wonder whether the system can really teach better than their present approach. The question should probably be, Does it teach as well? This cannot be answered at this time because it depends on the system and the approach with which it is being compared. The case studies presented in Chapter IV pointed out that, in several cases (the Fullerton math program and the English A program at Golden West), satisfactory results were being achieved by the use of an instructional system. In large institutions, where an instructional system for a given subject can be measured against the traditional approach to the same subject, it would be beneficial to find out how successful each system is and if there is a significant difference in the achievement of the students.

The achievement of the students, however, is only one aspect. Even if a system is capable of teaching only as well as the traditional approach, other factors may make it worthwhile, such as cost, better use of plant and personnel, and the ability to teach certain content areas that are difficult

to teach in the traditional way. The biology and English programs at Golden West College were more economical to teach by the systems approach than by the traditional approach.

Question 10: Will systems save money?

The development of systems is certainly much more expensive than the continuation of the traditional approach, and systems in and of themselves may not save money; however, some systems may be more economical in the long run because of better faculty use and the presentation of routine lectures and demonstrations by an auto-tutorial system. It is probable that well designed systems, once developed and implemented, will be a saving to the institution over the years. This saving, however, should not so influence designers that they try to put the entire program on an auto-tutorial system and eliminate the need for a live instructor. It would be certain to create morale problems among the students as well as the faculty and ultimately destroy the chances of success for any multi-media system.

Question 11: Can new instructional configurations increase learning while decreasing costs?

With experimentation in new teaching-learning configurations (seminars, learning teams, behavioral objectives, paraprofessionals, and the community as a learning laboratory), it may be that, over the years, community college instructors will discover how to increase learning while decreasing expenditures. Education today centers around a large and growing bureaucracy, which tends to be a low-trust organization. It may be that, with the development of multi-media instructional systems, where the student is more and more trusted to assume the responsibility for his own learning, these new approaches to learning will reduce the expenditures for instruction. Only the future and considerable experimentation by the community college faculty will resolve this problem.

Education has developed in a slow, loosely planned manner in this country. Technology has often been used as an aid to instruction, but has not yet been made a full partner in the enterprise. Only in the last five years has the computer been much used, and that mainly in the accounting and payroll departments and for scoring and grade reporting. Audio-visual materials have been used as aids to instruction, but little else has been done with this vast resource.

Perhaps it is time we up-dated our teaching-learning processes to capitalize on the available technology. The real obstacles in the road appear to be man and his understanding of what schools are all about. Perhaps this little book on instructional systems will help clear away some of these obstacles.

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