Education: The Crisis and a Plan

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EDUCATION: THE CRISIS AND A PLAN

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ABSTRACT

The crisis in education is described here in terms of quality, obsolescence, utilization of new technology, and economics. A plan is discussed for a flexible system of education which includes features such as elimination of the scheduled lecture as the center of educational operation, individual rate of progress, non-punitive grading system, year round operation. Specifically, a model is discussed for an undergraduate engineering curriculum. The problems of implementation and some possible ways to do this within five years are also discussed.

INTRODUCTION

The fact that a crisis exists in education can be illustrated by words and phrases that are well known to you - busing, de facto segregation, costs, student unrest, continuing education, dropouts, technology and education, public support of private schools, research support, relevancy, human obsolescence, government and university relations and others. A sampling of the wide interest this subject commands is illustrated in the appendix by a few extracts from the press and journals.

In this paper the crisis is considered in terms of four classes of problems: (1) quality of education, (2) obsolescence, (3) economics of education, and (4) technology and education. These basic components of the desperate situation in which we find ourselves calls for a "new" approach. One such approach which is the "Plan" referred to in the title is a flexible system of education that includes features such as individual rate of progress, non-punitive grading system, all year operation, elimination of the scheduled lecture as the center of educational operation, the human prod, and others. While I believe the strongest impact of the implementation of such a system is at the grammar and high school levels, this report is primarily concerned with the university (or junior college) level.

The plan, whose component parts are not new, really is a description of a system. I hope to convince you that this system not only contains elements of the solution for the crisis but that it could be implemented in existing as well as new school systems within a few years.

THE CRISIS:

Education offers us the means to achieve, and in itself adds quality to life. There are many problems in education that indicate an urgent need to examine our system.

Quality

At the college level we are aware of large differences among schools which offer degrees. We are also aware that many high schools give diplomas which are in effect certificates of attendance. In some deprived areas, teachers are faced with 25% absenteeism, inadequately prepared students, and regulations which prevent withholding the stamp of approval. The classroom morale is so low in many places that the willing student cannot escape the penalties of peer holdup. Presentation of diplomas and the premature promotion cheat both the recipients (who really fool nobody) and society.

Obsolescence

We know that a rapidly evolving society coupled with overwhelming technological possibilities does not always invoke enthusiasm and excitement in a better future. In simple terms we are personally afraid of exclusion for the new because there is no place for us. This, in turn, will make us reluctant to replace old machines, systems, and ideas, which means that we (all of us) cannot introduce significant improvements because we are not prepared to handle the social problem of personal refurbishment. For example let us suppose that we, here, invented a system (men and equipment) which would handle all our defense problems - but required only ten billion dollars per year to operate instead of one hundred billion.
The odds are, because we have no plan for the proper and humane way of working with the many people who would be displaced, that we would not accept the new system or at best incorporate it in parallel with the outmoded one.

The need for continuing education for updating and change are limited by various aspects of our present system. First, the present lecture centered system does imply schedules which are not compatible with work hours. Second, the distance between the sources of information and receivers may be too great. Third, the positive incentives may not be strong enough. For example while graduate students receive encouragement in concrete form to continue their studies, undergraduate workers usually do not.

Basically the inflexibility of our education system is one major obstacle to continuing personal intellectual and skills growth. There are many other obstacles but this discussion is limited to the education system.

New Technology

There are many new devices and systems which can help us learn more effectively. Computer-aided education, audio and video devices and systems, better texts, films, film strips, and others are examples of new aids which are useful or could be in the future. The most important developments are those in which individuals or small groups could learn at their own pace. Many of these devices can be introduced and used as supplements to our present class, lecture type approach. Others cannot be used conveniently this way.

In considering the techniques and objectives for education, I believe that the system should be flexible enough to incorporate whatever worthwhile devices are developed but not to build the system on any particular device. This would allow introduction, replacement, modification of new ideas more readily than with our present system.

Economics

There are some trends in cost increases in education that are alarming. First, a significant portion of gross national product (GNP) is attributable to education ($4 billion for formal education, 1967). Second, the average rate of increase in education expenditures (about 7.5%) is about twice the rate of growth of GNP. Third, the productivity of most segments of our economy has improved (output per man hour labor input) but this concept has not appreciably been brought into our "industry." I would highly recommend that you read, "The Economics of the Major Private Universities" by William G. Bowen (Carnegie Commission on Higher Education, 1968) because the elements of cost and income presented in this report give a staggering picture of resource requirements if we continue on our present course. The cost picture is probably not significantly different in the public domain of education.

While we may have been able to convince a "slow to convince" power structure that there is something sacrosanct about educational needs and that one should not apply the same yardsticks for spending here that we apply to other segments of society, the pressures to examine all significant expenditures (including defense) in society may find us (the country) the victim of arbitrary and chaotic cuts which hurt across the board not only the professional educators (meaning us) but ruin the system by which we invest in people thus resulting in large "educational deficits."

Certainly we will not be able to look at projected enrollments and programs and blithely apply multiplicative factors to establish budgets. A strong resistance is very properly in sight so that even the relaxation of the financial pressure of war will not enlarge our scope of operations uncritically. We will have to defend our expenditures in competition with other worthwhile investments in people. Sooner or later we must answer questions concerning our operations such as

(1) How many graduate schools do we really need to teach Anthropothermal Engineering, if any?
(2) How do we evaluate our product?
(3) Is our present organization the best for our objectives and money?
(4) Is the term cost effectiveness meaningful in education?
(5) Others

What I am suggesting is that we regard the problems described above as a challenge for which we can provide answers. The technology is here. Our prod (or should I say motivation) is sharp. The time is now.

THE PLAN:

A General Description:

The system which was proposed earlier (1) attempted to do the following things: (1) include individual rate of progress techniques, (2) Eliminate the lecture as a center of teaching, (3) Use broader areas for educational units than the three-hour semester system. This latter idea may
also provide the economic features that will make the total system feasible. (4) Eliminate the punitive system of grading. We should recognize as a principle that our main concern with the student is when he succeeds rather than how often he tries and fails. At any rate, the number of failures should not be part of the permanent record of any individual. (5) Try to separate the educational problem from the social problem of the student. This is a "no nonsense" system because the prod of required periodic examinations, if not taken seriously, would result in temporary withdrawal of the student until he is ready to return. (6) There is no starting or finishing time dictated by a calendar. The facilities are operated 12 months a year.

We would hope that our products would be people who are self learners.

A Model For Our Consideration

Suppose we examine how such a system might be applied to an engineering school. This description is certainly not complete but does consider (1) Organization (2) The Areas of Study (3) Basic Engineering, A Specific Area (4) Some Ideas on Cost (5) Other Items.

I hope that you will consider this more from the viewpoint of how one should or should not present a model than to become concerned about specific aspects of this model about which you disagree. For example the concept of a department may be radically different than the one we now have. We might have a better suggestion for organization than the one presented below. There may be many alternate ways of developing a flexible system of education. I am advocating that the non-lecture centered aspects of the system is one of the most important major changes to produce the desired flexibility.

Organization - A possible organization chart as applied to engineering is presented on the following page without comment.

Progress Towards a Bachelor Degree in Engineering

Let us examine the areas of an engineering education at the undergraduate level. An estimate of the equivalent semester hours is included with the prerequisites in Table I.

I cannot at this stage of the study describe all areas in detail. In the Engineering Skills Area students might be given a choice, depending on background and interest among computer programming, drafting, communication, shop skills, surveying (basic), accounting procedures, and others.

In some cases students might choose another set of areas which would not give them an engineering degree but may still find themselves with a marketable background. For example, suppose, one wanted to avoid studying the humanities. We might believe this is important enough not to grant a degree but some companies might still hire the student in an engineering capacity. The "intrinsic" value of a person to society might include the number of area certificates obtained, the fields, and the currentness.

We could decide that in order to obtain a first degree in a field (e.g. electrical engineering) that the student would be required to option an elective in electrical engineering (See Table I, Area 9 and choose another 10 to 15 hour area in electrical engineering to receive a degree in that field. The first degree would be a B.S. in Engineering (126 of our old semester hours).

The student could decide, with the aid of an advisor, whether he worked more effectively in one, two, or four areas simultaneously.

Regulations would indicate how much time each year is allowed for vacation. The student, in this system, simply signs out for the appropriate period when he finds it desirable.

The system would operate within each area as follows: A student would be handed a booklet which would contain a list of the items which he would be expected to understand and discuss at the end of the completion of a given area. This would include problems as well as vocabulary and concepts. The student would then be given an orientation concerning the methods available for learning. For example, audio or video tapes of his own professor, or professors; special lecture demonstrations, films, film strips, etc. He would be told that the area is divided into a number of segments and that he would be expected to submit himself for segment examinations at regular intervals. There would be a time assigned for him and everyone in this area to meet with faculty and assistants if they so desire. At this time they could receive help directly, or make use of the various available aids. Other times would be made available, too. An advantage of this setup is that the moment a new device or system for teaching any aspect of the area is developed, it can be incorporated into the system without a major syllabus change.

When the student successfully passes a
segment of the area, he proceeds to the next segment until he is ready for his final examination within the area. If the student fails to pass the segment, he receives a diagnostic, which could result in his trying another method for study, or a simple statement that he had not studied adequately, or at all. If too many of this latter type of diagnostics come to the attention of the student's main adviser, the student would be asked to drop out of school until he is ready to return.

It would be hoped that every several segments a discussion segment, aimed at relevance, would be incorporated into the system.

The moment the student completes an area, he can proceed immediately into the next area. This is another advantage of this type of system. One could progress at his own rate of speed; thus, the student who can organize himself well and is smart, might conceivably complete what had been a two-year norm in eight and one-half months. Or, a student who would need a little more time might complete what is normally a two-year norm in two years and four months. Some students may wish to spend more time in a given area simply because they are interested. The final grade for each student in each area might be satisfactory or excellent. It really is not important in this system that a student attempted and failed at some time during his progress through a given area. In order to take full advantage of all methods of learning, lists of students working on common segments would be available so that students could work together if they find that this is a helpful way to make progress.

You can see, then, that the basic system as visualized here, places an emphasis on providing many methods for learning, gives the student a choice of methods, and avoids the problem of peer holdup; that is, every student can move forward at his own rate of speed and take advantage of all methods of learning.

Basic Engineering Sciences - Area

In all areas we should plan (1) clearly defined academic objectives (2) student guides regarding admission, objectives, use of facilities, learning tools, personal help, examinations, and other necessary items (3) description of required faculty background, responsibilities (4) facilities and procedures for operations (5) budget analysis (6) evaluation.

The combination of basic mechanics, thermal sciences, and electrical sciences can do what we do now but hopefully provide a cohesiveness by means of examples where all three divisions are present in some relevant problems. Properly some segments of this area could include laboratory, demonstrations, and discussions concerned with practice.

This would be equivalent to 15 or 18 hours in our present system. The operating costs of this area are divided into the following categories (Table II):
TABLE I

Appropriate Areas of Study - Engineering

<table>
<thead>
<tr>
<th>AREA</th>
<th>TITLE</th>
<th>EQUIVALENT SEMESTER HOURS</th>
<th>PREREQUISITE</th>
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<tr>
<td>1.</td>
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<td>2.</td>
<td>Basic Humanities</td>
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<td>High School Equivalent</td>
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<td>3.</td>
<td>Basic Mathematics</td>
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<td>Basic Engineering Science</td>
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<td>9.</td>
<td>Elective-Intermediate Engineering In another</td>
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<td>field than Area 8, intermediate science,</td>
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<td>intermediate or advanced mathematics, business</td>
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<tr>
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<td>area, or other with approval</td>
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Total 126

TABLE II

POSSIBLE OPERATING COSTS IN SELECTED AREA (15 HOURS)

(500 students handled per 12 month year)
(An "average" of input and output)

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<th>SALARIES:</th>
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<tr>
<td>1. Director and Assistant</td>
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<td>2. Faculty Salaries</td>
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<td>(Three half time staff up to 500 students,</td>
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<td>then about the same for each additional 500)</td>
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<td>3. Student Assistants @ $4,000</td>
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<td>4. Non Professional Employees (a) $10,000</td>
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<td>5. Faculty Development (20% of 1 and 2)</td>
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</table>

TOTAL SALARIES $136,000

| TOTAL NON SALARY COSTS                        | $117,000 |
| TOTAL COSTS                                  | $253,000 |
| Cost per student                             | $506     |
| Cost per Student Semester Hour               | $34      |
Table III shows some costs for areas encompassing 6, 15, and 21 semester hour units for average enrollments of 50 to 1050 students, assuming basic costs are constant up to 250 students and basic components of educational costs are the same regardless of size of unit (equivalent semester hours). The assumed scaling was included in a program so that analysis of effects of variables could be studied. For example a 20% change in costs of non salary items would affect the total costs of a 15 semester hour 750 student unit by 4% where a 20% change in cost of salaries affects the total by about 16%. It is also possible to project trends from a given base year. Other cost evaluations such as student semester hours per full time faculty member and total costs per student are shown.

IMPLEMENTATION:

If one hopes to implement a system change as described above, there are many problems for both the transition in a mechanical sense, and problems with establishing the team work necessary to make the system work. Let us consider a list of implementation problems. These problems commence after an administrative decision has been made in regard to the selection of areas, or schools, for trial. The administrative decisions provide the means for establishing the detailed plans for the change-over, or in the case of a new school, plans for start-up. Some of the problems the planners would include:

1. Selection and recruiting of personnel.
2. Preparation of facilities, learning materials, and administration.
3. Presentation of ideas to affected people (students, faculty, and administrators.)
4. Development of cost analyses and plans for operation.
5. Development of plans for evaluation.
6. Approval of administration, etc.
7. Time required for change.

All the problems listed above are important but the most important, in order to actually achieve a changeover in a short time (one to three years) is item 2. Specifically what would take the place of the lecture? In the long term all technological devices would be brought into the system as they are feasible but for now the most practical and least expensive would be the audio cassette tape with accompanying lecture notes and exercises. These can be prepared professionally (publication quality) at approximately $10,000 per three hour course (my estimate, based on a course I have prepared of this type) or at about one fourth the cost to simply tape lectures, presented by the teacher, of a course where pictures are taken of the board (or pad for TV lectures) and are combined with sample exercises and examinations furnished by the instructor. While this latter approach may not be the best it would allow a transition within about one year in a given school. There are several other ways in which the replacement of the lecture represents a trade off in quality and cost. It is easy to see that the transition for a school system would represent some significant investments that have to be carefully designed but this is no different than other capital investments. If successful there would be both a quality and economic pay-out.

ACTIVITIES IN EDUCATION

None of the components of this proposed system are new. There is much activity today by people with varied backgrounds who are concerned with learning and teaching. Their areas of concentrations can be divided into several categories (this is oversimplified):

(1) Application of devices (old and new) to specific subjects (2) - (6)
   a) computer aided education
   b) programmed learning
   c) audio and video aides
      - movies
      - slides
      - projectors
      - video tapes
      - audio tapes
      - others
   d) text books still offer the most economical method for presenting information. Better methods for use and development of texts are needed.

(2) Special experiments in educational methods (7) - (21)
   a) Self paced courses
   b) ungraded schools
   c) non structured systems
   d) many others

(3) The Study of Systems (1), (22) - (32)

Selected material which exemplifies these categories are included in the References. This particular paper could be classified under the study of systems.
### TABLE III

**AREA EDUCATIONAL COST FACTORS**

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- **U** - Equivalent number semester hours
- **A** - Number students/year in unit
- **T** - Total annual cost ($)
- **Z1** - Total cost per student semester hour (SSH)
- **Z2** - Total salary cost ($ per SSH)
- **Z5** - Total non salary costs ($ per SSH)
- **Z6** - Total overhead costs ($/SSH)
- **Z3** - Educational Salary and Development ($/SSH)
- **Z4** - Costs - Non Salary Items and Non Professional Salary ($/SSH)
- **D** - Costs per student
- **B** - SSH per full-time faculty
CONCLUSION

In this paper the proposal of a flexible system of education has been placed before you in order to convince you that we can overcome the crisis in which we find ourselves.

The radical changes called for, could be achieved in a relatively short time (e.g. the 70's) if we can recognize the urgency for change and HELP WITH THE ACTION.

ACKNOWLEDGEMENT

There are many people who have encouraged my interest and have supplied me with advice and criticism. These include Ralph M. Varhaug, Charles A. Benio, Kenneth W. Heizer, Charles R. Vail, Thomas L. Martin, Jr., Lee Harrisberger, Jeffrey S. Blum, Ruth Wallad, Ray H. Marr, Truman Cook, and Jack P. Holman.

My environment at Southern Methodist University has been most conducive to the development of ideas.

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(3) "Little Black Box of Teaching and Learning; Lectures vs. Discussion Sections," Trans-action, 6:10, Oct. 1969.


(9) "Where Failures Make the Grade: Two Schools for Dropouts," Carnegie Quarterly, 16:1, Fall 1968.


APPENDIX: Samples of Written Expressions Concerning Education Crises:

(1) COSTS - DISORDER ---
"---Public Disappointment: There appear to be a number of reasons why hard-pressed real estate and income tax payers believe the rising cost of higher education is a major part of their burden. Student disorders—for which the campus at Berkeley is almost a symbol—coming on top of the tax burden have spread the notion that students themselves should pay for the full cost of their education. If students have to work to pay tuition, many Californians seem to believe, they won't have time to smoke pot, make love or demonstrate. Above all, however, sensitive observers in California sense a certain public disappointment with the very idea of the university and of higher education itself....."

(2) COSTS - PAROCHIAL SCHOOL SUPPORT ---
"---In arguing the case for increased public support, the spokesmen for the parochial schools (and, incidentally, for some 75,000 children in Jewish day schools along with some Protestant denominational schools) say that they are providing education under the law that calls for uni-

versal schooling.....

"...These are among their specific objections to repeal:

The Federal Constitution, they say, was not concerned with public school questions. Therefore, it was up to the states to spell out the restrictions, as 48 states in fact did.

The public schools already operate under inadequate budgets. Funds for nonpublic schools would therefore be taken away from the public schools.

Those who see this as a threat to public education add that it could lead to the withdrawal of middle-class and particularly white children from public schools, leaving them with an even greater proportion of the deprived. They warn that by inviting all denominations to expand their own educational programs, religious divisions may be aggravated...."

"Plan Urged to Aid Open Admissions...A Queens College Study group made up of student, faculty and administrative representatives has proposed a series of academic and administrative changes to smooth the way for open admissions next fall..."

"Summerhill in Ithaca There is no principal. Pupils need not attend class. There are few desks and no neatly stacked textbooks. The children learn photography and human reproduction, paint prehistoric villages, play chess, nurse gerbils and frolic in the halls. But this is not just another unconventional and expensive private school. It is East Hill Elementary School in Ithaca, N.Y., quite possibly the most innovative U.S. Primary school ever supported by taxpayers..."

"...Julius Hobson, Washington's leading black militant: 'Of course—integration is a complete failure...what we've got is no longer an issue of race but of class, the middle class against the poor, with the Federal government standing by... the schools in Washington have deteriorated to a point almost beyond repair—if I could afford it. I'd send my own children to a private school... I have an opinion I hesitate to voice, because it's too close to George Wallace, but I think it's time we tried to make the schools good where they are...the
integration kick is a dead issue.'...

"...Here (in a tone of anguish) is Richardson Dilworth, liberal Democrat, former mayor of Philadelphia, and president of that city's Board of Education: 'I've never seen the cities in such terrible shape ... people don't listen, they just scream at us, and a lot of the whites are worse than Georgia rednecks. But I just don't think you can give up on integration. If you do, the cities are lost."

"...Also last week, Sen. Abraham Ribicoff of Connecticut, one of the shrewdest and most perceptive politicians on Capitol Hill, rose to brand the North "guilty of monumental hypocrisy" on the race issue. In the colloquy that followed, Ribicoff gave this chilling description of the American school system:

'When we have a school system ready to blow up across the nation, when teachers have to be escorted to school by police, and when students are fighting one another in the schools and classrooms, we have a civilization in disintegration.'

The implication is clear--that integration threatens disintegration. But if integration is a failure, what is to be done?..."