THE COST - EFFECTIVENESS OF INSTRUCTIONAL TECHNOLOGY: A PROPOSITIONAL INVENTORY OF THE LITERATURE

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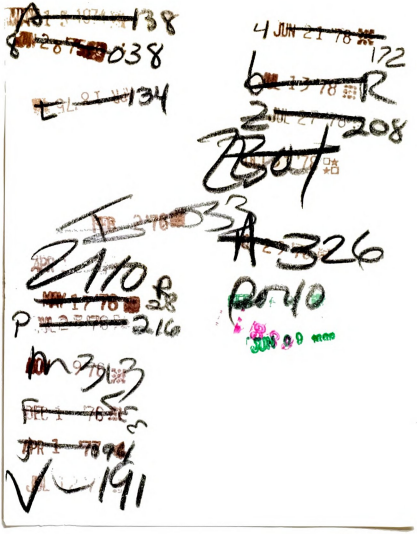
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ABSTRACT

THE COST-EFFECTIVENESS OF INSTRUCTIONAL TECHNOLOGY: A PROPOSITIONAL INVENTORY OF THE LITERATURE

By

Edward P. Caffarella, Jr.

This study contains a list of propositions pertaining to the cost-effectiveness of instructional technology. The propositions were formulated by collecting, analyzing, and synthesizing existing studies that deal with the subject.

Statement of the problem

Colleges and universities across the country are currently facing financial problems. The problems are not limited to any particular type of institution but are found throughout higher education. One cause of the problem is that tuition costs have risen sharply during the past fifteen years. However, even with these increases in tuition the student paid a smaller percentage of the costs of his education in 1970 than he did in 1960. Another cause is that since education is a labor-intensive industry, it must expend a major percentage of its budget for personnel.

Before productivity can be raised in a labor-intensive industry, it must become more capital-intensive.

Institutions are meeting the financial crisis primarily by utilizing short-range, stop-gap solutions. Among those being utilized now are the following: 1) delay of non-essential building repairs, 2) elimination of non-productive programs, 3) elimination of faculty positions, 4) decrease in the budgets of all departments, and 5) post-ponement of faculty raises.

Higher education must find long-range solutions to the financial crisis; otherwise it will continually need to find new short-range solutions for financial problems. It appears that if the long-range solution is to be a real solution, then the current structure of higher education, particularly the organization of instruction, must change.

Instructional technology as a solution

Many leading educators have been suggesting instructional technology as a means by which institutions of higher education can meet, at least in part, the current financial crisis. Through the use of instructional technology higher education can become less labor-intensive and more capital-intensive. Thus, it will be possible to increase the productivity of higher education and simultaneously to increase the cost-effectiveness of instructional technology.

Purpose of this study

The purpose of this study was to formulate a list of propositions pertaining to the cost-effectiveness of instructional technology by collecting, analyzing, and synthesizing existing studies that deal with the subject.

Methodology

The methodology used is the propositional inventory research design which has been used in a number of sociological studies. The first step in the methodology was the development of a bibliography of all studies which measured the cost-effectiveness of instructional technology. The initial bibliography consisted of four hundred and twenty-nine references. Of this number approximately three hundred were evaluated in terms of two criteria. The first criterion was that the study must deal with the cost-effectiveness of instructional technology. The second criterion was that the study had to be either an empirical study or its findings had to be supported with quantative data. From the thirty-two studies that met these criteria sixteen propositions were formulated which encompass the findings of these studies.

Propositions

The propositions cover such subjects as closed-circuit television, sixteen millimeter films, production of instructional materials, student time, and audience size.

A typical proposition is: Proposition Number 1B. The cost of utilizing open circuit television for instruction will be less expensive than the cost of providing instruction through the use of one instructor for each thirty students when the total course size is greater than five hundred students.

THE COST-EFFECTIVENESS OF INSTRUCTIONAL TECHNOLOGY: A PROPOSITIONAL INVENTORY OF THE LITERATURE

By

Edward P. Caffarella, Jr.

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To my wife, Rosemary,
I dedicate this study.

I need so much the quiet of your love
After the day's loud strife;
I need your calm all other things above
After the stress of life.

I crave the haven that in your heart lies,
After all toil is done;
I need the starshine of your heavenly eyes,
After the day's great sun.

--Charles Hanson Towne

PREFACE

This study, though it is comprehensive, certainly does not include all the existing research on the cost-effectiveness of instructional technology. Research which was conducted after the writing of this study is, of course, not included. As readers identify additional research which should be included in a subsequent edition of this study the author would appreciate being informed of the research.

Any dissertation, and particularly this one, involves the work and encouragement of many people. To these people the author owes a great debt:

To Dr. Paul W. F. Witt for his untiring guidance and encouragement during my entire doctoral program and especially for serving as a distinguished exemplar of the profession that I now enter as a college professor.

To Dr. James R. Nord for giving me the opportunity to learn so much from him while working as his administrative assistant.

To Drs. Kent L. Gustafson, Floyd G. Parker, and Everett M. Rogers for exposing me to new frontiers in the fields of education and communication.

To the Resource Utilization Project Staff and Fellows for providing a dynamic and exciting environment within which to work during the past year.

To the Instructional Development and Technology Graduate Students for teaching me so much during the past two years.

To the authors of the thirty-two reports in this study for providing me with the data used in formulating the propositions.

To my wife for persevering with loving care during my doctoral study.

To all, a heartfelt thank you.

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CHAPTER I

PROBLEM, RATIONALE AND PURPOSE

This study contains a list of propositions pertaining to the cost-effectiveness of instructional technology that were formulated by collecting, analyzing, and synthesizing existing studies that deal with the subject. The propositions should be viewed with caution since they are supported by a relatively small number of studies.

Instructional technology has been suggested as a means whereby higher education can overcome, at least in part, the financial crisis it now faces. Although most of the studies are not empirical or data-based investigations, several have been executed which measure the cost-effectiveness of specific aspects of instructional technology. However, there is no study which measures the cost-effectiveness of instructional technology in general. This study advances sixteen propositions relating to the general cost-effectiveness of instructional technology that have been developed from existing studies on specific aspects of instructional technology.

Statement of the Problem

Financial crisis in higher education

Higher education in America is in the midst of a financial crisis affecting colleges and universities, both public and private, across the nation.

The titles of two books by Jellema describe succinctly the financial crisis in higher education. The first book is entitled The Red and the Black: Special Preliminary Report on the Financial Status, Present and Projected, of Private Institutions of Higher Learning.[1] The second book shows the increasing seriousness of the financial condition of colleges and universities by refering to the color of the ink on the ledger page in its title which is Redder and Much Redder: A Follow-Up Study to "The Red and the Black."[2]

Cheit[3] in 1971 studied the financial conditions of forty-one institutions of higher education including

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[1]William W. Jellema, The Red and the Black: Special Preliminary Report on the Financial Status, Present and Projected, of Private Institutions of Higher Learning (Washington, D. C.: Association of American Colleges, n.d.).

[2]William W. Jellema, Redder and Much Redder: A Follow-Up Study to "The Red and the Black" (Washington, D. C.: Association of American Colleges, 1971).

[3]Earl F. Cheit, The New Depression in Higher Education: A Study of Financial Conditions at 41 Colleges and Universities (New York: McGraw-Hill, 1971).

nationally prominent universities, local community colleges, public institutions, private institutions, science colleges and liberal arts colleges. His findings show rather conclusively that a large percentage of American institutions of higher education were either in financial trouble or were headed for financial trouble. He found that:

> . . . 29 of the 41 colleges and universities in the study (71 percent) were, at the time of the campus visit, headed for financial trouble or were in financial difficulty. The remaining 29 percent, 12 schools, were considered not in financial trouble at the time of the campus visit.
>
> For purposes of this study, an institution was judged in financial difficulty if its current financial condition forced upon it a loss of program or services that are regarded as part of the program. An institution was classified as headed for financial trouble if, at the time of the study, it had been able to meet current responsibilities without reducing quality, but either could not ensure that it could much longer meet current program and quality standards or could not plan support for evolving program growth.[1]

Based upon Jellema's report on the financial condition of private colleges and Cheit's study of a fairly representative sample of American institutions of higher education it is quite clear that a great many of the colleges and universities of the nation are in serious financial difficulty.

Explanations for the crisis

While several explanations have been proposed for the present financial problems in higher education, two:

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[1] Ibid., p. 139.

rise in tuition costs; and the fact that education is a labor-intensive industry, are regarded as of major significance.

The rise in tuition costs. One explanation for the financial crisis is that tuition covers a much smaller percentage of the cost of educating the student than it did ten years ago. A study of independent colleges in Ohio[1] showed that in 1959-60 tuition and fees covered 76% of the costs of educating the students and by 1969-70 this had dropped to 64%. As a consequence of this explanation one suggested means of solving the financial crisis is to increase the percentage of the costs which students pay in tuition and fees. This has been attempted by private colleges in Ohio where the average tuition was $748 in 1959-60 and by 1969-70 had risen to $1,559. Even with this increase in tuition the percentage of the costs of educating the students covered by tuition fell from 76% to 64% during the same period. Obviously, the increase in tuition has not solved the financial problems of the colleges in Ohio.

Howard R. Bowen in a review of the financial needs of higher education indicates that increases in tuition

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[1]Association of Independent Colleges and Universities of Ohio, Toward an Effective Utilization of Independent Colleges and Universities by the State of Ohio (Columbus, Ohio: Association of Independent Colleges and Universities of Ohio, 1971), p. 17.

do not solve the financial problems of higher education because: "Rising expenditures for higher education are due not only to expanding enrollments but also to rising costs per student. . . . costs per student nearly doubled between 1955 and 1968."[1]

There is a point beyond which many students are unable to pay higher rates for tuition. Consequently when an institution charges tuition a student cannot afford he is quite likely to withdraw from the institution. Thus by charging higher tuition an institution runs the risk of making its financial plight worse rather than better. For example, if a college with an enrollment of 4,000 students were to attempt to increase its operating budget by raising its fees from $4,000 to $5,000 per year, it would actually decrease its income from fees from $16,000,000 to $15,000,000 if the higher fees caused 1,000 of its students to withdraw from the college.

Since tuition in many colleges is approaching levels many students cannot pay, other means must be found to meet the financial crisis. One possible means is to reduce the overall costs of educating students through the use of technology. If the overall cost is reduced, then the amount paid by the student covers a larger percentage of it. For

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[1]Howard R. Bowen, "Financial Needs of the Campus," in The Corporation and the Campus, ed. by Robert H. Connery, Proceedings of the Academy of Political Science, 1970, p. 80.

example, if a college with a tuition fee of $2,000 were to decrease the cost of educating the student from $3,000 to $2,750 per year, it would actually increase the percentage that tuition covers of the costs from 67% to 73% without an increase in tuition fees.

Education is a labor-intensive industry. Industries that expend a major percentage of their resources for personnel are referred to as labor-intensive industries. Industries that expend a major percentage of their resources for capital goods (raw materials, machinery, etc.) are considered capital-intensive industries.

Because education expends a major percentage of its budget for salaries of faculty and staff it is categorized as a labor-intensive industry. Conversely, since the automotive industry expends a large percentage of its budget on capital goods it is a capital-intensive industry.

A parallel can be drawn between education and the performing arts. The performing arts, like education, is a labor-intensive industry. The performing arts largely utilize the talents of a live performer or a group of live performers to entertain a live audience. Because of the current high cost of live performers, the performing arts are also facing serious financial problems. Since both education and the performing arts are labor-intensive industries, the financial problems encountered by both are similar.

In 1966 the Twentieth Century Fund conducted a study to investigate the financial problems plaguing the performing arts. In a report of that study Baumol and Bowen state that:

> . . . because of the economic structure of the performing arts, these financial pressures (i.e.: cost of the performer, maximum ticket price which patrons will pay) are here to stay, and there are fundamental reasons for expecting the income gap to widen steadily with the passage of time.[1]

Later in the same volume these authors describe the problem that a labor-intensive industry encounters when it attempts to increase its productivity.

> Human ingenuity has devised ways to reduce the labor necessary to produce an automobile, but no one has yet succeeded in decreasing the human effort expended at a live performance of a 45 minute Schubert quartet much below a total of three man hours.[2]

Since the largest percentage of the costs of the performing arts and education is for salaries, the costs of both performance and instruction increase almost directly proportional to the increase in salaries making it almost impossible to increase the productivity of a labor-intensive industry. On the other hand, the manufacturing industry, a capital-intensive industry, has been able to increase its productivity at a rate of 2½%

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[1]William J. Baumol and William G. Bowen, Performing Arts: The Economic Dilemma (Cambridge, Massachusetts: M.I.T. Press, 1966), p. 161.

[2]Ibid., p. 164.

per year primarily through the use of technology.[1]

Howard Bowen further substantiates the finding of the Twentieth Century Fund study that education is a labor-intensive industry when he states that:

> Higher education is a labor-intensive industry. The bulk of the budget goes to pay salaries. The size of the staff, both professional and non-professional, relative to the work load, is therefore a critical factor in cost. And within the salary budget, professional salaries bulk large.[2]

Bowen also implies that as long as education remains a labor-intensive industry it will continue to have major financial problems.

Jenny and Wynn believe that education should change from a labor-intensive industry to an industry that is more capital-intensive.

> It has been our experience that higher education is and has been denied precisely those types of funds in adequate amounts which are most needed to combat inflation and to enhance educational quality. Capital has been a most scarce economic resource for colleges . . . .[3]

Education, in all likelihood, will never become a capital-intensive industry. If, however, education can invest a larger percentage of its resources in capital, such

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[1] Ibid., p. 162.

[2] Bowen, "Financial Needs," p. 82.

[3] Hans H. Jenny and G. Richard Wynn, Turning Point: A Study of Income and Expenditure Growth and Distribution of 48 Private Four-Year Liberal Arts Colleges, 1960-1970 (Wooster, Ohio: The College of Wooster, 1972).

as instructional technology systems, it may be possible to make education less labor-intensive. By making education less labor-intensive, it will be easier to increase the productivity of education.

The two explanations presented in this section have centered around a lack of resources in sufficient quantities to meet the increasing costs of education and the financial structure of education whereby a large percentage of the available resources are expended for personnel.

Solutions to the financial crisis proposed in the past

For many years higher education has been involved in numerous financial crises and a variety of solutions has been proposed and implemented.

For example, Harvard University, the oldest university in America, founded in 1636, attempted these financial reforms: 1) In 1824 the faculty voted not to fill any vacancies thereby saving money for the university.[1] 2) The combining of Harvard University and the Massachusetts Institute of Technology has for decades been the object of feasibility studies.[2] 3) The Harvard Veterinary School was

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[1]Seymour E. Harris, Economics of Harvard (New York: McGraw-Hill, 1970), p. 397.

[2]Ibid., p. 402

closed in 1900 because it had incurred a deficit of $4,206.96.[1] For each of the examples from Harvard's history, parallel situations can be found in contemporary higher education. For example: 1) In 1973 Syracuse University is not filling faculty vacancies when they occur. 2) The state supported institutions of higher education in New York, California and Maine have in each state been merged into one statewide institution. 3) Parsons College was recently forced to close because its deficit grew too large.

As with the institutions described above other institutions have responded to the financial crisis in a variety of ways. The Carnegie Commission on Higher Education in a study of the means by which higher education could meet the financial crisis expands on how institutions are currently dealing with it.

> Already the financial crisis has forced many institutions of higher education to curb increases in expenditures. Some have taken great care to assure that expenditures might be pruned in ways that would be least harmful to the quality of education. But too often the pattern is one of across-the-board costcutting, such as deferred maintenance, a general freeze on hiring, uniform budget cuts for all departments, and, in public institutions, restrictions on the enrollment of qualified students. Some of these measures, such as deferred maintenance, may help in the short run but merely exacerbate problems in the long run, as costs rise. A general freeze on hiring may, unless it is administered with some degree of flexibility, have

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[1] Ibid., p. 402.

> undesirable repercusions in a situation in which there is a need for expansion in some fields and contraction in others in response to the dramatic changes that are occuring in the job market for college graduates.[1]

As this quotation makes clearly evident, institutions of higher education are not achieving long-range solutions to their present financial crises. Instead they are employing short-range, stop-gap measures which may, in fact, have negative long-term effects on their institutions.

Two case examples illustrate some of the short range solutions which have been employed by institutions which are in financial difficulty in order to extricate themselves from their plight.

> New York University. In 1970-71 (the situation has worsened since then) the university will carry a deficit of over $5 million and will need to borrow to cover it. The university has partially offset its difficult financial situation by the sale of noneducational business assets. The number of faculty has been frozen and the number of teaching assistants reduced. Research has been cut back, and a moderate reduction has been made in the number of administrative posts. The student faculty ratio will rise in 1970-71.
>
> Saint Louis University. The School of Dentistry, the four engineering departments, and Parks College --a small affiliate specializing in aeronautical science--have been closed. Forty-five faculty positions were eliminated, and forty permanent faculty members were consequently given two years' notice of severance from employment. The current allocation of the Medical School is one-third what it was three years ago. Library acquisitions and

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[1]Carnegie Commission on Higher Education, The More Effective Use of Resources: An Imperative for Higher Education (New York: McGraw-Hill, 1972), p. 31.

> research programs were trimmed. Faculty salaries were raised only 3 percent--it is feared that some faculty may leave as a result. Many courses were postponed, and the student-faculty ratio has risen. The debate program has been eliminated for next year.[1]

As evidenced by these examples, institutions of higher education are meeting the financial crisis by employing two basic strategies. One strategy has been to curtail or eliminate certain programs and/or services within the institution. The other strategy has been not to expand the institution's offerings even though there was a need for programs in new fields. Both of these strategies are short-range solutions to the financial crisis which will have long-term negative effects on the institutions.

Higher education must find long-term solutions to the financial crisis. Otherwise, it will be limited to continually substituting short-range solutions and will never solve the financial problems. It is highly probable that the long-range solutions will entail a restructuring of the current organization of higher education.

Howard Bowen and Gordon Douglass, in a recent study sponsored by the Carnegie Commission on Higher Education, proposed several means for increasing the efficiency of higher education. Each of the means, however, necessitates a restructuring of the present organization of instruction which is used in higher education.

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[1]Cheit, Depression, p. 99.

> The instructional systems which Bowen and Douglass considered (in addition to the conventional plan) were modification of the conventional plan by introducing a few large lecture courses of large enrollment (a variant of the Ruml plan), programmed independent study of a type that would require minimal time of the instructor and minimal specialized equipment other than library books, tutorial instruction (the Bakan plan), programmed independent study using mechanical aids (the Kieffer plan), and a plan of our own (the eclectic plan) combining these several methods.[1]

Bowen and Douglass presented and described the costs of these systems using a hypothetical liberal arts college with an enrollment of 1200 students as a setting. For purposes of this study, the important point is that Bowen and Douglass see a need to modify the current organization of instruction if higher education is to become more efficient.

In the examples cited in this section there were no institutions which increased their efficiency by employing the strategies suggested by Bowen and Douglass. If higher education is to find long-range solutions to the financial problems which it faces, it must restructure the organization of instruction utilizing strategies similar to those suggested by Bowen and Douglass. Instructional technology is one such strategy that can be utilized in long-range solutions.

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[1]Howard R. Bowen and Gordon K. Douglass, Efficiency in Liberal Education: A Study of Comparative Instructional Costs for Different Ways of Organizing Teaching-Learning in a Liberal Arts College (New York: McGraw-Hill, 1971), p. 95.

Instructional Technology as a Solution

As is suggested above, instructional technology may be a means by which higher education can solve, at least in part, the financial crisis which it now faces. This section contains a description of the ways that instructional technology can be utilized to help to solve the financial crisis.

The use of instructional technology by higher education

Currently the usage of instructional technology by colleges is at a relatively low level. "Only a small percentage of the annual budget of any school, college or university is available for instructional materials (including books)."[1] If instructional technology is to help solve the financial crisis, then the level of use of technology will need be increased.

As already noted, the performing arts, like education is a labor-intensive industry, has increased its use of technology during the past two decades. The performing arts have changed somewhat from a labor-intensive industry toward a capital-intensive industry by utilizing television to increase their productivity.

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[1]Sidney G. Tickton, ed., To Improve Learning: An Evaluation of Instructional Technology, Vol. I (New York: Bowker, 1970), p. 1, 84.

> . . . An orchestral performance on television, which we are told by the professionals, takes less than twice the man-hours of a live performance, can reach an audience of 20 million instead of the 2,500 persons who occupy a concert hall, thus yielding an increase in productivity of four hundred thousand per cent![1]

Four hundred thousand percent is an astonishing increase in productivity. If all programs in a college could increase their productivity by just one hundred percent the college could double its present program without an increase in the current level of expenditure. Although an increase in productivity will not solve the financial crisis, it can provide a means which educators can use to solve, at least in part, the problem.

The report of the President's Commission on Instructional Technology states that technology can be used to relieve teachers of many of the administrative and information transmission tasks which they currently perform. By relieving teachers of these tasks the teacher can then assume those tasks which human beings can perform best.

> Technology can make education more productive. With the demand for education outstripping education's income, more effective and more efficient learning is vital. Instructional Technology has shown its ability to speed up the rate of learning. It can help the teacher make better use of his time. It can reduce the teacher's heavy burden of administrative tasks and take over some of the teacher's routine job of information transmission. Thus, the teacher would be able to

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[1]Baumol, Performing Arts, p. 163.

> spend more time on teaching-inspiring students to learn and encouraging them to apply newly acquired information in useful and interesting ways.[1]

The use of instructional technology in a way such as this will mean a restructuring of the organization of the academic program in higher education.

The Carnegie Commission on Higher Education released in June of 1972 a report entitled The Fourth Revolution: Instructional Technology in Higher Education. The report deals with the role which instructional technology has played in the past and the role which it will play in the future of higher education. Its recommendations for the future state that:

> Although short-run costs for the development and introduction of new technology are expected to be very great, they will ultimately yield dividends. Much of the expanding technology has the potential economic effect of spreading the benefit of investment in a single unit of instruction among very large numbers of students. It therefore has an ability to increase the productivity of higher education. The earlier efforts are made to develop the expanding instructional technology fully, the earlier this increased productivity will be realized.[2]

In a further discussion of the role instructional technology will play in higher education in the future the report lists the following ways technology can help college and university professors increase their productivity:

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[1]Tickton, To Improve Learning, Vol. I, p. 32.

[2]Carnegie Commission on Higher Education, The Fourth Revolution: Instructional Technology in Higher Education (New York: McGraw-Hill, 1972), pp. 45-46.

1. By decreasing the time required by students to learn specified modules of information.

2. By taking maximum advantage of the capabilities of available technological capacity.

3. By releasing faculty time.

4. By prolonging the time during which instruction is available.

5. By utilizing quality instructional materials produced off the campus.

6. By sharing high-quality instructional programs and learning materials with other institutions.

7. By a conscious integration of all available technologies to produce desired objectives.

8. By enlarging the market for instructional materials and instructional media.

By increasing the productivity of professors, colleges and universities can alleviate part of the financial crisis.

In the eight point list above, the Carnegie Commission on Higher Education is suggesting, although not in these words, that the use of instructional technology in higher education is cost-effective. That is, instructional technology programs will either cost the least or will yield the highest effectiveness when two or more programs are compared. However they do not support their points with data or references. The other studies in this section also suggest that the use of instructional technology is cost-effective but do not support their statements with data. Since they are not documented it is impossible to determine

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[1] Ibid., pp. 83-85.

the validity of the statements. However, it may be possible to measure the cost-effectiveness of instructional technology by examining existing studies on the subject.

The need for the current study

The need to investigate the cost-effectiveness of instructional technology is recognized by several prominent educators writing in a variety of publications. For example, Robert Heinich in a discussion of the management of instruction through the application of instructional technology states that:

> We need to experiment with instructional management arrangements that permit mediated instruction to pay for itself. Cost-effectiveness information is a first step in buttressing arguments for such arrangements. Much more research, time, and effort are needed in this area.[1]

He further emphasizes the need for data on cost-effectiveness in his monograph entitled Technology and the Management of Instruction when he states that:

> The first step would be a thorough examination of places that have claimed savings in staff or buildings, such as Dade County, Hagerstown, and Pennsylvania State University, and other programs where economies are implied such as IPI. Much of the use of technology in education today is very akin to featherbedding and we cannot afford the comparison. Increased productivity with differentiated staffs will place the profession in a much more favorable position in respect to available money.[2]

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[1]Robert Heinich, "What is Instructional Technology?" Audiovisual Instruction, 13 (March, 1968), p. 222.

[2]Robert Heinich, Technology and the Management of Instruction (Washington, D.C.: Association for Educational Communications and Technology, 1970), p. 181.

Heinich sees a need to devote more research to the study of the cost-effectiveness of instructional technology. He also sees a need to examine those places which have claimed savings from the use of instructional technology.

The report of the President's Commission on Instructional Technology stresses the lack of data on the cost-effectiveness of instructional technology in the contention that:

> Most data on the costs of instructional technology lack the necessary scope and depth to help education's managers make policy decisions. The data are usually subject to many limitations and footnotes . . . .[1]

If educators are to make data-based decisions regarding the use of instructional technology then they must have the data upon which to base those decisions. Currently educators do not have the data in a form usable for decision making.

Johnson and Dietrich see an immediate need for cost-effectiveness information on instructional technology. They believe that the lack of cost-effectiveness information is hurting the educational decision making process. They claim that:

> At present, cost data on educational technology is almost nonexistent. The lack of these data severely impedes the academic decision-making process. Regardless of costing procedures used . . . , ways must be found to place costs of educational technology in perspective.

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[1]Tickton, To Improve Learning, Vol. I, p. 87.

> Present inadequate cost data are frequently so subjective that they are nothing more than pious hopes. The time is here to come to grips with the reality of cost analysis in the academic decision making process.[1]

The ideas stated in this quotation are parallel to the ideas expressed by Heinich and the Commission on Instructional Technology. These three quotations make clear that there is a need for information on the cost-effectiveness of instructional technology which can be used in the educational decision making process.

The Carnegie Commission on Higher Education, in its publication The Fourth Revolution, goes beyond stating a need for information on the cost-effectiveness of instructional technology. Recommendation number fifteen exhorts that:

> An independent commission, supported either by an appropriate agency of the United States Department of Health, Education and Welfare or by one or more private foundations should be created to make assessments of the instructional effectiveness and cost benefits of currently available instructional technology. Findings of the commission should be published and appropriately disseminated for the advice of institutions of higher education, such cooperative learning-technology centers as may be established, and governments and foundations supporting the advancement of instructional technology.[2]

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[1]F. Craig Johnson and John E. Dietrich, "Cost Analysis of Instructional Technology," in To Improve Learning, Vol. II, ed. by Sidney G. Tickton (New York: Bowker, 1971), p. 365.

[2]Carnegie Commission, Fourth Revolution, p. 87.

While this study will not achieve the same results that an independent commission is likely to achieve, it will provide an initial assessment of the cost-effectiveness of instructional technology. Possibly this study could also serve as a basic resource when and if such a commission is created.

It is clear that the user of instructional technology must be prepared to make educational decisions which reflect the cost-effectiveness of instructional technology. If the user of instructional technology is to make such decisions he must have data upon which to make the decisions that are cost-effective. This study meets the need by providing data on the cost-effectiveness of instructional technology.

Purpose of This Study

The purpose of this study was to formulate a list of propositions pertaining to the cost-effectiveness of instructional technology by collecting, analyzing and synthesizing existing studies that deal with the subject. To achieve this purpose a propositional inventory research design was employed to develop the propositions listed in Chapter IV.

Summary of Chapter I

In this chapter, higher education in America has been shown to be in the midst of a grave financial crisis.

Among the reasons presented for this crisis were the financial problems encountered by labor-intensive industries. Several means of dealing with the financial crises in the past were described. Instructional technology was suggested as a means to solve, at least in part, the financial crisis in higher education. The need was presented for a study to investigate the cost-effectiveness of instructional technology. The chapter concluded with the statement of the purpose for this study.

CHAPTER II

DEFINITIONS AND MODEL

This chapter is composed of two sections. The first section contains definitions of terms used in this study and the second section contains a description of a cost-effectiveness model.

Definitions

This section contains the definitions for all terms used in this study that may be confusing or new terms to the reader.

Cost-Benefit is the ratio of the cost of a project to the benefits to be derived from that project. An example is the ratio of the costs of a flood control dam to the value of the property which will be saved from flood damage by the dam. This definition is based upon a report of the Organization for Economic Co-Operation and Development (OECD).[1]

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[1]Organization for Economic Co-Operation and Development, Budgeting, Programme Analysis and Cost-Effectiveness in Educational Planning (Paris: Organization for Economic Co-Operation and Development, 1968, ED 057477, p. 34.

Cost-Effectiveness is the comparison of the costs and effectiveness of two or more programs. The comparison takes either of two forms. In the first form, the comparison is made between the costs of alternative programs which have equal effectiveness. In the second form, the comparison is made between effectiveness levels of alternative programs with the cost factor held constant. An example of the first form (comparison of costs) is the decision between constructing a concrete flood control dam and a less expensive earthen flood control dam. An example of the second form (comparison of effectiveness) is the selection of a dam type which will provide the most protection for the fixed number of dollars which have been appropriated for the project. This definition of cost-effectiveness is derived from the writings of the OECD and Harmon.[1]

Productivity is the ratio of the quantity of output for a given product for each unit of input. Normally productivity is shown as a change in this ratio over time. An example of productivity is the ratio of the number of cubic yards of concrete poured for each man working on a dam project. An increase in the ratio from one day to the

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[1]Ibid., p. 30; Paul Harmon, "Curriculum Cost-Effectiveness Evaluation," Audiovisual Instruction 15 (January, 1970), p. 26.

next shows an increase in productivity. Two reports, by Rogers and Smith,[1] provided the conceptualization for this definition.

Instructional Technology, as defined for purposes of this study, includes any of the technologies, human and machine, which are available to the educator to achieve the instructional goals of the educational institution. Some examples of technologies available to the educator are instructional television, programmed instruction, audio tapes, scheduling systems, and filmstrips.

This meaning of instructional technology is consistent with the first definition expressed in the Report of the Commission on Instructional Technology. The second definition used in the Report, however, is being adopted by more and more instructional technologists. It defines instructional technology as

> . . . a systematic way of designing, carrying out and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and nonhuman resources to bring about more effective instruction.[2]

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[1]Daniel Rogers, "Productivity and Efficiency within Education," Education in National Development, ed. by Don Adams (London: Routledge and Kegan Paul, 1971), p. 47; Virginia B. Smith, "More for Less: Higher Education's New Priority," in Universal Higher Education: Costs, Benefits, Options, ed. by Logan Wilson and Olive Miles (Washington, D. C.: American Council on Education, 1972), p. 126.

[2]Tickton, To Improve Learning, Vol. I. p. 7.

Since the reports in this study are based upon the first definition, it will be accepted as the meaning for instructional technology.

Description of a Cost-Effectiveness Model

This section contains a description of one of the less complicated cost-effectiveness models that have been proposed during the past decade.[1] It is adapted from a model proposed by Levine[2] at the 26th Joint Study Group on Military Research Allocation Methodology in 1970. The process entailed in the measurement of the cost-effectiveness can be viewed through the graphic design of this model.

Cost-effectiveness, as defined in the previous section, is the comparison of two or more programs. The comparison can take either of two forms: comparison of costs or comparison of effectiveness. Levine's cost-effectiveness model (Figure 1) is a graphic representation of the process entailed in making either of the two forms of comparison.

The first step in the process is to design alternative programs to achieve a given goal. For this example the goal will be an increase in the score for high school

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[1]A special bibliography of references on cost-analysis models, including cost-effectiveness models, is included at the end of this study for the reader desiring more information.

[2]Donald M. Levine, Structuring Program Analysis for Educational Research Publication P-4565, (Santa Monica, California: The Rand Corporation, 1971), ED 057467.

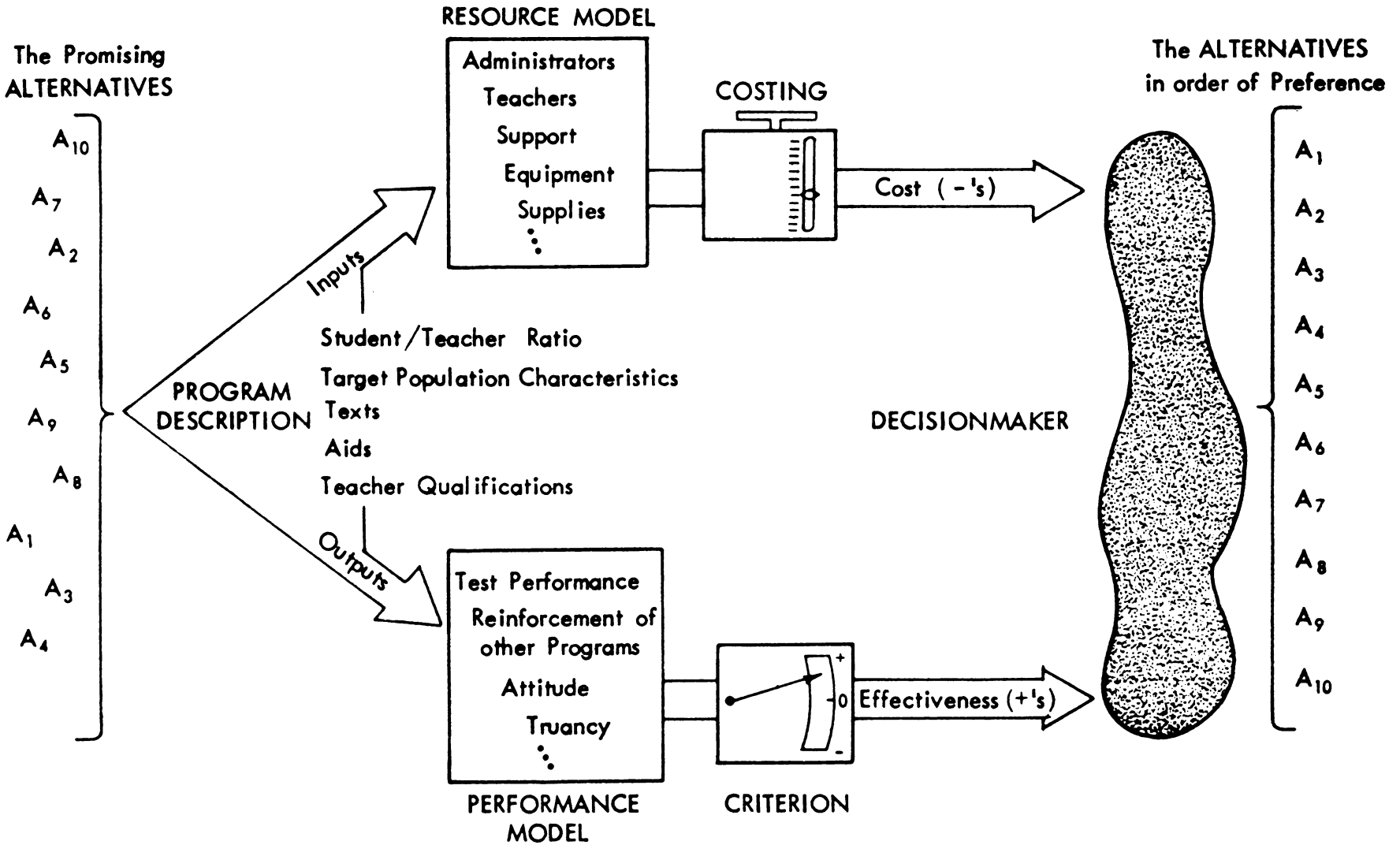

Figure 1.--Levine's cost-effectiveness model.

students on the Scholastic Aptitude Test. There are ten "promising alternatives" for achieving the increase including programs such as a change in the student/teacher ratio, introduction of a new text book and a requirement that all teachers have a masters degree. At this point the "promising alternatives" are not ordered in any way.

The educational decision maker then must analyze the cost-effectiveness of the various alternatives. To compare the costs he uses the upper section of the model (inputs, Resource Model) and holds the lower section (outputs, Performance Model) constant. To compare the effectiveness he uses the lower section of the model and holds the upper section constant. The two examples which follow describe how the model is applied using both of these forms of cost-effectiveness.

For the first example, the costs of the alternatives are compared. First it must be assumed that the educational decision maker has data (test scores) which show that adoption of either of the "promising alternative" programs will result in equal achievement on the Scholastic Aptitude Test. In the next step the educational decision maker must list the resources required for each alternative program. This list must include costs such as salary costs for teachers, administrative costs, facility costs, heating costs, library costs, textbook costs, media costs and software costs. After determining the costs of each alternative program the

educational decision maker must then decide the order of preference for the alternatives. This step is shown as the free form grey area at the right hand side of the model. Since the process of cost-effectiveness is not exacting at the present time, it is necessary that the assignment of the order of preference be done by a person so that any factors which were not taken into account previously can be considered in the decision making process.

For the second example, the other form of cost-effectiveness (comparison of effectiveness) is used. To use this form it must be assumed that the educational decision maker has a given amount of money to achieve a given goal. The educational decision maker then measures the performance of the students using each of the alternative programs. Then he must decide the order of preference for the alternative programs taking into account any factors which were not considered previously in the analysis.

The two examples describe in detail the two forms of cost-effectiveness which were defined earlier in this chapter. Some authors believe that a third form of cost-effectiveness is possible. The third form is used when it is not possible to hold either the cost or the effectiveness constant. In this form the educational decision maker must measure the costs and effectiveness simultaneously. The grey "decisionmaker" area in the model becomes crucial in the process with this form of cost-effectiveness since

the educational decision maker must compare units of cost and units of effectiveness at the same time. Since there is no way to put cost and effectiveness on the same scale, the educational decision maker is faced with a situation similar to the proverbial comparison of apples and oranges. It is for this reason (mixing unlike quantities) that many authors do not accept the third form of cost-effectiveness.

As was stated in the beginning of this section, Levine's Cost-Effectiveness Model is not the only cost-effectiveness model which has been proposed. This model, however, describes succinctly the two basic forms and a third possible form of cost-effectiveness. The unique part of this model is the grey "decisionmaker" area which is necessary since at present cost-effectiveness is not determined by an exacting process.

Summary of Chapter II

This chapter contains definition of the terms cost-benefit, cost-effectiveness, productivity and instructional technology which are not in common usage. The second section of the chapter contains a detailed description of Levine's Cost-Effectiveness Model.

CHAPTER III

METHODOLOGY

The procedures used in this study, to achieve the purpose described in Chapter I, are similar to the methodology used in several sociological studies. The methodology has been referred to by a number of names such as conceptual variable analysis, middle range theory building and most recently propositional inventory. Basically the methodology provides a means for collecting existing studies on a given subject and then inductively developing propositions about the subject from the data in the studies. It is a research design for collecting, analyzing, and synthesizing data taken from existing research studies.

Examples of Propositional Inventory Types of Research Designs

Propositional inventory research designs have been used in a number of studies dealing with such subjects as small group decision making, the reasons for revolution, and the diffusion of innovations. This design was used by McGrath and Altman[1] in their study of how small groups make decisions.

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[1]Joseph E. McGrath and Irwin Altman, Small Group Research: A Synthesis and Critique of the Field (New York: Holt, Rinehart and Winston, 1966).

Gurr[1] constructed a theory of the causes of revolutions using this methodology. Gurr[2] later used that research as the basis for the book Why Men Rebel.

Ekman, Friesen and Ellsworth[3] also used a similar methodology to synthesize the existing studies on facial expressions. An earlier study by March and Simon[4] on organizations similarly used a propositional inventory type of design. Reindel[5] used a propositional inventory design in a study of organizational communication.

Explanation of the Propositional Inventory Research Design

The detailed explanations of the propositional inventory research design contained in three studies was the basis for the development of the methodology for this study.

The first of these is a study by Collins and Guetzkow. In the opening of their book they stated that:

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[1]Ted Robert Gurr, "The Genesis of Violence: A Multivariate Theory of Civil Strife" (unpublished Ph.D. dissertation, New York University, 1965).

[2]Ted Robert Gurr, Why Men Rebel (Princeton, N.J.: Princeton University Press, 1970).

[3]Paul Ekman, Wallace V. Friesen, and Phoebe Ellsworth, Emotion in the Human Face (New York: Pergamon, 1972).

[4]James G. March and Herbert A. Simon, Organizations (New York: Wiley, 1958).

[5]Max H. Reindel, "Propositions on Information Management of Innovation Processes in Organizations" (unpublished Ph.D. dissertation, Michigan State University, 1970).

> Our motivation for writing this book was grounded in an optimism about the unrealized potential in scattered "empirical" studies of the group process. . . . We endeavored to build eclectically and cumulatively upon the thinking and empirical work of our predecessors and colleagues. This book presents an inductive theory of face-to-face groups.[1]

A detailed explanation of the procedures used by Collins and Guetzkow is included in Appendix A.

In a simplified version, their research design consisted of listing each of the hypotheses from the studies they reviewed. The hypotheses were then grouped so that studies measuring the same or similar concepts were in the same group. Propositions were then formulated to subsume the consistent findings from the grouped concepts. By employing this procedure they compiled a list of propositions that the group worker can use to facilitate or control a group.

Rogers and Shoemaker[2] used a propositional inventory research methodology in Communication of Innovations. In an earlier edition of Communication of Innovations which was entitled Diffusion of Innovations Rogers used the terminology conceptual variable analysis to refer to the same methodology.

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[1]Barry E. Collins and Harold Guetzkow, A Social Psychology of Group Process Decision Making (New York: Wiley, 1964).

[2]Everett M. Rogers, Diffusion of Innovations (New York: Free Press, 1962) and Everett M. Rogers with F. Floyd Shoemaker, Communication of Innovations: A Cross Cultural Approach (New York: Free Press, 1971).

In the latest edition they stated as their purpose:

> The primary purpose for this book is to synthesize a series of generalizations from research on the diffusion of innovations. Each of these generalizations represents the relationship found between two or more concepts. This book is essentially, then, a distillation of the results of more than 1,500 diffusion publications. Our objective in deriving these generalizations is to facilitate understanding of the diffusion process by change agents and by social scientists.[1]

The procedures employed by Rogers and Shoemaker are in Appendix B. The procedures used by these two scholars consisted of the following basic steps:

1. Express all concepts as variables.
2. State a postulated relationship between two concepts.
3. Test the postulated relationship by means of an empirical hypothesis.
4. Accept or reject the empirical hypothesis.
5. Support or reject the postulated relationship on the basis of the corresponding empirical hypothesis.
6. Develop a general body of theory based upon the accepted postulated relationships.

A key point in this procedure is the decision to support or reject the postulated relationship (step number 5). Rogers and Shoemaker did not state the criteria for the decision to support or reject a postulated relationship nor did they state the criteria for the minimum number of studies which must relate to a given postulated relationship. They have accepted a large number of generalizations (see Appendix C) with a

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[1]Rogers with Shoemaker, Communication, p. 41.

relatively small number of supporting studies (from 1 to 275 with a mean of 22.7, a median of 9 and a mode of 5) but with a high percentage of support (from 53% to 100% with a mean of 83.5%, a median of 85% and a mode of 100%).

Much of the research methodology which was employed by Rogers and Shoemaker was based upon the work of Merton.[1] Merton proposed the creation of middle range theories through the use of middle range analysis. Merton sees middle range analysis as the transformation of theoretical (abstract) hypothesis into a workable (concrete) theory which can be applied in the real world. The example in Figure 2 shows the process of middle range analysis. Each of the operations is defined in terms of a particular concept. The same

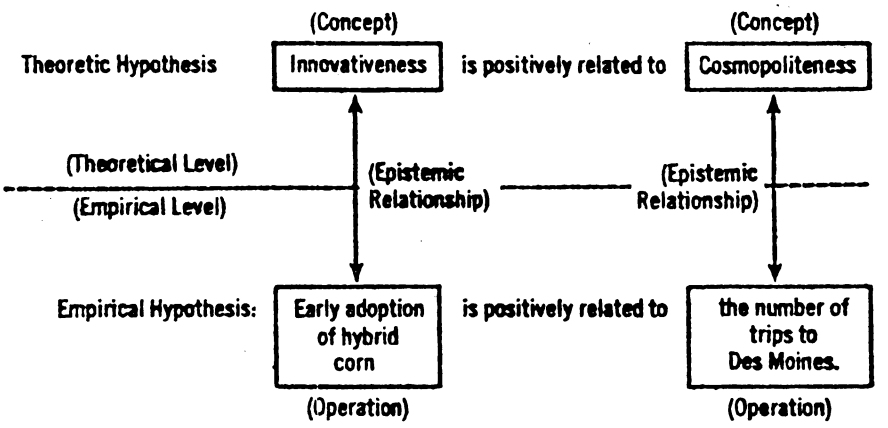

Figure 2.--Diagram of a middle range analysis.[2]

[1]Robert K. Merton, Social Theory and Social Structure (Glencoe, Illinois: Free Press, 1968).

[2]Rogers with Shoemaker, Communication, p. 89.

relationship which existed previously between the operations is applied between the corresponding concepts. If the relationship of the concepts remains consistent when tested, it is accepted as a middle range theory.

Research Design for the Current Study

The current study, utilizing the designs discussed above, developed a series of propositions on cost-effectiveness as it relates to instructional technology by employing the following procedures.

Development of the bibliography

First an extensive bibliography of the literature on cost-effectiveness as it relates to instructional technology was developed. The bibliography was developed from a wide range of sources including the Current Index to Journals in Education, the Michigan State University Library Card Catalog, Dissertation Abstracts, Government Reports Index, and Research in Education. In addition the bibliographies in the following publications were consulted: The New Depression in Higher Education by Earl F. Cheit, An Annotated Bibliography of Administering for Change by Louis M. Maguire and others, An Evaluation of Comprehensive Planning Literature with an Annotated Bibliography by Sanford Temkin, "Annotated Bibliography on the Cost of Education" in the November, 1971 issue of Audiovisual Instruction, The More Effective Use of Resources by the Carnegie Commission on Higher Education, and

The Fourth Revolution by the Carnegie Commission on Higher Education. Three computer based searches were run at the Michigan State University Library utilizing the System Development Corporation Interactive Retrieval Service of documents in the ERIC retrieval file set. The search was conducted of all documents in the ERIC file set which were cataloged under the descriptor cost-effectiveness and one or more of the following descriptors: educational economics, systems analysis, instructional media, instructional technology, educational technology, and educational facilities. Documents cataloged under these descriptors were listed on the print out from the computer.

Securing the references

The total number of references assembled from the above sources totaled four hundred and twenty-nine. These references were secured from the Michigan State University Library, the Instructional Development and Technology Library at Michigan State University, the Wayne State University Library, the Indiana University Library, the University of Connecticut Library, and in a few cases directly from the authors. By utilizing these sources it was possible to secure documents for almost three hundred references. It was not possible to secure the other documents because some were unpublished reports, some were foreign publications, some were in uncommon periodicals, or because some of the citations were incomplete.

Criteria for selection

There were two criteria which a study had to meet before it was chosen for the formulation of a proposition. The first criterion was that the study must deal with cost-effectiveness as it relates to instructional technology. The second criterion was that the study had to be an empirical research study or its findings had to be supported with quantative data. Studies which did little more than make expository statements without data to support the statements were not utilized in the formulation of propositions. Thirty-two (32) studies met the criteria and are included in the propositions chapter.

Development of the postulated relationships

The hypotheses and/or relevant data from each of the thirty-two studies above were recorded on keysort cards. These cards were then sorted and re-sorted such that studies which measured the same or closely related concepts were grouped. After all the cards measuring a particular concept were identified a postulated relationship was written based upon that particular concept. The postulated relationship was then accepted or rejected based upon the previously determined criterion that sixty percent of the studies related to a postulated relationship must support the postulated relationship in order for it to be accepted. The accepted postulated relationships are the propositions in Chapter IV.

The studies related to the proposition are cited following each proposition.

Summary of Chapter III

This chapter opens with a listing of several studies which have used propositional inventory research designs. The research designs used by Collins and Guetzkow, Rogers and Shoemaker, and Merton are described in detail. The research design for the current study, consisting of four basic steps, concludes the chapter.

CHAPTER IV

PROPOSITIONS

This chapter is divided into three sections. The first section contains a review of the propositional inventory research design which was described in Chapter III. The next section contains a discussion of the generalizability and limitations of the propositions. The last section presents a list of sixteen propositions pertaining to the cost-effectiveness of instructional technology.

Review of the Research Design

The sixteen propositions in this chapter are related to the cost-effectiveness of instructional technology. The propositions were developed by means of a propositional inventory research design. This design entailed assembling a bibliography of all the studies related to the cost-effectiveness of instructional technology and securing the documents for these references. The studies were then read and evaluated in terms of the criteria outlined in Chapter III. These criteria were that the study was either an empirical study and/or a data-based study and was related to the cost-effectiveness of instructional technology. Thirty-two studies met the

criteria and were chosen for use in formulating the propositions. The propositions were formulated by grouping together studies which measured the same of a similar concept. Each proposition was then written so that it encompassed the similar findings of the studies in that group. The studies which are related to each proposition are listed immediately after that proposition.[1]

Limitations of the Proposition

Generalizability of the propositions

The propositions developed in this study are generalizable only to situations similar to the situations in the studies which support each proposition. Therefore, the generalizability of each proposition will be different from the others. For example, propositions numbered 1A and 1B, dealing with the class size for CCTV, are supported by studies which were conducted at institutions of higher education. These propositions are generalizable to institutions of higher education only. Proposition number 8, dealing with savings in learning time, is supported by studies done in both higher education and elementary education. Therefore proposition 8 is generalizable over more levels of education than propositions 1A and 1B.

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[1]A listing of the studies used to support the propositions is included in a separate bibliography at the end of this study.

Several of the propositions are supported by studies done in countries other than the United States. If the findings of these studies were markedly different from the findings of the studies conducted in the United States there would be grounds for questioning whether the foreign studies were generalizable to situations in the United States. However, the findings of the studies supporting these propositions were parallel regardless of the nations in which the studies were done. Thus, the studies included in this research project that were conducted in countries other than the United States tend to be generalizable to the United States.

Similar to the situation with the foreign studies is the concern over the reliability of studies which were conducted a number of years ago. As with the findings of the foreign studies, the studies done as many as fifteen years ago had findings that were parallel to the findings of more recent studies. For example, proposition number 12, dealing with the decrease in cost per student when the number of students is increased, is supported by studies done during the period from 1958 to 1971. The findings of all the studies related to proposition number 12 are consistent.

Since, neither the country of origin nor the data of the studies appear to cause a variance in the support of the propositions the generalizability for each is

controlled by the types of situations in which the studies were conducted.

Utilization of the propositions

In Chapter I a number of statements praising the cost-effectiveness of instructional technology were quoted from authorities in the fields of higher education and instructional technology such as Bowen and Douglass, Tickton, and the Carnegie Commission on Higher Education. The Carnegie Commission study in particular listed eight ways that instructional technology could help professors increase their productivity. After completion of this study, it appears that the statements by these authorities are at best supported by very few studies and in some cases are not supported by any studies.

It should be noted that the propositions in this study are supported by very few studies. In this sense the propositions are not much more valid than the statements by the various authorities in Chapter I except that the propositions are supported with documentation. Because of the small number of studies supporting each proposition it is evident that there is a limited amount of research dealing with the cost-effectiveness of instructional technology. Therefore statements that instructional technology will solve the financial problems because it is cost-effective should be made with caution at present.

The reader should also note that most of the studies used to support the propositions measured cost-effectiveness by comparing the costs while assuming that the effectiveness was equal. Therefore the propositions deal with the costs of programs and not with their effectiveness.

Propositions

The propositions are grouped according to the major concept in the proposition. The groups are:

Proposition Number 1-4	Television
Proposition Number 5	Sixteen Millimeter Films
Proposition Number 6	Amplified Telephone
Proposition Number 7	Production of Materials
Proposition Number 8	Student Time
Proposition Number 9-11	Administration
Proposition Number 12-13	Audience Size
Proposition Number 14-15	Expanding Opportunities

Television

Class size for closed-circuit television

Proposition Number 1A. The cost of providing instruction through use of one instructor lecturing to thirty students will be less than the cost of utilizing closed-circuit television when the total course size is less than two hundred students.

Proposition Number 1B. The cost of utilizing closed-circuit television for classroom instruction will be less than the cost of providing instruction through the use of one instructor for each thirty students when the total course size is greater than five hundred students.

The size of the group for which closed-circuit television (CCTV) is being considered as an instructional strategy is an important consideration. When CCTV is utilized, costs are incurred for such items as television cameras, control equipment, television receivers and the personnel to produce the programs and operate the equipment. The savings that result by using one instructor for the entire group rather than one instructor for each thirty students must offset these CCTV costs in order for the system to be cost-effective.

The findings of the four studies related to this proposition, conducted at Pennsylvania State University, Purdue University, Rensselaer Polytechnic Institute, and Michigan State University, all support both numbers 1A and 1B.

Carpenter and Greenhill at Pennsylvania State University found that: ". . . the economic advantages of using television begin with classes of about 200 students and increase progressively from this point as the number of students in the TV section increases."[1] They included in the cost of conventional instruction the costs of instructors, graduate assistants, and hourly labor. The cost of televised

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[1]C. Ray Carpenter and L. P. Greenhill, An Investigation of Closed-Circuit Television for Teaching University Courses (University Park, Pennsylvania: Pennsylvania State University, 1958), p. 105.

instruction included the costs included for conventional instruction plus the cost for operating the television system. They did not include the overhead costs such as space, utilities and other auxiliary costs.

Seibert at Purdue University ascertained that: "An instructional cost gain might be obtained through TV instruction in courses which could provide for simultaneous instruction for 150 to 270 or more students."[1]

At Rensselaer Polytechnic Institute a study was conducted which compared the teaching of a course by television and by conventional instruction. The course was a laboratory course entitled "Strength of Materials" which regularly used bulky and expensive laboratory equipment. The television section was taught by senior faculty members. The conventional section was taught by graduate assistants. The study found that: "The use of TV instruction is economical for this type of course only when there are approximately 400 students to be taught each term."[2]

Jones, Johnson and Dietrich[3] at Michigan State University calculated the cost of CCTV courses by adding

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[1]James W. Brown and James W. Thornton, Jr., New Media in Higher Education (Washington, D. C.: National Education Association, 1963), p. 55.

[2]Brown and Thornton, Media, p. 40.

[3]Gardner Jones, Craig Johnson and John Dietrich, "Unit Costs Provide Basis for Meaningful Evaluation of Efficiency of TV Courses," College and University Business, 46 (April, 1969), pp. 124-130, and F. Craig Johnson and John Dietrich, "Cost Analysis of Instructional Technology," in

together the costs for 1) instructional staffing (professors, graduate assistants), 2) room usage and distribution costs (room overhead, TV receiver costs), and 3) CCTV operating costs (studio costs, broadcast costs). They concluded that the point at which a television course become less expensive than a conventionally taught course was when the enrollment in the course exceeds five hundred students.

These studies support the proposition that in courses with less than 200 students the costs of CCTV are greater than the costs of conventional instruction with one instructor and thirty students. These studies also support the proposition that when the group size is greater than 500 students the costs of CCTV are less than the costs of conventional instruction.

Class size for open circuit broadcast

Proposition Number 2. The cost of utilizing open circuit television for instruction will be less expensive than the cost of providing instruction through the use of one instructor for each thirty students when the total course size is greater than nine hundred and fifty (950) students.

As with propositions 1A and 1B dealing with CCTV, the group size is important for open circuit broadcast.

To Improve Learning, ed. by Sidney G. Tickton (New York: Bowker, 1971), p. 967.

Open circuit broadcast entails many of the same costs which were listed for CCTV such as cameras, control equipment, and the personnel to produce the programs and operate the equipment. Open circuit broadcast, however, does not pay for the television receivers but instead must pay the costs of a transmitter and a tower. The costs for transmission tend to raise the costs for open circuit broadcast substantially above the costs for CCTV. Therefore the group size must be larger for open circuit broadcast to be cost-effective. A study done at San Francisco State College is the only one that measured the group size necessary for open circuit broadcast.

At San Francisco State College an experimental study was conducted to compare instruction by means of Television at Home, Television on Campus, and Conventional Instruction on Campus. The report of the study stated that:

> the cost experience of these experimental professionally presented, open-circuit TV courses showed that . . . it is economically feasible to offer lecture-discussion courses by television with enrollments of 950 students.[1]

Although there is only one study that supports the proposition that the minimum class size for open circuit broadcast is 950 students, there also are no studies which fail to support the proposition.

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[1]Brown and Thornton, Media, p. 67.

Airborne television

Proposition Number 3. Airborne transmission facilities can distribute television signals at a cost less than any other distribution system over relatively flat territory if the area to be covered is greater than 150,000 square miles.

The transmission of a television signal from an airplane was studied by the Midwest Program on Airborne Television Instruction (MPATI). Video tapes were prepared on the ground and were loaded onto a plane each morning. The plane then flew lazy eights over Montpelier, Indiana at an altitude of 23,000 feet. After the plane was in position a twenty-four foot antenna was lowered from the belly of the plane. Then the television crew, aboard the plane, would begin transmission on two UHF television channels and continue transmission throughout the day.

Soverign[1] studied the costs of this system in comparison to the costs for a land based transmitter. He found that an airborne broadcast system costs $8.38 per square mile for one channel and that a ground based broadcast system cost $13.73 per square mile. The savings become even more dramatic when signals are broadcast on more than one channel. The costs for an airborne system with

[1]Michael G. Soverign, "Comparative Costs of Instructional Television Distribution Systems" (unpublished Ph.D. dissertation, Purdue University, 1965).

six channels were $15.72 while the costs for a ground based system employing six channels were $50.35.

Since the study was completed MPATI has ceased operations. Therefore, for the present time it will be impossible to replicate the study. It should be noted that in all probability the costs have risen since the 1965 study due primarily to inflation. However, since costs for both systems have been affected by the same rate of inflation, the relationship of the costs will remain constant and, therefore, the proposition does not need to change.

Shared broadcast facilities

Proposition Number 4. The utilization of existing broadcast facilities on a part-time basis for educational broadcasts will reduce the otherwise necessary capital expenditure for the education institution.

The capital expenditure necessary to establish a broadcast facility (television or radio) is large. Equipment such as cameras, recorders, control room equipment, transmitters, as well as the building to house the equipment and the tower to support the antenna must be purchased before the station can broadcast a signal. By utilizing existing broadcast facilities on a part-time basis the educational institution pays to the owner of the shared broadcast station an amount equal to a percentage of the

capital costs which corresponds to the percentage of time which they use the facility.

The findings of the four studies related to this proposition all support the proposition. One of the studies was conducted in the United States and the other studies were conducted in the foreign nations of Peru, Australia and Colombia.

The Chicago Television College (CTC) was operated by Chicago City Junior College to bring televised credit courses to housewives. During the period from 1956 through 1965 approximately 100,000 individuals registered for courses at CTC. The CTC utilize "existing educational and broadcasting facilities and existing student television sets."[1] By utilizing these facilities CTC has been able to bring education to a student body who could not attend regular classrooms, for a cost less than the average classroom costs.

Telescuela Popular Americana (TEPA)[2] is a televised educational program in Peru which broadcasted five series of programs including such subjects as literacy skills,

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[1]Maxwell McCombs, "Chicago's Television College," in New Educational Media in Action: Case Studies for Planners--2, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 126.

[2]Jack Lyle, et al., "La Telescuela Popular Americana of Arequipa, Peru," in New Educational Media in Action: Case Studies for Planners--2, ed. by Wilbur Schramm (Paris: UNESCO, 1967).

primary education, community development, and basic arithmetic. Initially broadcast time for the programs, amounting to 120 minutes each week, was provided free by the local station. Later, programming was expanded to six hours each day and the TEPA paid the station for the use of its facilities.

Australia operated correspondence schools[1] for those students unable to attend regular schools. The schools employed a wide variety of instructional strategies. Among the strategies were broadcasts over the facilities of the Australian Broadcasting Corporation. The correspondence schools also utilized the two-way transceiver facilities of the Flying Doctor Service. The Flying Doctor Service was designed to provide a communication network on which people living in areas without telephone service could obtain medical advice. The network when not used for medical messages was made available to other groups, particularly the correspondence schools.

Colombia shared its television broadcasting service between entertainment and educational programming. The cost of the broadcast service was divided between the entertainment and educational programming based upon the percentage of time which each used the facility.

> The total investment cost of INRT (National Institute for Radio and Television) television programme was determined on the basis of the proportion of total broadcasting hours in 1965 devoted to educational programming. INRT broadcast an estimated total of

> 2,950 hours that year and 745 hours, 25 percent of the total, were used for educational television.[1]

By utilizing the facilities of the broadcast service the INRT was able to provide instruction over television to 275,000 pupils scattered in 800 schools.

These studies support the proposition that by sharing broadcast facilities, education can save at least part of the cost of building a broadcast facility. It should be noted that when the educational station is using a large percentage of the broadcast time it may want to consider building its own facility so that it has direct control over scheduling and station improvements.

Sixteen Millimeter Films

Proposition Number 5. The ownership of sixteen millimeter films by local school districts is more economical than renting the films from a centralized film library or than distributing the films over television.

The question of whether a school system should purchase a 16mm film or rent the film when needed has been discussed many times by instructional technology specialists. This proposition suggests that it may be more cost-effective for school districts to have their own films rather than to rent the films when needed.

Gjerde[1] in an investigation in Iowa compared the effectiveness of securing 16mm films through a school system film library with the prevailing practice of securing films from a film rental library. He found that securing 16mm films through a school system library was more effective. His conclusion is based upon such facts as teachers involved in the decentralized plan (local school system film library) used more films than the teachers who used a centralized film library and that booking problems were reduced with the decentralized plan.

Brown[2] investigated the costs of distributing 16mm films by four methods: 1) open circuit television, 2) closed-circuit television, 3) rental from a university film library, and 4) loan from a school system film library. He found that rental and/or local ownership appeared to be more economical than distributing the films over television to the classrooms. The basic problem with television distribution was a lack of a coordinated schedule between the schools so that there was no time which was best at all schools to view the film.

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[1]Waldemar Gjerde, "A Study to Determine the Effectiveness of a Planned Film Program in Selected Counties in Iowa" (unpublished Ph.D. dissertation, State University of Iowa, 1965).

[2]Robert M. Brown, "Programming a Film Series: A Case Study Analysis of Factors Affecting the Cost of Selected Methods of Distributing Film Series" (unpublished Ed.D. dissertation, Indiana University, 1960).

A study was conducted of the Regional Instructional Materials Centers in the State of Pennsylvania[1] which compared the costs of operating the centers with the costs of providing the same services (mainly 16mm films) in each of the school districts of the state. The findings of the study showed that it is more cost-effective to operate the regional centers rather than to operate centers in all of the local school districts.

Since this proposition is supported by two out of three or 67% of the studies, it is acceptable according to the criteria in Chapter III. However, it is contrary to the beliefs of many instructional technologists, including the author. Until additional studies are conducted, using this proposition as an hypothesis, that either support or fail to support it, the instructional technologist should carefully evaluate his own needs for sixteen millimeter films and the most cost-effective means for securing them.

Amplified Telephone

Proposition Number 6. The utilization of an amplified telephone interview can provide guest lecturers at a cost less than the cost of bringing the person to the class for an "in-person" lecture.

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[1]Philip J. Mulvihill, Cost Effectiveness Study of Regional Instructional Materials Centers (Harrisburg, Pennsylvania: Department of Education, 1971), ED 060503.

The faculty of Stephens College experimented with the use of amplified telephone lectures as early as 1958. They have used amplified telephone to provide guest lecturers in courses such as American Government, World Literature, and Introduction to Business without the high costs of bringing these lecturers "in person" to the classes. A report of their experience with amplified telephone lectures contains the following statement.

> Amplified telephone interviewing provides a useful new dimension to teaching and learning. Its flexibility ranges from the student-directed interview to the tele-lecture (an eminent authority lecturing for most of a period). It brings men and events to the classroom at a moderate cost (average telephone charge is $10 for 20 minutes).[1]

It is of interest that since the study was conducted at Stephens College telephone companies have developed more sophisticated amplified telephone equipment.

Production of Instructional Technology Materials

Proposition Number 7. The costs of instructional technology vary with the level of sophistication of the production.

The costs for producing educational materials can vary from a very low to a very high cost. The production of a teacher made audio-tape may cost only a few dollars while a television production such as The Electric Company costs several million.

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[1]Brown and Thornton, Media, p. 100.

In his review of the costs of several instructional technology systems, Tickton discovered that: "The costs of instructional technology vary widely, depending upon the range of equipment and services."[1] He supports this statement with a list of examples such as:

> "Nine self-instructional units of a physiology course . . . at Michigan State University . . . cost $40,000 [and the] . . . physics course produced by the Physical Science Study Committee . . . cost $6.5 million."[2]

McConeghy found that the costs of video productions were variable depending upon the type of production. The cost of two video productions which he studied were $91.83 for one and $261.31 for the more sophisticated production.[3]

Both of these studies emphasize that the costs for instructional technology vary over a wide range depending upon the sophistication. Since there is a wide range in the costs of instructional technology it is necessary to decide on the level of production sophistication before designing the system.

Student Time

Proposition Number 8. The use of instructional technology can result in savings in student learning time.

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[1]Tickton, To Improve Learning, Vol. I, p. 84.

[2]Ibid., p. 85.

[3]Gary L. McConeghy, "An Analysis of Certain Time and Cost Measures Involved in the Integration of Systems for Individualized Electronic Instruction" (unpublished Ed.D. dissertation, Wayne State University, 1966), p. 140.

The amount of time a student spends obtaining his education is a cost factor many times overlooked. If the amount of time a student spends in college can be reduced then savings can be realized by the educational institution and society as well as the student. Since students will need to spend less time in class, the institution can add new students to occupy the spaces that the students already enrolled will no longer need. Society benefits by having a person, with needed skills, gainfully employed in a shorter period of time. The student benefits by expending less time obtaining an education thereby entering the work force sooner.

A study at San Jose State College investigated the use of television as a magnification device in the laboratory section of a human anatomy course. The investigators at San Jose State College stated that:

> . . . in a majority of the course units investigated, closed-circuit television as a magnification device was found to reduce substantially (in some cases by as much as 65%) the time required by the instructor to present a demonstration for an entire laboratory class.[1]

Allred studied the effectiveness of teaching audio-visual equipment operation by use of 35mm filmstrip-record combination, programmed-text, and "Each-One Teach-One" methodologies. He found that the filmstrip-record and programmed-text methodologies exhibited distinct advantages

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[1]Brown and Thornton, Media, p. 50.

over the "Each-One Teach-One" methodology. One of the advantages was that "the students learned to operate the equipment . . . in a shorter period of time."[1]

Plotkin studied methodologies for teaching spelling in the fourth grade. He did not find significant differences between the achievement of his experimental group which used teaching machines and the control group. However, he did find that the experimental group required less study time.

> The teaching machine device offered an economy of practice time. Experimental group pupils began the second week of the field trial requiring from fifteen to nineteen minutes of practice time in order to match the achievement of the control group pupils who received twenty-five minutes of daily instruction. By the end of the third week, experimental group pupils needed from nine to eleven minutes of daily practice to equal the achievement of the control group pupils. The control group, in which the teacher directed spelling followed the basal spelling series, averaged twenty-five minutes a day.[2]

A project in Charlottesville, Virginia, which also used fourth grade students, measured the effectiveness of programmed materials for teaching science. A report of the results of that project showed that it took the students

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[1]J. D. Allred, "A Study of the Comparative Effectiveness of Three Methods of Teaching the Operation of Selected Audio Visual Equipment" (unpublished Ed.D. dissertation, University of Oklahoma, 1967), abstract.

[2]Bennett H. Plotkin, "The Effectiveness of Programmed Learning in Fourth Grade Spelling" (unpublished Ph.D. dissertation, University of Connecticut, 1963), p. 111.

using the programmed material less time to learn the material than the time required by the other students.

> The first phase of the project was a pilot study with two fourth grade classes that used the programs and two that did not. Each class studied science for 30 minutes on Monday, Wednesday, and Friday for five weeks. Less than the full 7½ hours was needed by the classes using the programs; the average time required for them was 5 hours. In spite of the fact that they took less time, their achievement was higher than the students who did not use programs.[1]

The studies above supported the proposition that instructional technology can reduce the amount of time required for a student to learn.

Administration

Utilization of facilities

Proposition Number 9. The utilization of existing educational facilities for longer periods of time than they are currently used can result in cost savings to the educational institution.

Currently educational facilities are used extensively from September until June between the hours of 8 AM and 4 PM. During other times the use of facilities drops to a relatively low level. By utilizing the facility for a longer period of time it will not be necessary to build an additional facility thereby reducing needed capital expenditures.

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[1]Alvin C. Eurich, Reforming American Education: The Innovative Approach to Improving Our Schools and Colleges (New York: Harper and Row, 1969), p. 102.

Wehmoefer[1] reported on the Aliquippa School District extended school year experience that they had savings of approximately $282,059 during the seven year period when they had an extended school year. They found that most of their advantages were in reducing capital and debt expenditures and that most of the problems were administrative in nature.

The Ann Arbor Public Schools[2] found that by extending the school year by using three semesters (trimesters) they could reduce future expenditures. Their short term costs varied little while their long term costs were reduced substantially. The savings amounted to $12,500,000 in construction costs and $13,500,000 in interest costs.

Smith[3] found that the increased utilization of facilities did not reduce costs but in fact increased costs. He studied the change in class sizes in higher education when additional sections were added in the late afternoon and evening. He found that since students did not register in the same numbers for the late afternoon and evening

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[1]Roy A. Wehmoefer, "The Twelve Month School Year: A Study of the Advantages and Disadvantages of the Four Quarter System" Report of the Assistant Superintendent, Cook County Schools, Chicago, Illinois, February, 1968, ED 022252.

[2]"Implications of Instituting a Split-Trimester Calendar Plan in the Ann Arbor Public Schools: A Feasibility Study Report" Report of the Public Schools of the City of Ann Arbor, Michigan, June, 1970, ED 050494.

[3]Donovan Smith, "Optimal Class Scheduling," College and University 44 (Summer, 1969), pp. 383-401.

classes that the average class size dropped. This caused the average student credit load per professor to drop thereby increasing the cost of instruction.

This proposition is supported by two of the three studies related to it. Based upon this proposition educational institutions should explore ways to extend the amount of time which their facilities are in use so that building costs can be saved.

Increase in the student/faculty ratio

Proposition Number 10. Educational institutions can increase their student/faculty ratios through the use of instructional technology.

The Academy for Educational Development recently conducted a study that examined colleges having a student/faculty ratio which is 20 to 1 or higher. Behrens[1] in the report of the study stated that at least 80 colleges and universities have student/faculty ratios in excess of 20/1. The study also found that a large number of the institutions were using instructional technology to help maintain quality with a relatively high student/faculty ratio. Among the techniques which they were using were closed-circuit educational television, educational radio, AV materials, learning centers and laboratories, programmed

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[1]Anna Jo W. Behrens, Higher Education with Fewer Teachers (Washington, D. C.: Academy for Educational Development, 1972).

instruction, and credit for work taken over commercial television.

Institutional savings

Proposition Number 11. The utilization of instructional technology can result in an actual dollar savings to educational institutions.

This proposition is a general proposition which states that the costs of operating educational institutions can be reduced by utilizing instructional technology. The proposition is supported by three studies.

The Chicago Television College, referred to under proposition number four, has had economically beneficial effects from the use of television. "By 1961 the costs of television instruction per FSE [full-time student equivalent] were actually lower than class-room costs . . . ."[1] In another report dealing with the college Breitenfeld reported that: "Today the cost of a credit hour on TV is $23.43 as compared to $37.21 on campus."[2] The college has saved money by broadcasting courses rather than holding classes in campus facilities.

North American Aviation in California has had savings from the use of closed circuit television to train the

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[1]McCombs, "Chicago's Television College," p. 125.

[2]Frederick Breitenfeld, Jr., "Instructional Television: The State of the Art," in To Improve Learning, ed. by Sidney G. Tickton (New York: Bowker, 1971), p. 157.

workers who built the Apollo Spacecraft. The plant has 500 viewing locations where the workers can view television while at their job stations. A report on their use of CCTV states that the ". . . cost of training 1,000 workers in a specific subject was $0.55 per worker by CCTV as compared to $2.25 per person by regular methods."[1]

The Open University in Great Britian is designed to provide higher education to those people over 21 years old who for any reason are not able to attend regular universities. It operates as a high quality correspondence institution utilizing the services of the postal system and the British Broadcasting Corporation to carry its lessons. A report on the university stated that operating costs come ". . . to about $632 per student, far below the $2,000 to $2,400 per student cost at many new British universities."[2]

In each of the examples cited above the institution was able to save money by utilizing instructional technology instead of another method of instruction.

Audience Size

Enrollment

Proposition Number 12. As the number of students increases the costs per student decrease when instructional technology is utilized.

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[1] Ibid., p. 160.

[2] Nell Eurich and Barry Schwenkmeyer, Great Britian's Open University: First Chance, Second Chance, or Last Chance?

The actual costs for providing instructional technology services remain relatively constant regardless of the number of students who use the instructional technology. For example, it costs the same amount to show a 16mm film to one student as it does to show the same film to fifty students.

Studies by Carpenter and Greenhill, Kinane, Lefranc, Schramm, and Johnson and Dietrich[1] have compared the relationship between the size of the enrollment in a course and the cost per student for that course. All except Johnson and Dietrich have constructed graphs which show their findings. These graphs have shapes similar to the shape of the graph in Figure 3. Likewise if Johnson and Dietrich's data were graphed, it, too, would resemble the graph in Figure 3.

Schramm, in his discussion of the correspondence high school in Japan, states that:

> All these costs per pupil are figured on the 1965 enrolment [sic] of 13,165. If enrolment were

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(Washington, D.C.: Academy for Educational Development, 1971), p. 24.

[1]Carpenter and Greenhill, Closed-Circuit Television, p.104; Kinane, "Australia," p. 202; Robert Lafranc, "Educational Television in Niger," in New Educational Media in Action: Case Studies for Planners--2, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 36; Wilbur Schramm, et al., "Educational Radio in Thailand," in New Educational Media in Action: Case Studies for Planners--1, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 98; Wilbur Schramm, et al., "Ten Years of the Radio Rural Forum in India," in New Educational Media in Action: Case Studies for Planners--1, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 130; Johnson and Dietrich, "Cost Analysis," pp. 974-975.

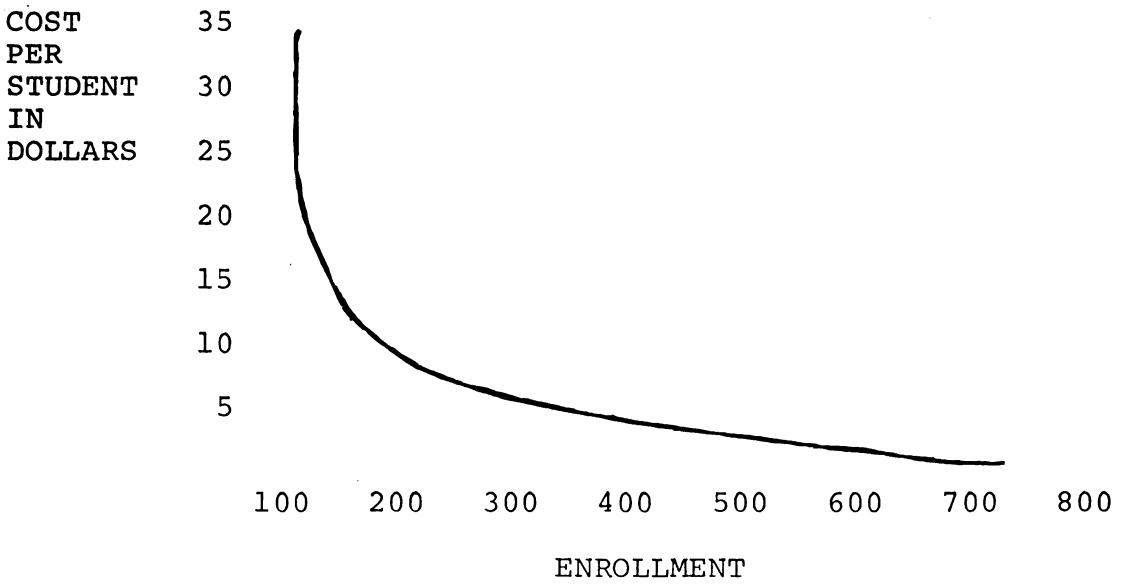

Figure 4.--Cost per student in relation to the number of students enrolled in the course.

> doubled, then all costs would rise at a rate approximately proportionate to the increase in enrolment except the expenditures for producing and transmitting the programmes, which should be very little changed. Costs per pupil would be reduced from $148.47 to $114.78 for a television student, from $91.25 to $83.67 for a radio student. If enrolment were quadrupled, the cost per television would be under $100 ($97.93) and would be within $20 of a radio student ($79.88).[1]

A report from the television center of Italy states that:

> The very high student-hour costs are due largely to the relatively small average audience. For example, in 1965/66, the average number of "It's Never Too Late" pupils per receiver was fifteen, for Telescuola, eleven. These small class sizes inevitably mean high reception costs.[2]

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[1]Wilbur Schram, et al., "Japan's Broadcast-Correspondence High School," in New Educational Media in Action: Case Studies for Planners--1, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 154.

[2]Jack Lyle, "Tne Centro di Telescuola of Italy," in New Educational Media in Action: Case Studies for Planners--3, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 36.

It is evident from the seven studies supporting this proposition that as the number of students increases the cost per student for instructional technology decreases. Higher education can decrease the cost per student by increasing the size of the group which utilizes instructional technology.

Reuse of materials

Proposition Number 13. The cost per pupil for instructional technology systems can be reduced if the instructional materials are used a number of times instead of being used just once.

This proposition is closely related to proposition number twelve in which it was implied that all students used the instructional technology system at the same time. In proposition thirteen the instructional technology materials are re-used a number of times during successive terms.

In the study of open circuit broadcast of college courses at San Francisco State College, described under proposition number one, the investigators found that: "Outlays for televised instruction may be reduced and break-even points may be reduced for subsequent semesters after the initial costs have been met."[1]

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[1]Brown and Thornton, Media, p. 67.

McConeghy in an examination of the costs for developing, equipping, and programming a dial access system found that: "Where the system is most effective in cost reduction . . . is in those cases in which large numbers of students are taught the same information over an extended period of time."[1]

As shown in the results of these two studies, educational institutions can reduce the costs of instruction by re-using the same materials a number of times. However, it is vital that the content of the materials should not be allowed to become outdated. If the material is not revised there will be a major reduction in the effectiveness of the material.

Expanding Opportunities

Instruction not otherwise available

Proposition Number 14. Instructional technology can provide instruction to students who otherwise, because of time or money constraints, would not be able to receive such instruction.

There are many students who for reasons such as living too far from a school, being geographically isolated or being confined to bed are unable to attend class meetings in traditional school settings. There are also many students who attend schools which are too small to provide specialized

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[1]McConeghy, "Individualized Electronic Instruction," p. 140.

subjects. The use of instructional technology can make it possible for these students to obtain an education that would otherwise be impossible.

The correspondence school in Australia was developed in 1916 and has utilized the various technologies of instruction as they have become available since then.

> The correspondence school provides education for . . . [1] secondary pupils attending one-teacher and subsidized schools. This is possibly the most important area for discussion in this report, as pupils work under the supervision of a teacher (untrained for secondary work) and papers are returned to the correspondence school for correction. . . . [2] Secondary pupils attending high schools which are unable to provide all courses required by the student (e.g., a foreign language required by only one or two students).[1]

The correspondence schools of Australia, as described earlier, use the facilities of the Australian Broadcasting Corporation and the Flying Doctor Service for their instruction.

New Zealand has had a correspondence school for almost as long as Australia.

> The Department of Education of the Government of New Zealand has run a correspondence school since 1922. The school opened with only one teacher, whose function was to tutor by post about fifty children of primary-school age living in lighthouses, on hill-country farms, and in other isolated places. At the present time the school has a headmaster, 140 teachers and a non-teaching staff of about forty, and it provides from its headquarters in Wellington postal lessons for

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[1]Kinane, "Australia," p. 173.

> approximately 1,000 primary and 500 secondary pupils . . . .[1]

By utilizing instructional technology in the correspondence schools New Zealand has been able to bring instruction to students who otherwise would be without instruction.

The television center of Italy was designed to serve many of the same purposes which the correspondence schools above have served in their respective countries.

> It was suggested that television instruction might provide an answer to the problem of bringing secondary instruction to those teen-agers who lived beyond the reach of existing schools.[2]

Later, the same report states that:

> Telescuola was conceived as a temporary measure through which secondary instruction could be made available to children in remote areas which could not support first-cycle secondary schools of their own and which were too isolated to permit children to attend schools in neighboring communities.[3]

As early as 1956 Hagerstown, Maryland was broadcasting lessons in four high school subjects, making it one of the first school districts in the United States to adopt instructional television on a large scale basis. Hagerstown used television to provide a wide variety of specialized courses in their district.

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[1]John L. Ewing, "The Use of Radio by the Correspondence School of the New Zealand Department of Education," in New Educational Media in Action: Case Studies for Planners--3, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 81.

[2]Lyle, "Italy," p. 15.

[3]Ibid., pp. 22, 24.

> Television has made it possible for pupils: (a) to take, instead of extremely limited amounts of elementary-school science and one year science courses in high school, a sequence of science courses that extends from grades 1 to 12; (b) to have special television instruction by experts in art and music; (c) to take a modern-language course beginning in grade 3; and to take advanced mathematics course in high school that covers calculus and analytics.[1]

Wells[2] studied the teaching of algebra by television to high school students in Nebraska who attended schools which were too small to have separate classes in algebra. The students worked independently receiving the instruction via television. A faculty member in the school was available for assistance but he was not responsible for the instruction. In fact, in many cases the faculty member had no training in mathematics. Wells found television to be an effective means to teach algebra.

The Chicago Television College was created to meet the educational needs of city residents who for one reason or another could not attend regular classes.

> Television College reaches a student body for whom class-room instruction on campus is largely inaccessable. Rather than competing with the regular city

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[1]Serena Wade, "Hagerstown: A Pioneer in Closed-Circuit Televised Instruction," in New Educational Media in Action: Case Studies for Planners--1, ed. by Wilbur Schramm (Paris: UNESCO, 1967), pp. 75-76.

[2]David W. Wells, "The Relative Effectiveness of Teaching First Year Algebra by Television-Correspondence Study and Teaching First Year Algebra by Conventional Methods" (unpublished Ed.D. dissertation, University of Nebraska Teachers College, 1959).

> junior college campuses, Television College brings new students into the college. Nearly three-fourths of the home television students are women. About half are housewives, busy at home rearing a family. Among those employed outside the home, the largest single group consists of clerical workers.[1]

The experiences of the six educational institutions shows how instructional technology can provide instruction for students who otherwise would not be able to receive instruction. The two examples from foreign countries on the use of instructional technology to teach students in remote areas, particularily Australia and New Zealand, should be considered as the United States investigates the possibilities of a university without walls.

Enrichment of the curriculum

Proposition Number 15. Through the utilization of television it is possible to reduce the cost of bringing qualified instructors to areas where the costs otherwise would be prohibitive.

Schramm and others[2] reported that prior to the introduction of educational television on American Samoa there were not a sufficient number of Samoan teachers who were qualified to fill all the classrooms on the islands.

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[1]McCombs, "Chicago's Television College," p. 112.

[2]Wilbur Schramm, et al., "Educational Television in American Samoa," in New Educational Media in Action: Case Studies for Planners--1, ed. by Wilbur Schramm (Paris: UNESCO, 1967), p. 43-45.

By employing television, the cost of $660 per pupil to hire all palagi (foreign) teachers was reduced to $423. Thus Samoa was able to increase the quality of its schools while at the same time keeping the costs reasonable.

Hagerstown, as described under proposition number fourteen was a pioneer in the utilization of educational television.

> During the school year 1957/58 . . . 3.4 teachers taught from television studios music and art lessons which would otherwise have required thirty-three special traveling teachers. Based on current salaries at that time, this represents instructional benefits of $171,600 for an expenditure of $17,680.[1]

Without television it would have been too expensive to provide music and art specialists for the schools.

The use of instructional television can reduce the costs of providing specialized education in schools. In both of the examples cited above it would not have been possible to attain their educational goals for a reasonable cost without the use of television.

Summary of Chapter IV

This chapter contains sixteen propositions relating to the cost-effectiveness of instructional technology. The propositions cover the following subjects: class size for closed-circuit television, class size for open circuit broadcast, airborne television, shared broadcast facilities,

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[1]Wade, "Hagerstown," p. 78.

sixteen millimeter films, amplified telephone, production of instructional materials, student time, utilization of facilities, increase in the student/faculty ratio, institutional savings, enrollment, reuse of materials, instruction not otherwise available, and enrichment of the curriculum. Each of the propositions is supported by data from one or more studies.

CHAPTER V

SUMMARY AND DISCUSSION

This chapter is divided into five sections. The first three sections, purpose of this study, methodology, and conclusions, contain a summation of the major points in Chapters I-IV. The fourth presents a discussion regarding the implementation of the propositions. The last section contains recommendations for future research dealing with the cost-effectiveness of instructional technology and the propositional inventory research design.

Purpose of This Study

The purpose of this study was to formulate a list of propositions pertaining to the cost-effectiveness of instructional technology by collecting, analyzing, and synthesizing existing studies that deal with the subject.

Methodology

The methodology used in this study is the propositional inventory research design which has been used in a number of sociological studies. Three of these studies, those by Collins and Guetzkow, Rogers and Shoemaker, and Merton, served as the models for the design in this study.

The first step in the methodology was the development of a bibliography of all the studies which measured the cost-effectiveness of instructional technology. The initial bibliography consisted of four hundred and twenty-nine references. Of this number approximately three hundred were evaluated in terms of two criteria. The first criterion was that the study must deal with the cost-effectiveness of instructional technology. The second criterion was that the study had to be either an empirical study or its findings had to be supported with quantative data. From the thirty-two studies that met these criteria, sixteen propositions were formulated which encompassed the findings of the studies.

Conclusions

The conclusions for this study are the sixteen propositions, each of which is stated and discussed in Chapter IV.

Implementation of the Propositions

The propositions can be used by educational decision makers when instructional technology is being considered as an instructional strategy. The propositions, however, should not be viewed as absolute laws but instead should be viewed as guidelines.

Since each educational institution is different, the implementation of the propositions at each should be evaluated

in terms of the unique characteristics of each. Since the propositions are only generalizable to institutions that are similar to the settings of the studies in Chapter IV, the generalizability of the propositions may be limited by the unique characteristics of each university.

The propositions also can provide "base-line" data for the study of the cost-effectiveness of instructional technology. By utilizing the propositions the educational decision maker can create guidelines which take into consideration the unique characteristics of his institution.

Recommended Research

The current quantity and quality of research on the cost-effectiveness of instructional technology is low. Since only thirty-two out of approximately three hundred studies reviewed met the established criteria, it is evident that even though there has been a proliferation of writings on the cost-effectiveness of instructional technology there has been very little research on the subject. Because of the small quantity and low quality of the research there is a need for additional empirical and data-based research regarding the cost-effectiveness of instructional technology. The need is general in that none of the propositions is supported by more than a few studies. It is true, however, that the need for research is greater in some areas than in others.

Most of the studies reviewed and used in this study dealt with the use of television in instruction. There is a need for studies on the cost-effectiveness of other media as well including audio tapes, slides, filmstrips, and programmed instruction.

Some of the studies cited in this study were as many as fifteen years old. Since instructional technology has changed in the past fifteen years, those studies should be repeated to determine if their findings are still reliable. However, in those propositions supported by studies which were old and fairly recent the findings of the old studies were consistent with the recent studies.

The use of many new technologies such as video cassettes, slow scan television, and audio cassettes have not been researched to measure their cost-effectiveness. Also, in the future new technologies are sure to be developed which will need to be researched to determine their cost-effectiveness.

Virtually all of the studies reviewed were comparisons of the costs of various programs. In these studies it was assumed that the programs under consideration were equally effective. There is a need to conduct studies which measure the effectiveness of programs while holding their costs constant.

One aspect of cost-effectiveness that has not been successfully researched in the attempt to measure the costs

and effectiveness of a given program at the same time. At present cost-effectiveness can be determined by measuring the costs while holding the effectiveness constant or by measuring the effectiveness while holding the costs constant. A methodology needs to be developed such that both costs and effectiveness can be measured simultaneously.

The research methodology used in this study has not been developed thoroughly. For example, since each researcher currently chooses his own criteria for acceptance of a proposition there can be a wide variance between the criteria for studies using a propositional inventory design. Therefore, there is a need to determine definitively the criteria that must be met for a proposition to be accepted. In this study the criterion selected was that 60% of the studies related to a proposition must support the proposition for the proposition to be accepted.

Another part of the research methodology which needs development is the procedure for formulating propositions. With a sufficient number of studies (possibly 100) the use of a computerized program to match together studies with the same or similar findings would save a great deal of time. Further research is needed to test this hypothesis.

With the current interest in cost-effectiveness it is likely that there will be a number of empirical studies conducted during the next few years which will measure the cost-effectiveness of various segments of instructional

technology. When a sufficient number of empirical studies has been completed it will be necessary to conduct another study similar to this one so that the propositions can be brought up to date.

BIBLIOGRAPHY

BIBLIOGRAPHY FROM THE PROPOSITIONS CHAPTER

Allred, J. D. "A Study of the Comparative Effectiveness of Three Methods of Teaching the Operation of Selected Audiovisual Equipment." Unpublished Ed.D. dissertation, University of Oklahoma, 1967.

Behrens, Anna Jo. W. Higher Education with Fewer Teachers. Washington, D. C.: Academy for Educational Development, 1972.

Breitenfeld, Frederick, Jr. "Instructional Television: The State of the Art." To Improve Learning. Edited by Sidney G. Tickton. New York: Bowker, 1971.

Brown, James W., and Thornton, James W., Jr. New Media in Higher Education. Washington, D. C.: National Education Association, 1963.

Brown, Robert M. "Programming a Film Series: A Case Study Analysis of Factors Affecting the Cost of Selected Methods of Distributing Film Series." Unpublished Ed.D. dissertation, Indiana University, 1960.

Carpenter, C. Ray, and Greenhill, L. P. An Investigation of Closed-Circuit Television for Teaching University Courses. University Park, Pennsylvania: Pennsylvania State University, 1958.

Eurich, Alvin C. Reforming American Education: The Innovative Approach to Improving Our Schools and Colleges. New York: Harper & Row, 1969.

Eurich, Nell, and Schwenkmeyer, Barry. Great Britian's Open University: First Chance, Second Chance, or Last Chance? Washington, D. C.: Academy for Educational Development, 1971.

Ewing, John L. "The Use of Radio by the Correspondence School of the New Zealand Department of Education." New Educational Media in Action: Case Studies for Planners--3. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Gjerde, Waldemar. "A Study to Determine the Effectiveness of a Planned Film Program in Selected Counties in Iowa." Unpublished Ph.D. dissertation, State University of Iowa, 1965.

"Implications of Instituting a Split-Trimester Calendar Plan in the Ann Arbor Public Schools: A Feasibility Study Report." Report of the Public Schools of the City of Ann Arbor, Michigan, June, 1970, ED 050494.[1]

Johnson, F. Craig, and Dietrich, John E. "Cost Analysis of Instructional Technology." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039730.

Jones, Gardner; Johnson, Craig; and Dietrich, John. "Unit Costs Provide Basis for Meaningful Evaluation of Efficiency of TV Courses." College and University Business 46 (April, 1969), pp. 124-130.

Kinane, Kay; Cole, R. T.; Petersen, R.; Morris, M; Tyrie, E; and Broadbent, D. "Australia's Correspondence Schools with Supporting Broadcast Programmes and Radio University." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Lefranc, Robert. "Educational Television in Niger." New Educational Media in Action: Case Studies for Planners --2. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Lyle, Jack; Germanacos, C. L.; Kahnert, Friedrich; and Torfs, J. "La Telesuela Popular Americana of Arequipa, Peru." New Educational Media in Action: Case Studies for Planners--2. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Lyle, Jack; Germanacos, C. L.; and Torfs, J. "Colombia's National Programme for Primary-Level Television Instruction." New Educational Media in Action: Case Studies for Planners--2. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

---

[1]References followed by a number such as this with an "ED" prefix are part of the Educational Resources Information Center (ERIC) microfiche collection.

Lyle, Jack; Kehnert, Friedrich; Benton, John; and Bertola, Francesco. "The Centro di Telescuola of Italy." New Educational Media in Action: Case Studies for Planners --3. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

McCombs, Maxwell. "Chicago's Television College." New Educational Media in Action: Case Studies for Planners --2. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

McConeghy, Gary Lynn. "An Analysis of Certain Time and Cost Measures Involved in the Integration of Systems for Individualized Electronic Instruction." Unpublished ED.D. dissertation, Wayne State University, 1966.

Mulvihill, Philip J. Cost Effectiveness Study of Regional Instructional Materials Centers. Harrisburg, Pennsylvania: Department of Education, 1971, ED 060503.

Plotkin, Bennett Herbert. "The Effectiveness of Programmed Learning in Fourth Grade Spelling." Unpublished Ph.D. dissertation, University of Connecticut, 1963.

Schramm, Wilbur; Amagi, Isao; Goto, Kazuhiko; Hiratsuka, Masunori; and Kumagai, Yukihiro. "Japan's Broadcast Correspondence High School." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Schramm, Wilbur; Krishnamoorthy, P. V.; Jahdav, D. D.; Bhattacharjee, J. P.; Ensminger, Douglas; Johnson, W. Bert; and Webster, Lyle. "Ten Years of the Radio Rural Forum in India." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Schramm, Wilbur; Malakul, Momluang Pin; Meesook, Khunying Ambhorn; Pookpakdi, Prani; Bhongbhibhat, Napa; and Siributr, Saising. "Educational Radio in Thailand." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Schramm, Wilbur; Nelson, Lyle M; Odell, William R.; Vaizey, John; and Spaulding, Seth. "Educational Television in American Samoa." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Smith, Donovan. "Optimal Class Scheduling." College and University. 44 (Summer, 1969), pp. 383-401.

Soverign, Michael G. "Comparative Costs of Instructional Television Distribution Systems." Unpublished Ph.D. dissertation, Purdue University, 1965.

Tickton, Sidney G., ed. To Improve Learning: An Evaluation of Instructional Technology. Vol. I. New York: Bowker, 1970.

Wade, Serena. "Hagerstown: A Pioneer in Closed-Circuit Televised Instruction." New Educational Media in Action: Case Studies for Planners--1. Edited by Wilbur Schramm. Paris: UNESCO, 1967.

Wehmhoefer, Roy A. "The Twelve Month School Year: A Study of the Advantages and Disadvantages of the Four Quarter System." Report of the Assistant Superintendent, Cook County Schools, Chicago, Illinois, February, 1968, ED 022252.

Wells, David Wayne. "The Relative Effectiveness of Teaching First Year Algebra by Television-Correspondence Study and Teaching First Year Algebra by Conventional Methods." Unpublished Ed.D. dissertation, University of Nebraska Teachers College, 1959.

GENERAL BIBLIOGRAPHY

"Annotated Bibliography on the Cost of Education." Audiovisual Instruction, 16 (November, 1971) pp. 25-28.

Association of Independent Colleges and Universities of Ohio. Toward an Effective Utilization of Independent Colleges and Universities by the State of Ohio. Columbus, Ohio: Association of Independent Colleges and Universities of Ohio, 1971.

Baumol, William J., and Bowen, William G. Performing Arts: The Economic Dilemma. Cambridge, Massachusetts: M.I.T. Press, 1966.

Beckwith, Hugh. "Innovations in Industry Likely to Affect Instructional Technology During the Next Ten Years." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039735.

Bowen, Howard R. "Financial Needs of the Campus." The Corporation and the Campus. Edited by Robert H. Connery. Proceedings of the Academy of Political Science, XXX (1970).

_____, and Douglass, Gordon K. Efficiency in Liberal Education: A Study of Comparative Instructional Costs for Different Ways of Organizing Teaching-Learning in a Liberal Arts College. New York: McGraw-Hill, 1971.

Carnegie Commission on Higher Education. The Fourth Revolution: Instructional Technology in Higher Education. New York: McGraw-Hill, 1972.

_____. The More Effective Use of Resources: An Imperative for Higher Education. New York: McGraw-Hill, 1972.

Carpenter, Margaret B., and Haggart, Sue A. "Cost-Effectiveness Analysis for Educational Planning." Educational Technology, X (October, 1970), pp. 26-30.

Center for Educational Research and Innovation. Educational Technology: The Design and Implementation of Learning Systems. Paris: Organization for Economic Co-Operation and Development, 1971.

Cheit, Earl F. The New Depression in Higher Education: A Study of Financial Conditions at 41 Colleges and Universities. New York: McGraw-Hill, 1971.

Collins, Barry E., and Guetzkow, Harold. A Social Psychology of Group Process Decision Making. New York: Wiley, 1964.

Ekman, Paul; Friesen, Wallace V; and Ellsworth, Phoebe. Emotion in the Human Face. New York: Pergamon, 1972.

Grayson, Lawrence P. "Costs, Benefits, Effectiveness: Challenge to Educational Technology." Science 175 (March 17, 1972), pp. 1216-1222.

Gurr, Ted Robert. "The Genesis of Violence: A Multivariate Theory of Civil Strife." Unpublished Ph.D. dissertation, New York University, 1965.

_____. Why Men Rebel. Princeton, New Jersey: Princeton University Press, 1970.

Harmon, Paul. "Curriculum Cost-Effectiveness Evaluation." Audiovisual Instruction. 15 (January, 1970), pp. 24-26.

Harris, Seymour E. Economics of Harvard. New York: McGraw-Hill, 1970.

Heinich, Robert. Technology and the Management of Instruction. Washington, D. C.: Association for Educational Communications and Technology, 1970.

_____. "What is Instructional Technology?" Audiovisual Instruction. 13 (March, 1968), pp. 220-222.

Humphrey, David A. "The Cost of Maintaining Educational Communications Equipment." A paper presented at the 24th Annual Meeting of the New York State Educational Communications Associations, Grossinger, New York, November 3, 1971, ED 055452.

Jellema, William W. The Red and the Black: Special Preliminary Report on the Financial Status, Present and Projected, of Private Institutions of Higher Learning. Washington, D. C.: Association of American Colleges, 1971.

_____. Redder and Much Redder: A Follow-Up Study to "The Red and the Black." Washington, D. C.: Association of American Colleges, 1971.

Jenny, Hans H., and Wynn, G. Richard. Turning Point: A Study of Income and Expenditure Growth and Distribution of 48 Private Four-Year Liberal Arts Colleges, 1960-1970. Wooster, Ohio: The College of Wooster, 1972.

Johnson, F. Craig, and Dietrich, John E. "Cost Analysis of Instructional Technology." To Improve Learning. Vol. II, Edicted by Sidney G. Tickton. New York: Bowker, 1971, ED 039730.

Kiesling, Herbert J. "On the Economic Analysis of Educational Technology." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039726.

Knezevich, Stephen J., and Eye, Glen G. Instructional Technology and the School Administrator. Washington, D. C.: American Association of School Administrators, 1970, ED 044789.

Levien, Roger E. The Emerging Technology: Instructional Uses of the Computer in Higher Education. New York: McGraw-Hill, 1972.

Levin, Henry M. "Cost Effectiveness Evaluation of Instructional Technology: The Problems." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039723.

Levine, Donald M. Structuring Program Analysis for Educational Research. Publication P-4565. Santa Monica, California: The Rand Corporation, 1971, ED 057467.

McGrath, Joseph E., and Altman, Irwin. Small Group Research: A Synthesis and Critique of the Field. New York: Holt, Rinehart, and Winston, 1966.

Maguire, Louis M.; Temkin, Sanford; and Cummings, C. Peter. An Annotated Bibliography on Administering for Change. Philadelphia: Research for Better Schools, 1971.

March, James G., and Simon, Herbert A. Organizations. New York: Wiley, 1958.

Merton, Robert K. Social Theory and Social Structure. Glencoe, Illinois: Free Press, 1968.

Miller, James G. "Deciding Whether and How to Use Educational Technology in the Light of Cost-Effectiveness Evaluation." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039728.

Molnar, Andrew R. "Media and Cost-Effectiveness." Paper presented at the Annual Meeting of the Department of Audiovisual Instruction, Detroit, Michigan, April 30, 1973, ED 044913.

Organization for Economic Co-Operation and Development. Budgeting, Programme Analysis and Cost-Effectiveness in Educational Planning. Paris: Organization for Economic Co-Operation and Development, 1968, ED 057477.

Prest, A. R., and Turvey, R. "Cost Benefit Analysis: A Survey." Surveys of Economic Theory, III (1966), pp. 155-203.

Reindl, Max H. "Propositions on Information Management of Innovation Processes in Organizations." Unpublished Ph.D. dissertation, Michigan State University, 1970.

Richardson, Edgar L. "A Financial Analysis of a University Audio-Visual Center with an Integrated Program of Education and Research, Campus Service, and Off-Campus Services." Unpublished Ed.D. dissertation, Indiana University, 1966.

Rogers, Daniel. "Productivity and Efficiency within Education." Education in National Development. Edited by Dan Adams. London: Routledge and Kegan Paul, 1971.

Rogers, Everett M. Diffusion of Innovations. New York: Free Press, 1962.

_____, with Shoemaker, F. Floyd. Communication of Innovations: A Cross Cultural Approach. New York: Free Press, 1971.

Speagle, Richard E. "Cost-Benefits: A Buyer's Guide for Instructional Technology." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039725.

_____. "The Costs of Instructional Technology." To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971, ED 039727.

_____. Educational Reform and Instructional Television in El Salvador: Costs, Benefits and Payoffs. Washington, D. C.: Academy for Educational Development, 1972.

Stowe, Richard A. "The Critical Issue in Instructional Development." Audiovisual Instruction, 16 (December, 1971), pp. 8-10.

Temkin, Sanford. An Evaluation of Comprehensive Planning Literature with an Annotated Bibliography. Philadelphia: Research for Better Schools, 1970.

Tickton, Sidney G., ed. To Improve Learning: An Evaluation of Instructional Technology. 2 vols. New York: Bowker, 1970 and 1971.

Wilkinson, Gene L. "Cost Evaluation of Instructional Strategies." AV Communication Review, 21 (Spring, 1973), pp. 11-30.

BIBLIOGRAPHY ON
COST-ANALYSIS MODELS

Abt Associates. System Analysis, Program Development, and Cost-Effectiveness Modeling of Indian Education for the Bureau of Indian Affairs. 5 vols. Cambridge, Massachusetts: Abt Associates, 1969, ED 060970, ED 032991, ED 032992, ED 032993, and ED 032994.

Abt Associates. "Technical Report of a Project to Develop Educational Cost-Effectiveness Models for New York State." Report of the University of the State of New York, Bureau of School Programs Evaluation, March, 1970, ED 043097.

Abt, Clark C. "Design for an Education System Cost-Effectiveness Model." Socio-Economic Planning Sciences. 2 (April, 1969), pp. 399-415.

Badran, Yehia. A Cost/Effectiveness Model for Educational Programs. Princeton, New Jersey: Educational Testing Service, 1970, ED 054523.

Chappell, Walter G. "A Model for Predicting the Unit Cost of Developing Self-Instructional Materials in Higher Education Biological and Physical Sciences." Unpublished Ph.D. dissertation, Michigan State University, 1970.

Cleckner, John. "A Critique of Selected References on Educational Cost Effectiveness with a Resource-Utility Model to Improve Resource Allocation." Unpublished Master's Project, University of Florida, 1971, ED 060516.

The COST-ED Model: A New Economic Tool for the School Administrator. Washington, D. C.: Education Turnkey Systems, 1971, ED 057462.

Faegre, Christopher L.; Darby, Charles A., Jr.; Carver, Ronald P.; and Van Colt, Harold P. Analysis and Evaluation of Present and Future Multi-Media Needs in Higher Education. Washington, D. C.: American Institutes for Research, 1968, ED 024351

General Learning Corporation. Cost Study of Educational Media Systems and Their Equipment Components. 3 vols. Washington, D. C.: General Learning Corporation, 1968, ED 024273, ED 024286, and ED 024281, also in To Improve Learning. Vol. II. Edited by Sidney G. Tickton. New York: Bowker, 1971.

Levin, Henry M. Frontier Functions: An Econometric Approach to the Evaluation of Educational Effectiveness. Research and Development Memorandum No. 80. Stanford, California: School of Education, Stanford University, 1971, ED 061629.

Organization for Economic Co-Operation and Development. Efficiency in Resource Utilization in Education. Paris: Organization for Economic Co-Operation and Development, 1969, ED 057473.

Quade, E. S. Systems Analysis Techniques for Planning-Programming-Budgeting. Publication Number P-3322. Santa Monica, California: The Rand Corporation, 1966.

Robertson, Lyle Russell. "A System for Determining Educational Program Costs: Application to Comprehensive Community College." Unpublished Ed.D. dissertation, Wayne State University, 1968.

Rogers, Donald D. "The Cost Analysis of Instructional Development: Some Managerial Considerations." Paper presented at the Annual Meeting of the Texas Association of Educational Technology, El Paso, Texas, November, 1972.

_____. "Cost Effectiveness Analysis in the Development of Mediated Instructional Modules." Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, Louisiana, February, 1973.

_____. "A Study of the Applicability of Cost Effectiveness Techniques to Small Scale Instructional Systems." Unpublished paper, Media Education Center, University of Texas, Austin, Texas, ED 067878.

Spiegelman, Robert. "A Benefit-Cost Model to Evaluate Educational Programs." Socio-Economic Planning Sciences. 1 (August, 1968), pp. 443-460.

Systems Research Group. The Development and Implementation of CAMPUS: A Computer-Based Planning and Budgeting Information System for Universities and Colleges. Toronto, Ontario: Systems Research Group, 1970, ED 047646.

Tanner, C. Kenneth. "A Hueristic Approach to Program Cost/Effectiveness Analysis." Paper presented at the Annual Meeting of the American Educational Research Association, New York, February, 1971.

Temkin, Sanford. A Comprehensive Theory of Cost-Effectiveness. Philadelphia: Research for Better Schools, 1970, ED 040503.

van Gigch, John P., and Hill, Richard E. "Systems Analysis for Program Planning and Cost Effectiveness." Paper presented at the 1973 Annual Meeting of the American Educational Research Association, New Orleans, Louisiana, February 27, 1973.

_____. Using Systems Analysis to Implement Cost-Effectiveness and Program Budgeting in Education. Englewood Cliffs, New Jersey: Educational Technology, 1971.

APPENDIX A

RESEARCH DESIGN FROM COLLINS AND GUETZKOW

RESEARCH DESIGN FROM

COLLINS AND GUETZKOW[1]

Let us explain the procedures we used to create the successive drafts of the book. We began by abstracting each empirically tested hypothesis in the studies in our initial bibliography onto 5 x 10 cards. Each such "proposition," or closely related group of propositions, was placed on a separate card. Starting with a minimal *a priori* outline of topics (little more than a tentative list of chapter titles) we searched our cards for findings relevant to a particular topic. This "topic pile" was then sorted and resorted until a number of "subpiles" were created, each with a series of relatively homogenous and focused empirical findings. Next, the "subpiles" were studied for common themes. In some cases several studies appeared to be testing the same general phenomenon. If the findings were consistent, or almost consistent, then a proposition might be formulated to subsume the separate findings. If the findings were apparently inconsistent, then reasons for the contradictions were sought. In some cases, such as the impact of heterogeneous personality (Chapter Five) and the communication to a deviant (Chapter Nine), a plausible explanation for divergent findings was found. In other cases, our efforts were not rewarded. Often we did not feel that the different cards in a "subpile" tested essentially the same proposition. In these cases the studies are still presented under the same conceptual heading, even if we could not formulate a specific proposition which plausibly subsumed all of the data.

Our heavy debt on previous workers is detailed with the frequent citations throughout the text. But we were surprised that standard review articles seldom allowed us to borrow directly from their summary statements. Campbell's (1958) propositions concerning errors induced by human links in communication systems is a notable exception. This is not because the quality of these reviews is not excellent; rather, we found that other reviewers either had not worded their conclusions in proposition form or else the propositions

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[1]Collins and Guetzkow, Social Psychology, pp. 3-8.

were not at a level of abstraction appropriate to the context of our other propositions. Lorge, Fox, Davitz, and Brenner (1958), Bass (1960), and Hare (1962) were frequently used for summaries and bibliography, but they did not use a propositional format. Also, Homans (1961) worked at a higher level of abstraction than most of the propositions in this work.

After a series of such propositions were found, they were examined for logical interdependence. Traditional philosophies of science (Cohen and Nagel, 1934, for instance) have placed heavy emphasis on the logical eloquence of the interrelationship between verbal or mathematical statements. Although our propositions were reorganized, reworded, and the data examined anew in service of a logical framework, our first concern remained with the inductive (descriptive and predictive) value of each individual proposition.

This book, then, is inductive in its origin. This is not to say that judgment and bias are absent. In many cases the actual operational definitions of the variables involved in a single proposition are quite different, but we postulated that a single, more fundamental process underlies divergent operational definitions. Even though we began with data, the very process of grouping several empirical tests under one conceptual proposition is a rudimentary kind of theorizing, and is bound to arouse our implicit theoretical biases.

In summary, our goal has been to present a special blend of theorizing and empirical review which we have called an "inductive summary and theory" of face-to-face group processes. We have restricted ourselves to empirical and quantitative data. Like an inductive process, the result has been strongly influenced by the selection of data from which the inductions were made. Since the selection of studies has played an important role in developing the following chapters, criteria for selection are reviewed.

Criteria for selecting the bibliography. (1) The first criterion was methodological. No study that did not report a relatively rigorous and formal collection and analysis of empirical data was included. Purely descriptive and insightfully speculative works were left for writers of other books. Furthermore, many studies were excluded if, in the judgment of the present authors, the experimental design did not allow a relatively unambiguous interpretation of the results. No attempt has been made to footnote the omissions; studies rejected because of fundamental weaknesses in design or other methodology are simply not included in the bibliography.

There are, however, a number of studies included whose interpretation seemed less than clear. Here again judgment entered. Depending on the seriousness of the ambiguity, such studies are discussed in the main text, in an optional section, or in a footnote. Although they did not completely invalidate the research findings, these methodological problems imposed an extra barrier to reliable induction. These studies were included for various reasons, to fill conceptual gaps, and, in the case of a few widely known studies, to point out their shortcomings so that their conclusions can be regarded with more caution.

(2) The second criterion concerns our substantive interest. Throughout the preparation of our bibliography, we worked toward a social psychology of group processes for decision-making. Only a minority of the studies reviewed actually deal with a "group" which is "making a decision." But this book was written in the faith that insight into group processes in general will be helpful in understanding group processes for decision-making in particular. Nonetheless, our original bibliography was considerably trimmed as articles were eliminated whose bearing on our subject matter seemed too remote.

(3) As the book progressed into later drafts, a third criterion emerged. The usefulness of a study was evaluated in the context of other research on similar topics. If an isolated hypothesis was barely confirmed statistically and further weakened by design flaws, it was probably omitted. But had this same finding been surrounded by other research on the same topic, then the more marginal item was included as evidence of additional support. Several ambiguous confirmations certainly do not equal one straightforward validation, but they are stronger than a single isolated ambiguous finding, especially if the source of ambiguity differs from study to study. We faced a happier dilemma when several studies seemed to make the same point. Although such studies were included, they were sometimes discussed in a footnote so as not to impede the progress of readers not interested in total documentation.

Contradictory evidence. We made a special effort to avoid omitting evidence merely because it seemed to go against the main theme of our generalizations and interpretations. There are a number of approaches to the problems of contradictory evidence. In the first place, a contributor believes that his generalizations and propositions--by and large--are true. He usually thinks his interpretation is the best available abstraction of the data. Some readers are interested in the best generalization that a writer can

make and are not interested in exceptions which mar a fit between a practical proposition and empirical evidence. This approach is particularly tempting when working with statistically supported hypotheses which undoubtedly contain "confirmations" due to random error (i.e., inappropriate rejections of the null hypothesis). To include these supposed exceptions in the text, some say, adds only confusion and ignores the fact that few generalizations in social science will completely subsume all the published findings.

On the other hand, scholars frequently criticize those who ignore contradictory evidence. The omission of "exceptions to the rule," they say, gives the less-than-sophisticated reader a false impression about the tenuousness of all theory in general and the author's generalizations in particular. Perhaps the most central reason for including the contradictions is their potential in sparking new and better formulations by others.

Our position is as follows. First, we stand behind the propositions we present as the best abstraction we can make from the data available to us. Secondly, we try to report the experimental designs and specific measurements in enough detail so that the reader can evaluate our generalizations. Third, we try to find reasons for contradictions. In a few cases we feel that we may have found the "other thing" which violates the ceribus paribus qualification implicit in any generalization. Finally, we demote to footnotes specific discussion of data we do not understand. For example, in discussing the relation of interaction to attraction in Chapter 6, a relatively well-founded generalization is qualified by a footnote. This supplementary evidence aids both authors and reader to recognize that the glibness of our more general conclusion should be viewed with circumspection. The practitioner and cursory readers can skip these footnotes and optional sections without losing the main argument. The more skeptical and the sophisticated professionals, however, are assured that we tried to include all data which, at this stage of the science, did not seem to fit our inductions.

APPENDIX B

RESEARCH DESIGN FROM ROGERS AND SHOEMAKER

RESEARCH DESIGN FROM

ROGERS AND SHOEMAKER[1]

Relating Theory and Research: The Middle Range

We prefer to operate at the middle range,[2] relating theory to research and research to theory. This means our theoretical basis must be specific enough to be empirically testable, and our data must test theoretical hypotheses. Theory that cannot be tested is useless, and data not related to theoretic hypotheses become irrelevant. The interplay between theoretical concepts and empirical data, although complex in nature, may perhaps be demonstrated by the following illustration of the essential procedural steps in middle range analysis.

1. All concepts must be expressed as variables. A *concept* is a dimension stated in its most basic terms. A conceptual variable utilized throughout this book is innovativeness, defined as the degree to which an individual is relatively earlier in adopting new ideas than other members of his social system. Ideally, a concept should be as general or abstract as possible so that it may be utilized to describe behavior in many different types of social systems. For example, the innovativeness concept has been studied in industry, education, medicine, and among primitive tribes.

2. The postulated relationship between two concepts is called a *general* or *theoretical hypothesis*. An example of a theoretical hypothesis tested in several research studies (that will be cited in future chapters) is: "Innovativeness is positively related to cosmopoliteness." In this example innovativeness and cosmopoliteness are concepts,

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[1]Rogers and Shoemaker, Communication, pp. 88-91.

[2]This idea comes from Merton (1957, p.9), who asks for "theories of the middle range," that is, postulated relationships which are testable but that deal with only a rather limited particular type of behavior. These middle range theories may eventually be consolidated into more abstract general conceptual schemes. We prefer to speak of middle range *analysis*, which is the formulation and testing of theories of the middle range.

and the theoretical hypothesis postulates a positive relationship between them. The logic is that individuals who have communication with sources external to their social system are more innovative.[1] If one has reference groups outside a social system, greater deviation from that system's expectations for one's behavior is likely, and the adoption of new ideas probably results.

Notice that the theoretical hypothesis illustrated here is limited in scope to the diffusion of innovations. This is why our type of analysis is termed "middle range;" application of our hypothesis is explicitly confined to one type of human behavior. This should not prevent, but rather encourage, postulation of similar hypothesized relationships dealing with other types of behavior. Middle range analysis can, therefore, offer one route toward more general theories.

3. A theoretical hypothesis is tested by means of an *empirical hypothesis* (or hypotheses), defined as the postulated relationship between two operational measures of concepts. An *operation* is the empirical referent of a concept; it may be a scale, index, observation, or the answer to a direct question. Whereas concepts exist only at the theoretical level, operations exist only at the empirical level. The degree to which an operation is a valid measure of a concept is called an *epistemic relationship*. Even though it is obviously of great importance, the isomorphism (or "identicalness") of this linkage between concept and operation cannot be tested except by intuitive means.

A middle range analysis of the relationship between innovativeness and cosmopoliteness is illustrated by an example from the Ryan and Gross (1943) hybrid corn study in Iowa [See Figure 2 in Chapter II].

4. An empirical hypothesis may be accepted or rejected on the basis of statistical tests of significance, as well as other criteria such as visual observation of the data. In the hybrid corn study, Ryan and Gross (1943) report

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[1]The development of a theoretical hypothesis may also be a result of derivations from other theoretical hypotheses. For example, if concept A is positively related to concept B, and concept B is positively related to concept C, then it may be postulated that concept A is positively related to concept C. Of course, this may not be the case if there are only weak relationships between A and B, and B and C.

a positive, significant relationship between a farmer's time of adoption of hybrid seed and his number of trips to Des Moines.

5. A theoretical hypothesis is supported or rejected on the basis of the tests of corresponding empirical hypotheses. Truth claims may be added to a theoretical hypothesis by similar findings from other analyses of the two conceptual variables in a variety of different social systems. As additional support is added to a general hypothesis, greater confidence may be placed in the relationship between the two concepts, and this relationship may be considered a *generalization* and eventually perhaps a *principle* or even a *law*.[1]

6. The relationships between each of the two concepts and other concepts may be analyzed, and, as findings of this nature gradually accumulate, a more general body of theory is developed.[2] Evidence is accumulated in an integrated and consistent manner.

We related the theoretical and empirical levels by the joint processes of *deduction* (going from theoretical to empirical hypotheses) and *induction* (from empirical results

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[1]Generalizations, principles, and laws represent three points on a continuum which indicates the degree of validity established for a relationship between two or more concepts.

[2]We are generally taught in graduate research methods courses that the design of an investigation should originate with theory and then move deductively to operational measures. However, inductive processes may be fruitful also; as in the case of serendipity. "Fruitful empirical research not only tests theoretically derived hypotheses, it also originates new hypotheses. This might be termed the 'serendipity' component of research, e.g., the discovery by chance or sagacity of valid results which were not sought for" (Merton, 1957, p. 96). A famous example of serendipity is Sir Alexander Fleming's discovery of penicillin; other examples are Roentgen's detection of X-rays, the discovery of the neutrino, and of the Hawthorne effect. The concept of serendipity comes originally from Horace Walpole's *The Three Princes of Serendip*, a narrative about three adventurers who blundered into fortunate discoveries.

to the conceptual level.) The eventual goal of middle range analysis is the development of an interrelated, integrated series of concepts, linked in a matrix of theories and of established relationships.

In the present book our objective is to fit a great number of empirical relationships that resulted from the many diffusion investigations into a series of middle range generalizations. These generalizations, which are both the main fruit of this book and its organizational skeleton, are limited in application to the diffusion of new ideas. *These middle range generalizations become stepping stones to more general theories of social change, once they are abstracted to a yet higher level of generality.*

Middle range analysis is a procedure by which theory and research may be related. In the present illustration, the theoretical hypothesis that "innovativeness is positively related to cosmopoliteness" is supported by a finding from the Ryan and Gross (1943) study, which indicates that early adoption of hybrid corn is positively related to the number of trips farmers make to Des Moines. Naturally, a number of other empirical relationships dealing with measures of innovativeness and cosmopoliteness could be related to the same theoretical hypothesis.

APPENDIX C

ANALYSIS OF DATA USED FOR ACCEPTANCE OR REJECTION OF GENERALIZATIONS BY ROGERS AND SHOEMAKER

ANALYSIS OF DATA[1] USED FOR ACCEPTANCE OR REJECTION OF GENERALIZATIONS BY ROGERS AND SHOEMAKER

	Percentage of studies supporting	Number of studies supporting	Number of studies related to proposition
Minimum	53	1	1
Maximum	100	275	402
Mean	83.5	22.7	29.2
Median	85	9	11
Mode	100	5	5

[1]Taken from data appearing in Appendix A (page 346-385) of Communication of Innovations by Everett M. Rogers with F. Floyd Shoemaker (New York: Free Press, 1971).