MEASURING EFFICIENCY AND EFFECTIVENESS OF UNIVERSITY INSTRUCTION
--A CENTRAL AMERICAN CASE--

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This is to certify that the

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ABSTRACT

MEASURING EFFICIENCY AND EFFECTIVENESS
OF UNIVERSITY INSTRUCTION
--A CENTRAL AMERICAN CASE--

by Lynn David Hemink

History notes that colleges and universities have been reluctant to apply input-output analysis to university instruction. The classroom has been perceived as incongruent with the input-output analysis. As a consequence, university administrators have been forced to allocate precious resources with a minimum of rational method and direction to insure maximum utilization in instruction.

To ameliorate this existing shortcoming, the following thesis is developed:

1. Important aspects of higher education instruction are amenable to input-output analysis, involving the constructs of efficiency and effectiveness.

2. Efficiency and effectiveness constructs are moderated by administratively controllable variables operating within the instructional environment.

3. When relationships are established empirically between administratively controllable variables and the efficiency-effectiveness constructs, a rational basis for administrative decision-making results.

A model of efficiency and effectiveness may be constructed that incorporates class enrollment, students presenting themselves for final examination, and the number of students passing a course. Two ratios of efficiency and one measure of effectiveness may be developed that isolate various phases in the instructional environment in which student inputs are being reduced.

The national universities of Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua illustrate the utility of the thesis. Data on all classes taught in the universities in the academic year 1962-63 formed the population. Data on six factors that could be affecting the efficiency-effectiveness ratios are gathered for the five universities. The six factors that could be affecting the efficiency-effectiveness constructs are:

1. The salary paid to the instructor in each class.
2. The size of each class.
3. The level of instruction as measured by the year in which a class is normally taken in a students program.
4. The type of instruction. (Lecture, laboratory, lecture-laboratory.)
5. The contact hours of the class with the instructor.
6. The number of classes taught by the professor during the academic year.

Using Chi square and mean difference comparisons, it is possible to determine relationships between the efficiency-effectiveness ratios and the six factors. The efficiency-

effectiveness constructs provide administrators with a method for future decision-making, and relationships between the constructs and the administratively controllable variables provide direction for future decision-making.

Interrelationships between the ratios of efficiency and effectiveness are evidenced in data analysis which support the theoretically constructed relationships between these ratios. These relationships validate the model of efficiency and effectiveness as a practical method for analysis of instruction.

Relationships between constructed ratios and the six factors that are administratively controllable provide direction for future decision-making that is relevant only in Central America. Specifically, the following directions are indicated in Central America:

1. Lowest salaries paid to instructors correspond to highest efficiency and effectiveness ratios. However, the type of person receiving a salary under $250 equivalents may be a practitioner instead of an academic professor.

2. Class sizes smaller than 29 are more efficient than classes of 30-109, and classes larger than 110. The administrative direction advocated, would be smaller class sizes.

3. Efficiency and effectiveness increase at successive levels of instruction. If this is a real difference and not the result of student self selection, administrators should attempt to ascertain means for holding more students at lower levels.

4. Laboratory classes tend to be more efficient than

other methods of instruction. However, these courses are usually smaller and taken at upper levels of instruction where ratios are higher.

5. Contact hours beyond 2500 result in a rapid decrease in efficiency. Smaller classes may reduce contact hours.

MEASURING EFFICIENCY AND EFFECTIVENESS OF UNIVERSITY INSTRUCTION --A CENTRAL AMERICAN CASE--

By

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CHAPTER I

NATURE, PURPOSE AND DELINEATION OF THE THESIS

Recent history notes that colleges and universities have been reluctant to apply input-output analysis to university instruction. The classroom has been perceived as incongruent with the input-output analysis that has proven to be successful in governmental agencies. As a consequence, university administrators have been forced to allocate precious resources with a minimum of method and direction for insuring that maximum resource utilization occurs in instruction. In order to ameliorate this shortcoming, the following thesis is advanced.

Statement of the Thesis

The thesis is threefold:

1. Important aspects of higher education instruction are amenable to input-output analysis, involving the evaluative constructs of effectiveness and efficiency.
2. These constructs (effectiveness and efficiency) are moderated by certain administratively controllable variables that are operating within the instructional environment.
3. When relationships are established empirically between the administratively controllable variables and the efficiency-effectiveness constructs, a rational basis for administrative decision-making results.

The potential worth of the thesis lies in the utility and validity of the method of analysis herein proposed, and in the direction for administrative planning and action that is indicated by the method when applied in concrete instructional situations. Specifically, the method of analysis is designed to maximize the use of the limited resources available to higher education instruction.

Thesis Development

The typical model of instructional productivity can be stated thusly:

FIGURE 1

MODEL OF INSTRUCTIONAL PRODUCTIVITY

$$(E) + (I) \rightarrow (A)$$

Given class enrollment (E), an instructional factor (I) is provided by the instructor and a number of students successfully pass the course (A). The ratio of A/E represents the extent to which the professor has been successful in producing an output (A) in relation to a given input (E). This model assumes that the instructional factor (I) is the only moderating influence on the quantity of students who will pass the course (A).

If this model is applied in concrete situations, however, there are factors other than the instructional factor (I) present in the institutional environment which affect the productivity of the class (A/E). In essence, losses in productivity

that formerly have been attributed to instruction (I) may result from other factors. For example, in institutions in which the examination procedure permits the student to take the final examination at his discretion instead of upon conclusion of coursework, the productivity of the instructor is difficult to assess. The examination procedure is an institutional policy decision that should be reflected in instructional productivity. It is necessary to construct a model that delineates institutional variables that would otherwise have been attributed to instruction.

In constructing a model that incorporates institutional factors such as the examination policy previously noted, another variable must be inserted in the structure of the model. If (Ex) represents those students who present themselves for final examination in a class, a new model is possible. (Figure 2).

FIGURE 2

REVISED MODEL OF PRODUCTIVITY

$$(E) + (I) \rightarrow (Ex) \rightarrow (A)$$

In this model, a class enrollment (E) and the instructional factor (I) produces examined students (Ex) from which successful students (A) result. In essence, an enrolled student (E) must become an examined student (Ex) and pass the examination before becoming a successful student (A).

The preceding model makes it possible to determine a variety of productivity ratios. For example, the ratio Ex/E

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represents the ratio of students presenting themselves for final examination (Ex) divided by the class enrollment (E). A/Ex represents the ratio of students who pass the course (A) divided by those who were examined (Ex), and A/E is the ratio of total output (A) divided by the total input (E).

The ratio Ex/E may be affected by factors other than instruction. For example, if an institution were to enroll all students on a full time basis with full course loads even if a student were only to attend one or two classes, this variation would be exhibited in the Ex/E ratio and could not be attributed entirely to instruction. In this ratio, it is possible to avoid attributing low productivity to the professor that more properly resides in other phases of the institutional environment. This ratio represents a significant development in determining where productivity is being impaired.

A/Ex is the ratio that more truly reflects instruction in an institution with a voluntary examination procedure. This ratio results from dividing the successful students by those examined. This ratio represents the relationship between the instructor and the academic ability of student an academician and is thereby a measure of instructional productivity.

The ratio A/E is subject to a variety of institutional factors. The ratio of A/E will be affected by the instructor passing students (A), and also by administrative policies. For example, if the administrative policy is in effect that all students will be enrolled with a full complement of classes even though the student desires to attend only one class, the

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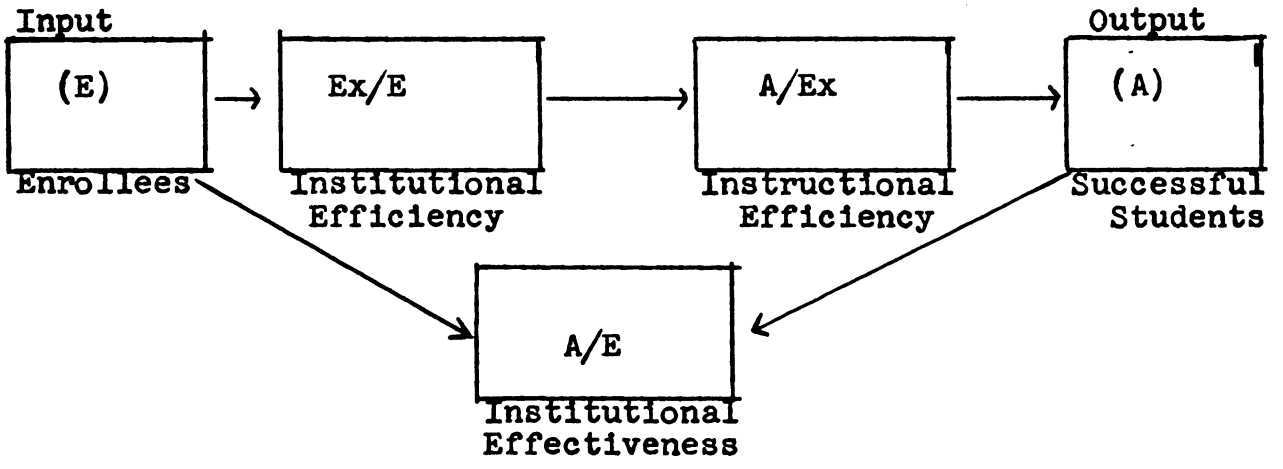
A/E ratio will reflect this procedure in part. Other factors may also affect A/E, and it is thusly apparent that A/E is affected by factors in the institutional environment in addition to instruction.

Efficiency and Effectiveness

Productivity may be divided into efficiency and effectiveness. If efficiency is defined as the maximization of the useful return or output from any given input,[1] and effectiveness is defined as the extend to which an intended outcome of a course of action becomes an observable and measurable outcome of that course of action,[2] it is possible to construct a model of ratios noted as efficiency and effectiveness ratios, (Figure 3).

FIGURE 3

MODEL OF EFFICIENCY AND EFFECTIVENESS



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[1] James Buchanan, The Public Finances, (Homewood, Illinois, Richard Irwin Co., 1965), p. 222.

[2] Burton Friedman, The Public Administration of Education in Central America, (IIME, E. Lansing, Michigan State University, 1964), p. 7.

The intended institutional outcome in enrolling students (E) is to produce successful students (A) in each class so that these students will ultimately be productive members of society. The extent of attainment of the institutional goal in each class is represented by dividing the number of successful students by the number of students enrolled (A/E). In essence, A/E is the extent to which a course of action has been effective in the institution. Whereas in previous models, A/E has represented the effectiveness of instruction, it is evident that the term insitutional effectiveness is more appropriate because it has been noted that many factors in addition to instruction may affect this ratio.

Ex/E is not an effectiveness ratio because it does not incorporate the desired institutional outcome of passing students (A). Ex/E represents the ratio of those examined (Ex) divided by the number of students enrolled in a class (E). This ratio (Ex/E) is an efficiency ratio because it represents the degree of maximization of an input that is necessary to achieve the desired institutional outcome (A). As noted previously, this ratio may be determined by factors other than instruction. Hence, Ex/E is designated as institutional efficiency in recognition of the many institutional factors operating on the ratio.

A/Ex is designated as instructional efficiency. The term instructional efficiency is employed in light of the major factor that affects this ratio. As noted previously, the

number of successful students (A) resulting from those examined (Ex) is determined by the instructor and the ability of the student. In essence, the instructional factor is clearly reflected in this ratio. A/Ex is regarded as a measure of efficiency because it does not incorporate total input. Instead, it utilizes (Ex) which is only a partial input in the institution.

The difference between efficiency and effectiveness in this thesis may be stated thusly. Effectiveness represents the extend to which total inputs (E) reach the institutional objective as total outputs (A). Efficiency, on the other hand represents the dispersal and loss of inputs at substages in the educative process that contribute to the effectiveness of the institution but are not desired outcomes in and of themselves. In essence effectiveness illustrates that an intended outcome occurred. Efficiency illustrates how the outcome occurred.

Time in the Efficiency-Effectiveness Model

In those institutions which permit a student to be examined whenever he desires, it is noted that the length of time necessary to pass each course is increased considerably.[3] The societal impact of lengthened matriculation is evident in developing countries that are in dire need of educated people

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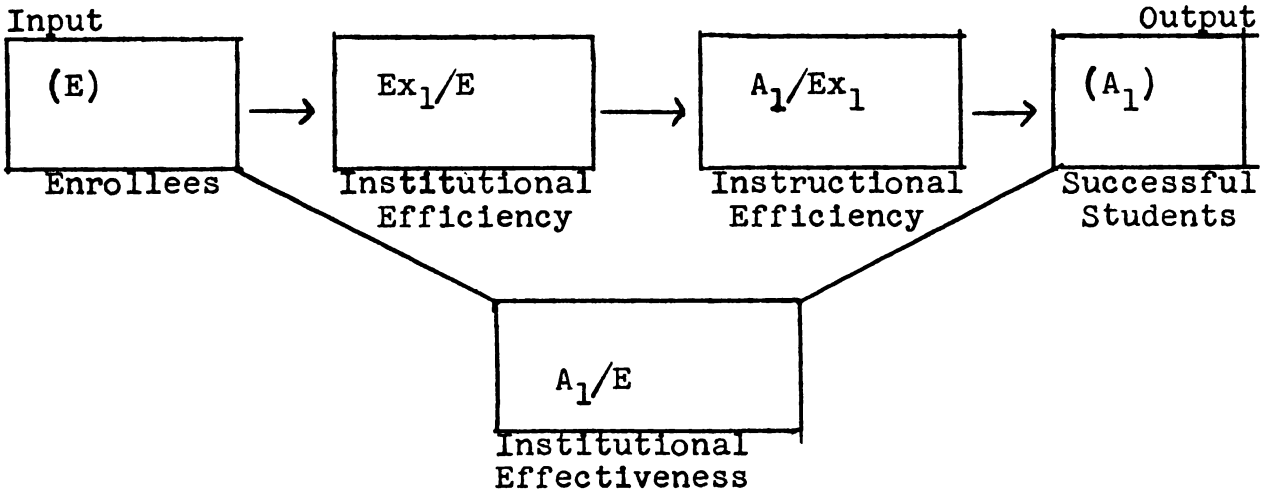
[3] IIME STAFF REPORT, A Case Study, Academic Progress of University Students, University of San Carlos of Guatemala, 1963, (IIME: E. Lansing, Michigan, 1964, p. 47.)

immediately. As the length of matriculation increases, the fewer people that are available to turn resources into economic production. The ideal procedure would thereby result in distinquishing students progressing rapidly from those who are lengthening their matriculation. For the lengthening of time in enrollment represents a loss in productivity.

The model of efficiency and effectiveness can be modified to distinguish students taking examinations immediately upon conclusion of a course from those that deferred taking the examination. The advantage of this modification in the model is that it is possible to ascertain the percentage of students who are progressing rapidly through an educational program from those who are lengthening their programs through failure of examinations or deferred examination. Figure 4 presents the efficiency-effectiveness model when the factor of time spent in matriculation is important.

FIGURE 4

TIME IN THE EFFICIENCY-EFFECTIVENESS MODEL



(Ex_1) represents those students presenting themselves for examination at the earliest opportunity. (A_1) represents those students passing a course at the earliest opportunity. It is noted that the ratios Ex_1/E, A_1/Ex_1 and A_1/E are designated in exactly the same terms as noted in the earlier model. It is thereby possible to compare ratios between models.

To illustrate the use of the model in Figure 4, if (E) = 10, (Ex_1) = 5, and (A_1) = 2, it is possible to determine ratios reflecting the number of students that are passing a course at the earliest opportunity and thereby are progressing rapidly. With an (Ex_1/E) ratio of 5/10, it is evident that only 50% of a class enrollment took the examination immediately upon conclusion of a course. If the (Ex) value was 8, it is possible to determine that three students had either failed the course previously, or had not taken the examination at the earliest opportunity. This distinction is of great importance in societies which need educated people immediately.

Variability of Efficiency and Effectiveness Concepts

Various interpretations of efficiency and effectiveness were reviewed for applicability to university instruction.

Eliot,[4] Benson,[5] Barnard,[6] Riecken and Homans,[7] Gage,[8] Etzioni,[9] and Williams[10] were reviewed and rejected because their definitions of these important terms were not amenable to the exigencies of university instruction. The definitions of Friedman and Buchanan possess utility for delimiting outputs in education that differ from most input-output analyses.

Factors Affecting Efficiency and Effectiveness

Having constructed measures of efficiency and effectiveness in which to evaluate input-output analysis in universities, it is necessary to determine the relationship of specific factors and the measures of efficiency and effectiveness.

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[4]Charles W. Iliot, Education for Efficiency, (New York: Houghton-Mifflin Co., 1909), p. 1.

[5]Charles Benson, The Economics of Public Education, (Boston, Houghton-Mifflin Co., 1961), p. 351.

[6]Chester Barnard, Functions of the Executive, (Cambridge, Mass., Harvard University Press, 1939), p. 19.

[7]H. W. Riecken and George C. Homans, Psychological Aspects of Social Structures. Ine Lindzey, G. (ed.) Handbook of Social Psychology, Vol. II, (Reading, Mass., Addison-Wesley, 1954), p. 805.

[8]N. L. Gage (ed.), Handbook of Research on Teaching, (Chicago, Rand McNally and Co., 1963), p. 117.

[9]Amitai Etzioni, Complex Organizations, (New York, The Free Press, 1961) pp. 71-88.

[10]Harry Williams, Planning for Effective Resource Allocation in Universities, (Washington, D.C., American Council on Education, 1966), pp. 2-3.

Six factors are delineated that are administratively controllable and yet may affect instruction.[11] These are:

1. The level of expenditure paid to the instructor for teaching a class. This factor may be controlled by administrative determination of the salaries paid to professors. The salaries paid may to aligned to correspond with the salaries deemed to result in optimum efficiency and effectiveness.
2. The class size of each class taught by each professor. The administration may limit enrollments in a class to conform to class sizes deemed to be most efficient and effective.
3. The level of instruction of each class as determined by the year in which each class is normally taken in a student program. The curricular variable may be administratively controlled by offering specified courses or a sequence of courses at levels that provide optimum efficiency and effectiveness.
4. The method of instruction utilized to teach each course. (Lecture, laboratory, lecture-laboratory.) The method of instruction may be somewhat controlled by an administrative policy which advocates usage of the optimum methods of instruction as evidenced in efficiency-effectiveness ratios.

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[11]The instructor is not considered as an administratively controllable variable because of the possible connotation as an impingement on academic freedom.

5. The number of contact hours of the instructor with each class. This factor may be manipulated by altering the hours of instruction or the size of a class. Contact hours that are deemed to provide the greatest efficiency and effectiveness would be the ultimate goal in manipulation.
6. The number of classes taught by each professor during the academic year. An administrative limitation may be placed on teaching loads that exceed the most efficient and effective class loads.

These factors were chosen specifically because they may affect instruction in each class, and may be controlled by administrators. As a result of examining relationships between the administratively controllable factors and the efficiency-effectiveness measures, it is possible to provide direction for future decision-making that reflects more optimum usage of limited resources.

Purpose of the Dissertation

The purpose of the dissertation is threefold:

1. To elaborate and examine the thesis in detail by applying it to concrete data.
2. To postulate appropriate uses of the model of efficiency and effectiveness.
3. To suggest possible direction for improving efficiency and effectiveness.

Overview of the Dissertation

In this chapter the thesis was developed that input-output analysis is amenable with university instruction. A model of efficiency and effectiveness was constructed to provide administrators with a method of determing the productivity of instruction. Six factors were identified that may provide direction for improving efficiency and effectiveness.

In the chapters that follow, the utility of the model of efficiency and effectiveness will be determined, the factors affecting these measures will be examined in concrete situations and directions for improving efficiency and effectiveness will be discussed. Specifically, the following will be discussed in subsequent chapters:

Chapter 2--Analysis Employed to Examine the Thesis

Chapter 3--Efficiency-Effectiveness Interrelationships

Chapter 4--Factors Related to Institutional Effectiveness

Chapter 5--Factors Related to Institutional Efficiency

Chapter 6--Factors Related to Instructional Efficiency

Chapter 7--Administrative Implications--A Case Study

Chapter 8--Summary and Conclusions

CHAPTER II

ANALYSIS EMPLOYED TO EXAMINE THE THESIS

The purpose of this chapter is to present the method of analysis employed in applying the efficiency-effectiveness model to a special population. Of particular importance were the population, instrumentation, procedure, design, the nature of hypotheses, and the limitations of the analysis. Additionally, the equalization of currency between countries is explained to insure understandable application throughout the remainder of the dissertation.

Population

The sources of data for analysis were the students and faculty of the five Central American national universities of Costa Rica, El Salvador, Guatemala, Nicaragua, and Honduras for the academic year 1962-63. Variables surrounding these data were enumerated as precisely as possible. As a result, the data utilized represent a comprehensive picture of students and faculty in the universities. There was no random sample; the population was finite and quantitatively measurable.

The national universities of Central America were chosen to ascertain the utility of the thesis for several compelling reasons:

1. Data collected by IIME[12] were adaptable to illustrate the thesis.

2. The region is comprised of developing nations that need strong higher education institutions, hence the method advanced here may be directly beneficial to the administration of such institutions.

3. Direction obtained from analyses would likely be acted upon by the Central American universities, thereby affording the basis for long-term field testing of the ideas and methods herein advanced.

Having chosen Central America as the location in which to illustrate the thesis, limitations were necessarily accepted as a result of administrative policies operating in the five universities. The most important of these are:

1. The five universities under consideration enroll students as full time students, when in fact few students attend a full load or classes any semester.[13]

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[12](IIME) Interuniversity program of the university of San Carlos of Guatemala and Michigan State University--A research center conceived by Michigan State University and the University of San Carlos of Guatemala to conduct regional research and development in Central America. IIME invented proposals for improvements in Central America's educational systems. It engaged in the design of plans for educational improvement, and it offered its services to lend planning assistance to others.

[13]The fact that few students enroll on a full time basis in terms of class attendance does not reflect a lack of seriousness on the part of the students. Most students may be employed in addition to school attendance at rates that may exceed 44 hours per week. Employment may be necessary to support families in Central America and this does not diminish the seriousness of the students.

This administrative policy maybe interpreted as enrolling all students on a program basis instead of on an individual course basis as is found in the United States

2. The examination procedure is comparable to the traditional European system of examing students at their leisure and not necessarily at the conclusion of coursework. This administrative policy is utilized in many universities throughout the world.

Instrumentation

The initial inventory employed to gather the data for this, as well as other studies, was developed by the IIME staff. The principle inventory was the "pink sheet" located in Appendix A. The completed inventory was then transferred to a computer card for future use. These data were analyzed in a variety of ways for specific IIME publications, and were reduced to the extent that each section of each course taught in the five Central American universities during the academic year 1962-63 could be ascertained.

From the initial bank of data, it was possible to modify the section analysis cards to form a new computer card which incorporates relevant measures of efficiency and effectiveness in addition to possible factors that could be affecting these institutional ratios. The result was a computer card designated as, "Efficiency-Effectiveness Summary Card."

Procedure

The efficiency-effectiveness summary card contained the following data:

1. The university, faculty, and department of the instructor giving final grades in each class.
2. A number to identify each professor.
3. The level of instruction of each course taught. For example, a course could be offered to those in their second year of study. This is a second level course.
4. The method of instruction of the course taught. In this way, it was possible to distinguish a course that is primarily lecture from one that is laboratory content from one that is a combination of lecture and laboratory instruction.
5. The hours of instruction a class received. This variable (H), refers to the total hours of instruction received by a class during a term by the professor giving the final grades.
6. The number of students enrolled in a class (E).
7. The number of students who presented themselves for examination in a course (Ex).
8. The number of students who presented themselves for examination immediately upon completion of the formal coursework (Ex_1).
9. The number of students who took the examination and

upon completion of the course and passed. (A_1).

10. The total number of students who took the examination and were successful (A).

11. The instructional salary (level of expenditure) of the professor giving the final grades (C).

12. The number of classes taught by the professor during the 1962-63 year.

With this information for each class, it was possible to develop all of the efficiency-effectiveness ratios mentioned in Chapter 1. It was also possible to design an experiment to measure any existent relationships between the efficiency-effectiveness ratios (A/E, Ex/E, A/Ex, A_1/E, A_1Ex_1, Ex_1/E) and:

1. Faculty load (HxE). This variable was derived by multiplying the hours of instruction by the number of students enrolled in a class. This variable was known as contact hours.

2. Level of expenditure (C). This figure represented the salary paid to the instructor giving final grades. Under conditions operant in Central America, the professor is paid by the course, and (C) represented his salary for this class alone.[14] Currency equalization will be discussed later in this

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[14] In all universities except University 5, some faculty were paid on a salary basis irrespective of the number of classes taught. The salary was divided evenly among the number of classes taught by a professor in this instance.

chapter. It will have a direct bearing on the meaning of the level of expenditure.

3. Class size as expressed in enrollment (E).

4. Level of instruction of the course.

5. Method of instruction employed in the course.

6. Number of courses taught by the professor.

7. Relationships between any and all of the efficiency-effectiveness ratios. As an illustration, is there any relationship between institutional efficiency (Ex/E) and institutional effectiveness (A/E) in a given university?

Design

Using the ACT II (Analysis of Contingency Tables) program and the CDC 3600 at Michigan State University, bivariate frequency distributions were developed for each of the five universities. The actual distributions were:

A/E x Class Size	A/E x Level of Expenditure
A/E x Method of Instruction	A/E x Contact Hours
A/E x Level of Instruction	A/E x A/Ex
A/E x Class Size	A/Ex x Level of Expenditure
A/Ex x Level of Instruction	A/Ex x Contact Hours
A/Ex x Method of Instruction	A/Ex x Ex/E
Ex/E x Class Size	Ex/E x Level of Expenditure
Ex/E x Level of Instruction	Ex/E x Contact Hours
Ex/E x Method of Instruction	
A_1/E x Class Size	A_1/E x Level of Expenditure
A_1/E x Level of Instruction	A_1/E x Contact Hours
A_1/E x Method of Instruction	A_1/E x Ex_1/E

A_1/Ex_1 x Class Size	A_1/Ex_1 x Level of Expenditure
A_1/Ex_1 x Level of Instruction	A_1/Ex_1 x Contact Hours
A_1/Ex_1 x Method of Instruction	A_1/Ex_1 x Ex_1/E
Ex_1/E x Class Size	Ex_1/E x Level of Expenditure
Ex_1/E x Level of Instruction	Ex_1/E x Contact Hours
Ex_1/E x Method of Instruction	

The ACT program performed the following operations on the designated tables: row and column means and standard deviations; percentages of each cell on the associated row, column and table totals; theoretical frequencies, cell contributions to table Chi square, table Chi square and degrees of freedom for test of independence; and product moment correlation coefficient.

As an adjunct in the interpretation of data on the number of classes taught by a professor during the academic year, statistical means were computed for all of the professors in a university who taught one class, two classes...15 classes. Differences between means and standard deviations were then ascertained.

In Summary, Chi square and mean differences were the techniques employed to determine any relationships between the isolated factors and the defined ratios. The utility of the model was determined by the relationship between efficiency-effectiveness ratios.

Nature of Hypotheses

The review of efficiency and effectiveness in Chapter 1 indicated that there are varying definitions that may be applied to these terms. Similarly, there is no theory that deals with

factors that may be affecting productivity in Central American universities. While it is feasible to apply assumptions from other nations and regions, there is no assurance that factors such as class size will affect production of successful students in precisely the same fashion. The resultant problem is that it was not possible to build statistical hypotheses that are grounded in prior research or in an existent body of theory.

The problem was not insurmountable however. As Saupe states:

> ...Hypotheses are not absolutely necessary for research, even in doctoral research, to be respectable. While it is possible to argue that the significance (not statistical) of educational research can be measured by the extend to which it draws upon past research and a body of theory and contributes to it, it is still true that there is much virgin territory to be explored by educational researchers. The first study in an area can not be guided by research hypotheses, but it can result in the suggestion of fruitful hypotheses for further research efforts and thereby stimulate the development of a body of theory.[15]

The significance of this thesis lies in the generation of problem statements that culminate in the generation of hypotheses about Central American university efficiency and effectiveness.

Joseph L. Saupe, A Plea for Order, College of Education Quarterly, (East Lansing: Michigan State University, July, 1961), p. 4.

> If there is no theoretical scheme which applies to an area of investigation or if the topic for study represents a sizable jump from such body of theory, the researcher may then have no specific hypothesis concerning the subject of his research. He has only a problem. He has no basis for guessing that there is not a difference among the variables he chooses to study. It would then be out of place for him to attempt to formulate hypotheses about the particular piece of nature with which he is concerned.[16]

In keeping with the rather cogent opinion of Saupe, this thesis generates hypotheses about the following questions:

1. What is the relationship between institutional effectiveness and level of expenditure, level of instruction, type of instruction, contact hours, class size and the number of classes taught by the professor?

2. What is the relationship between institutional efficiency and level of expenditure, level of instruction, type of instruction, contact hours, class size and the number of classes taught by the professor?

3. What is the relationship between instructional efficiency and level of expenditure, level of instruction, type of instruction, contact hours, class size, and the number of classes taught by the professor?

4. Is it possible to attribute any integrity to the theoretical postulations that have been asserted between the efficiency and effectiveness ratios?

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[16] Ibid., p. 4.

Limitations of the Analysis

While the limitations of the analysis were not extensive, they were rather important to the scope and possible outcome.

1. The focus of the analysis were those factors that can directly affect instruction within the universities. No attempt was made to minimize the importance of factors of a non-instructional nature on the total efficiency and effectiveness of the institution, but these factors were not within the purview of present analysis. Therefore, the physical plant, administrative factors and other similar factors were not considered in the determination of efficiency and effectiveness.
2. The full level of expenditure per class was not always utilized because of the unique fashion in which each class may be divided among faculty members in Central America. In contrast to the system in operation in the United States, a professor may teach a class for only three class meetings and then another professor may teach for another period of time. Each person teaching a segment of a term, be it one hour/term or two hours/week, is paid at a rate that is commensurate with his title and his knowledge. It is therefore possible for 20 people to deliver the content of of a course given to a class and then to receive

20 different salaries. For the purposes of this analysis, the professor who assigned final grades (A), was the only person whose salary was designated as being significant in terms of the factors that affect the various ratios.

3. Not all factors that could be affecting instruction were controlled within the framework of analysis. For example, it is entirely possible that the lack of ventilation in a class room may have a deleterious effect on the professor to the extent that it adversely affects his presentation. Ultimately, the efficiency-effectiveness ratios also could be affected adversely. Similarly, there are other factors that could be controlled. The intent in presenting relationships between efficiency-effectiveness and six factors was to illustrate what might be done with the efficiency-effectiveness model. No claim is made that these factors represent a significant determination of comprehensive factors affecting efficiency and effectiveness in instruction in Central America.
4. The influences of budget and societal influences were not considered in measuring the efficiency and effectiveness of the institution. Wortman considered the cost/productivity relationships in these universities, and the societal influences may be too disparate to quantitatively measure in this thesis.

5. Measures of efficiency and effectiveness and factors affecting these measures are categorized for statistical analysis. The range of each category was arbitrarily delimited and no intimation should be made that these divisions are in any way rigid or significant. An entirely different method of dividing data would be equally useful.

In summary, the delineated measures of efficiency and effectiveness were matched with certain factors indigenous to to the internal structure, organization and philosophy of the institution as limited above.

Currency Equalization

The countries in which the five Central American national universities are located, utilize different national currencies that are not comparable. In order to add meaning to these disparate entities, each level of expenditure (C) was converted into United States dollars at the official exchange rate as of 1962. One United States dollar is equal to:

6.625 Colones in Costa Rica

2.50 Colones in El Salvador

1.000 Quatzales in Guatemala

2.00 Lempiras in Honduras

7.1 Cordobas in Nicaragua

The equalization of currency did not in any way suggest that interuniversity comparison of level of expenditure could be made without extensive qualification. The salaries paid to professors and the cost of living vary between countries

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and thereby necessitate a complete elaboration of inherent conditions before any trans-country comparisons would be meaningful. The reason for converting local currencies into United States dollars was to provide a familiar frame of reference for operation. It was this familiarity that is sought in conversion.

In a concommitant fashion, it was recognized that there was a wide salary fluctuation between departments within the same institution. This is not an occurrence that is unique to Central America however, as the same practice is found in most universities in the United States. The law of supply and demand was applicable throughout as was the concept of higher salaries for particular professions like law and medicine.

The implication to be gathered is that comparison of faculties between universities and also within universities would be misleading and may be discrepant. The local idiosyncracies and internal differences cannot be overlooked and as a result, local qualification is necessary before meaningful comparisons can occur.

CHAPTER III

EFFICIENCY-EFFECTIVENESS INTER-RELATIONSHIPS

In this chapter the inter-relationships between the efficiency-effectiveness ratios are examined by university and also by ratio comparisons within these universities. The importance of inter-relationships cannot be minimized because the model of efficiency-effectiveness is predicated upon a series of assumptions that must be upheld if the model is to have practical utility. If no relationships were to be found when the model was applied, the model would have little utility in measuring the effects of factors upon the individual ratios. Therefore, inter-relationships between particular ratios are essential in determining the applicability of the theoretical model.

To examine model applicability, efficiency-effectiveness data were distributed by university. Utilizing Chi square, it was possible to determine if a relationship between ratios did exist, and by utilizing mean scores derived from the Chi square framework, it was possible to determine the patterns of the relationship.

Institutional Effectiveness (A/E) and Institutional Efficiency (Ex/E) Assumption. If the theoretical model is accurate, there should be a relationship between institutional efficiency as measured by (Ex/E), and institutional effectiveness (A/E).

Specifically, as Ex/E increases, A/E also should increase.

The theoretical rationale behind this assumption is evident. The number of examined students (Ex) normally cannot exceed the total class enrollment (E). However, (Ex) can approach (E) if most of the enrolled students (E) present themselves for examination (Ex), the closer that (Ex) comes to (E), in absolute numbers, the more closely (Ex) comes to being interchangable with (E).

To illustrate in more concrete fashion, suppose that (Ex/E) (the measure employed for institutional effectiveness) in a given class is 4/10. This indicates that if all of those examined were to be successful (A), the maximum institutional effectiveness would result in an A/E ratio of 4/10. However, if for the same class the Ex/E ratio were to be 8/10, the maximum (A) value is now 8, and the maximum institutional effectiveness ratio of A/E would be 8/10.

It is not necessary for maximal values to be employed in order to expect that the assumption will be supported. For example, in a class of 10 students, only four present themselves for examination. Suppose that 50% of those examined were successful. Clearly, the effectiveness ratio (A/E) is 2/10. If eight students presented themselves for examination, the effectiveness ratio (A/E) would be 4/10.

Data from the five Central American universities that were considered support the assumption that an increase in institutional efficiency (Ex/E), results in an increase in

institutional effectiveness (A/E). These data are presented in Table 3.1.

TABLE 3.1--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A/E) BY LEVEL OF INSTITUTIONAL EFFICIENCY (Ex/E)

	Level of Institutional Efficiency			
University	Ex/E 0-50%	Ex/E 51-80%	Ex/E 81+ %	Chi square Significance Level
1	25.5%*	49.9%	82.6%	.01
2	25.5	56.7	92.5	.01
3	25.5	47.9	78.4	.01
4	25.5	49.1	89.2	.01
5	25.5	56.3	87.7	.01

*Because of computer program limitations, raw scores were transformed into coded scores in order to process the data. As a result the minimum percentage that can be shown is 25.5% and the maximum is 95.5%. The pattern is not affected, however.

In Table 3.1, Ex/E values are expressed in three groups:

1) 0-50% 2) 51-80% 3) 81+ %

The A/E values were examined within each category of Ex/E, and are expressed in percent.

Without exception, the percent of institutional effectiveness (A/E) increases as institutional efficiency (Ex/E) increases. For example, in University 1, A/E is 25.5% when the Ex/E is less than 50%. A/E rises to 49.9% when the Ex/E value is between 51 and 80 percent and rises to 82.6% when Ex/E is greater than 81%.

Institutional Effectiveness (A/E) and Instructional Efficiency (A/Ex) Assumption. If the model is applicable, there also should be a relationship between instructional efficiency (A/Ex)

and institutional effectiveness (A/E). Theoretically, as A/Ex increases, A/E should increase also.

The rationale for this assumption is encompassed once again in the values of examined (Ex) and enrolled students (E). The successful student value (A), cannot be larger than examined value (Ex). However, it is theoretically possible that (A) could equal (Ex) if all those who were examined passed the examination. It becomes apparent that as A/Ex increases, E, being a fixed value, cannot fluctuate in the A/E ratio. If successful students (A) approaches examined students (Ex) in the A/Ex ratio, institutional effectiveness (A/E) will necessarily be high.

As an illustration, let (A)=5, (Ex)=8, and (E)=10. In this instance, A/Ex=5/8 and A/E=5/10. If the (A) value were to be raised to 7, the A/Ex value equals 7/8 and A/E equals 7/10. Hence, in theory, as A/Ex increases, A/E should increase also. To confirm these relationships, data from the five Central American universities were examined. Results are represented in Table 3.2

TABLE 3.2--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A/E) BY LEVEL OF INSTRUCTIONAL EFFICIENCY (A/Ex)

	Level of Institutional Effectiveness			
University	A/Ex 0-50%	A/Ex 51-80%	A/Ex 81+%	Chi Square Significance Level
1	29.5%	52.7%	82.9%	.01
2	51.1	74.8	89.2	.01
3	29.1	52.3	75.7	.01
4	27.9	58.3	87.1	.01
5	45.5	72.7	89.5	.01

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In each university as instructional efficiency (A/Ex) increases, institutional effectiveness (A/E) increases also. For example, in University 2, when the ratio of instructional efficiency (A/Ex) is less than 50%, the institutional efficiency is 51.1%. However, when A/Ex is 51-80%, A/E becomes 74.8%, and reaches 89.2% when A/Ex is greater than 81%. The analysis of data thereby supports the assumption that as instructional efficiency (A/Ex) increases institutional effectiveness (A/E) increases also.

Institutional Efficiency (Ex/E) and Instructional Efficiency (A/Ex) Assumption. Theoretically, there should be no relationship between institutional efficiency (Ex/E) and instructional efficiency (A/Ex).

The rationale for the preceeding assumption can be illustrated when the two ratios are analyzed. Ex/E is a ratio of those presenting themselves for examination (Ex), divided by those initially enrolled in a class (E). A/Ex represents those who passed (A) divided by those examined (Ex). In the Ex/E ratio, Ex is the varying quantity, and in the A/Ex ratio, Ex is the fixed quantity. Seeing that the common variable is not free to vary in both ratios, it does not appear likely that the two ratios should evidence a patterned relationship. Any relationship that is evidenced would indicate that an extraneous factor may be operating on both ratios. These relationships were examined in the five Central American institutions and are presented in Table 3.3.

TABLE 3.3--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex) BY LEVEL OF INSTITUTIONAL EFFICIENCY (Ex/E)

	Level of Instructional Efficiency			
University	Ex/E 0-50%	Ex/E 51-80%	Ex/E 81+%	Chi Square Significance Level
1	75.1%	78.1%	84.7%	.01
2	92.8	90.4	90.1	NS
3	74.5	79.6	77.5	NS
4	79.6	84.1	88.6	.01
5	94.0	89.5	91.0	NS

The analysis of universities indicated a most interesting series of patterns. In universities 1 and 4 there is a constant increase in A/Ex as Ex/E increases. For example, as Ex/E rises from 0-50, 51-80 and 81+%, university 1, A/Ex rises from 75.1, 78.1 and 84.7%. The same relationships is evidenced in university 4. For these universities it appears that the higher the holding power of the class, as evidenced by Ex/E the higher the percentage of students who will pass (A).

In raising possible reasons for the pattern noted in universities 1 and 4, it becomes necessary to speculate based upon current operating procedure in Central America. Because all students are registered as full time students, with a full load of courses, even though they may actually be attending only one or two classes, is it possible that those classes that are fully attended and examined are justly rewarded for their attendance? This possibility would appear to gain support in the university data.

The other universities exhibit a diversity of patterns

even though the Chi square values are not significant at the .05 level. University 2 exhibits a steadily declining percent in instructional efficiency (A/Ex) as institutional efficiency (Ex/E) increases. University 3 has the highest A/Ex percentage when Ex/E is 51-80%. University 5, on the other hand, shows a high A/Ex percentage when Ex/E is below 50%, a decline when Ex/E is 51-80%, and a slight increase when Ex/E is high (81+%).

With a variety of patterns exhibited in the five universities, (including contrary expectations) it could be stated that the data fail to support the assumption that institutional efficiency (Ex/E), and instructional efficiency (A/Ex) are unrelated. Because of the nature of the efficiency ratios, this lack of support may indicate that an extraneous factor is apparent that is causing theoretically unwarranted patterns. This possibility is further explored in Chapter 6.

Internal Consistency

Another method of measuring the utility of the model is to compare the mean scores of A/E, Ex/E and A/Ex to insure that they follow a logical and meaningful pattern that is based upon the theoretical statements surrounding the model. The data in Table 3.4 indicate the mean scores for A/E, Ex/E and A/Ex for all classes in each university.

TABLE 3.4--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E), INSTRUCTIONAL EFFICIENCY (A/Ex), AND INSTITUTIONAL EFFECTIVENESS (A/E) BY UNIVERSITY

University	Ex/E	A/Ex	A/E
1	82.0%	80.8%	70.6%
2	90.1	90.7	86.8
3	77.5	77.8	63.5
4	87.7	88.3	80.8
5	90.7	84.7	83.2

If the model is workable, the A/Ex ratio of instructional efficiency should be greater than the A/E ratio of institutional effectiveness because there is no university in which the examined value (Ex) equals the enrolled value (E). As evidenced by all universities, A/Ex is indeed larger than A/E.

In university 5, the difference between A/Ex and A/E is 1.5 percentage points. This would indicate that the Ex/E value should be high. The reason for this similarity is that the closer Ex is to E as represented by Ex/E, the smaller the difference between A/Ex and A/E. This pattern can be seen in university 3 where there is a low Ex/E and a 14.3 percentage point difference between A/Ex and A/E.

Lastly, the A/E value for any university should be smaller than the Ex/E value because in no university does (A) equal (Ex). As evidenced in each university, this is indeed the case.

Time in the Efficiency-Effectiveness Ratios

Time is a relevant factor in the production of educated persons, particularly in the developing nations. For example, in university 3, the average student invests 13.32 years to complete his required studies. In some fields, as many as 17 to 30 years are invested before completing curricula of 5 or 6 years duration.[17] There is an apparent advantage to the university to examine students and to permit them to become successful at the earliest opportunity, consistent with good

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[17] p. it., p. 2

practice. The longer the time needed to educate a person, the smaller the productive contribution of that individual.

One factor affecting the period of time to complete courses is the examination procedure itself. In Central America, it is not always necessary for the student to take his final examination in a course immediately upon conclusion of the coursework. The examination may be deferred for a period as long as 18 months under certain conditions, or--as in university 4--the examination procedure may be divorced completely from course instruction. In this context, all of the efficiency-effectiveness ratios mentioned heretofore in this chapter have not differentiated students who took the examination immediately upon conclusion of the course from those who waited as long as 18 months. A second efficiency-effectiveness model can thereby be applied that encompasses only those students who are examined and pass at the earliest opportunity.

Institutional Effectiveness (A/E) and Institutional Efficiency (Ex_1/E) Assumption. Let (Ex_1) represent the student who presents himself for examination at the earliest opportunity. Let (A_1) represent those students who successfully complete the examination at the first opportunity. As institutional efficiency (Ex_1/E) increases, institutional effectiveness (A_1/E) increases. This assumption is based upon the derivation of the (Ex_1) and (A_1) values. Those examined immediately (Ex_1) must come from the quantity (E). The closer that (Ex_1)

is to the value (E), the more students that are potentially successful (A_1).

The following data from the five Central American universities indicate that as Ex_1/E increases, A_1/E increases.

TABLE 3.5--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A_1/E) BY LEVEL OF INSTITUTIONAL EFFICIENCY (Ex_1/E)

	Level of Institutional Efficiency			
University	Ex_1/E 0-50%	Ex_1/E 51-80%	Ex_1/E 81+%	Chi Square Significance Level
1	25.5%	47.9%	86.2%	.01
2	25.5	53.9	89.2	.01
3	25.5	44.7	85.7	.01
4	25.5	49.5	89.2	.01
5	25.5	52.3	84.7	.01

Using university 1 as an illustration, when Ex_1/E is less than 50%, the mean value for A_1/E is 25.5%. However, when Ex_1/E lies between 51% and 80%, A_1/E rises to 47.9%. Similarly, when Ex_1/E is 81+%, A_1/E averages 86.2%. The pattern is without exception in the five Central American universities. It would appear therefore that the data support the assumption: as institutional efficiency (Ex_1/E) increases, institutional effectiveness (A_1/E) increases.

Institutional Effectiveness (A_1/E) and Instructional Efficiency (A_1/Ex_1) Assumption. As A_1/Ex_1 increases, A_1/E increases. The rationale underlying this assumption is the same as that utilized in explaining the relationship between A/Ex and A/E. Since A_1 cannot exceed Ex_1, the closer that A_1 comes to Ex_1,

the higher the absolute quantity of A_1. Since enrollment (E) is a fixed value, the amount of successful students (A_1) will determine the percentage of institutional effectiveness (A_1/E), just as it was observed to determine the percent of instructional efficiency (A_1/Ex_1). Since (Ex_1) and (E) are fixed, an increase in (A_1) should produce an increase in both ratios (A_1/Ex_1 and A_1/E). The data from the five universities (Table 3.6) confirm the relationships.

TABLE 3.6--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A_1/E) BY LEVEL OF INSTRUCTIONAL EFFICIENCY (A_1/Ex_1)

	Level of Instructional Efficiency			
University	A_1/Ex_1 0-50%	A/Ex_1 51-80%	A_1/Ex_1 81+%	Chi Square Significance Level
1	25.5%	39.9%	79.6%	.01
2	25.5	57.1	87.4	.01
3	25.5	33.1	70.3	.01
4	25.5	42.3	84.7	.01
5	25.5	49.5	82.6	.01

With each successive increase in instructional efficiency, (A_1/Ex_1) a corresponding increase may be observed in institution effectiveness (A_1/E). Variation among the universities may be observed in the amount of increase in A_1/E, however. For example, in university 2, an A_1/Ex_1 score of 51-80% corresponds to an average A_1/E value of 57.1%. However, in university 3, in the corresponding category, the A_1/E value is 33.1%.

The data support the assumption that as instructional efficiency (A_1/Ex_1) increases, institutional effectiveness (A_1/E) increases also.

Institutional Efficiency (Ex_1/E) and Instructional Efficiency (A_1/Ex_1) Assumption. There is no consistent relationship between institutional efficiency (Ex_1/E) and instructional efficiency (A_1/Ex_1). As stated previously with regard to the relationship between Ex/E and A/Ex, the variables within the variables within the ratios would not theoretically appear to be dependent one upon the other to the extent that a value in one formula could dictate a pattern in the other ratio. The Ex_1 value is the common value in the ratios. The (E) value is previously established, so that the ratio of Ex_1/E is dependent upon the Ex_1 value. But in the second ratio, A_1 is the fluctuating variable and Ex_1 is already established before the A_1 value is known. It would appear that there should be no relationship between the values of institutional efficiency and instructional efficiency. As illustrated in Table 3.7 the data belies the theory.

TABLE 3.7--PERCENT OF INSTRUCTIONAL EFFICIENCY (A_1/Ex_1) BY LEVEL OF INSTITUTIONAL EFFICIENCY (Ex_1/E)

	Level of Instructional Efficiency			
University	Ex_1/E 0-50%	Ex_1/E 51-80%	Ex_1/E 81+%	Chi Square Significance Level
1	55.1%	66.1%	82.3%	.01
2	89.5	87.7	89.2	.01
3	48.7	58.3	72.7	.01
4	74.7	75.1	86.8	.01
5	79.6	79.0	85.0	.01

In universities 1,3 and 4 there is a steady increase in instructional efficiency (A_1/Ex_1) as institutional efficiency (Ex_1/E) increases. The percentages in this pattern vary widely, however, In university 3, when Ex_1/E is less than 50%, the A_1/Ex_1 ratio is 48.7%. If hypothetical figures were used to illustrate this university based upon mean scores, the data indicates that an (E) of 100 yield of Ex_1 value of 50% or less. Assuming that the maximum value of 50% is employed, the Ex_1/E ratio would be 50% and the maximum Ex_1 value would be 50. From these 50 students, the average A_1/Ex_1 would be 48.7%. This would mean that 24.4 students would be the maximum expected to pass (A_1) from an initial enrollment of 100.

A different pattern is evidenced in universities 2 and 4. The A_1/Ex_1 percentage declines in the middle Ex_1/E category. In university 2, for example, when Ex_1/E is less than 50%, A_1/Ex_1 is 89.5%, but when Ex_1/E is 51-80%, A_1/Ex_1 is 87.7%. As Ex_1 increases to 81+%, the A_1/Ex_1 value increases to 89.2%.

The pattern exhibited by universities 2 and 4 raises a question as to why A_1/Ex_1 is high when Ex_1/E is low. Is it possible that in those instances where a high percentage of class enrollment (E), has been lost during a term, an attempt is made by the professor to salvage a greater percentage of those that have remained (A_1/Ex_1)? If this is not the case, could a low Ex_1/E indicate that very few enrolled students actually were attending classes? If this be true, is A_1/Ex_1 a more realistic indication of class attendance than the Ex_1/E ratio? Because all students are enrolled as full time students

in Central America, the possibility does exist that a low Ex_1/E ratio may incorporate large numbers of "phantom" students as enrollees, whereas A_1/Ex_1 may reflect an Ex_1 that more closely approximates the actual attendance.[18]

An analysis of data indicates that the assumption of no relationship between Ex_1/E and A_1/Ex_1 is not supported. Two distinct patterns emerge that are dissimilar in nature. Because Ex_1/E and A_1/Ex_1 in fact seem to be related, the model is in no way affected. Instead it must be recognized that there may be a third factor that is affecting these ratios that was unanticipated.

When time is an important factor in student success, it appears that the ratios A_1/E and A_1/Ex_1 and Ex_1/E have utility in Central America. Each ratio is able to isolate at a specific point in time the efficiency and effectiveness in any class within an institution. It would thereby appear that the model, when applied to specific data is workable and useful.

Data Differences Between Models

One advantage in using the two models of efficiency and effectiveness is that it becomes possible to distinguish ratio differences between A/E and A_1/E; Ex/E and Ex_1/E; A/Ex and A_1/Ex_1. The importance in analyzing these comparisons stems from the very nature of the Central American need for an educated populance. By comparing differences between those who

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[18]Attendance records are not consistently maintained by the universities, hence the question may not be resolved directly.

passed at the first opportunity with those who passed at a later date, it is possible to ascertain the percentage of students who are extending the time necessary to pass a course.

To more clearly illustrate this advantage of the models, Table 3.8 contains the A/E and A_1/E mean scores for each university. The A/E value indicates the percentage of successful students (A) from those enrolled (E). A_1/E represents those enrolled students who were successful at the first opportunity.

TABLE 3.8--INSTITUTIONAL EFFECTIVENESS (A/E and A_1/E) DIFFERENCES BY PERCENT

University	A/E	A_1/E	Difference
1	70.6%	66.1%	4.5%
2	86.8	82.6	4.2
3	63.5	53.9	9.6
4	80.8	77.5	3.3
5	83.2	73.3	9.9

By university standards in the United States, all the mean scores are relatively low. Without assigning a value to the rightness or wrongness to the pass-fail philosophy in Central America, it is possible to note that in universities 3 and 5, a large percentage of students fail to pass their examinations at the first opportunity. In university 3, the difference between the A/E and the A_1/E mean is 9.6%. This indicates that 9.6% of all successful students were retaking an examination that they had previously failed, or had not taken at the earliest opportunity. When the A/E percentage at univer-

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sity 3 of 63.5% is examined, it appears that on the average, 36.5% must retake the examination or take it at a later date before they can ever hope to move on the more advanced courses. It has been noted also that students in this category account for only 9.6% of the successful total.

The time spent in achieving successful completion of courses and graduation is greatly lengthened as can be determined rather dramatically in the preceeding examples. The full impact was elucidated in a case study by the IIME staff at the University of San Carlos of Guatemala. By utilizing the Index of Academic Achievement which is an expression of the number of calendar years spent by a student to complete one year of course work, the authors state, "If one adopts the definition that the only 'successful' full time student is the student who completes his courses in no more than the number of years scheduled in his course of study, there were only 466 successful full time students among the 5,036 who reenrolled in 1963; 9.25 percent of the total".[19]

Similar comparisons can be made between Ex/E and Ex_1/E. These ratios exhibit the percentage differences between those being examined at the first opportunity and those being reexamined or prolonging the period before taking the examination. University differences are noted in Table 3.9.

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[19]IIME staff report, op. cit., p. 47.

TABLE 3.9--PERCENT DIFFERENCES IN INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E)

University	Ex/E	Ex_1/E	Difference
1	82.0%	75.4%	6.6%
2	90.1	89.2	.9
3	77.5	66.1	11.4
4	87.7	84.7	3.0
5	90.7	83.2	7.5

The percentage difference represents those students who for one reason or another did not take the examination at the first opportunity, or were not successful at the first opportunity. As illustrated, there is wide variation in this figure between universities. It should be noted that the higher the percentage difference, the more students who have lengthened the amount of time necessary to complete a single course. When it is recognized that the percentage differences represent the average for each university, it becomes evident that universities 1, 3 and 5 have a substantial percentage of students that are progressing, perhaps, unnecessarily slowly. This would tend to support the low rate of successful full time students noted in the IIME staff report.

Probably the most significant comparison that can be made between the two models involves the means of A/Ex and A_1/Ex_1. These ratios represent the percentage of those passed (A) out of those examined (Ex) and the percentage of those who passed at the first opportunity (A_1) out of those who were examined at the first opportunity (Ex_1). If A_1/Ex_1 were signi-

ficantly lower than the A/Ex ratio, this might indicate that preference is given to those who have already failed the examination or had foregone examination at an earlier time. However, the figures in Table 3.10 do not support this possibility.

TABLE 3.10--INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) DIFFERENCES IN PERCENT

University	A/Ex	A_1/Ex_1	Difference
1	80.8%	81.7%	.9%
2	90.7	90.4	.3
3	77.8	76.9	.8
4	88.3	88.6	.3
5	84.7	85.3	.6

The greatest difference between A/Ex and A_1/Ex_1 is .9 of 1% in university 1. All universities exhibit very stable percentages for both groups. Therefore, the data indicate no noticeable difference in percentages between those passing and those examined at either the first opportunity or at a later date. Moreover, the percentages of those passing to those examined are quite high at either time. In university 2, for example, over 90% in either category will be successful. If nine out of ten of those examined are to be successful, it would appear that one of the problems of Central America is how to increase the absolute numbers of students who present themselves for examination. Once students present themselves for examination (Ex or Ex_1), the probability of being successful (A or A_1) is relatively high.

Summary

The purpose of this chapter was to present substantive data from the five Central American universities to support the constructed models of efficiency and effectiveness. Interrelationships between ratios were supported for all theoretical assumptions with the exception of the two relationships between institutional efficiency (Ex/E) or (Ex_1/E) and institutional effectiveness (A/E) or (A_1/Ex_1). In this instance, conflicting and unanticipated patterns were observed. The cause of the conflict may be a third factor or cluster of factors that are extraneous to both ratios. The utility of the model is not affected by this unanticipated pattern. The models isolate efficiency and effectiveness at selected stages of any course, thereby enabling an observer to ascertain at which points inputs are being reduced.

By comparing ratios from one model to the other by university, it is possible to determine differences between students taking courses for the first time and those who are not. Because there is little difference in either measure of instructional efficiency within any of the universities, it would appear most advantageous to attempt to delineate those factors that may be limiting Ex in absolute numbers. For if a student is examined, it appears that the probability of being successful is relatively high. Moreover, there would seem to be no real justification to continue the multiple examination procedure itself. Each university could gain materially in institutional efficiency by limiting itself to a single exam at the conclusions of each course.

CHAPTER IV

FACTORS RELATED TO INSTITUTIONAL EFFECTIVENESS

Six factors related to institutional effectiveness (A/E and A_1/E) are examined in this chapter. As indicated in Chapter 1, these specific factors were selected because they fall within the ability of the institution to control administratively. According to the model, institutional effectiveness is the extent to which an intended outcome of a course of action becomes a reality. Within the context of higher education, institutional effectiveness is the extent to which an intended output (A or A_1), becomes a reality from any given input (E).

It appears axiomatic that the effectiveness of an institution will be affected by factors that are inherent in the dynamic operation of the institution. By isolating specific factors--and the effect that they have upon the effectiveness of the institution--it becomes administratively feasible to effect change that will make the effectiveness of the institutional more congruent with institutional needs and objectives.

Within the framework of the efficiency-effectiveness model, it is possible to spread the ratio of institutional effectiveness (A/E or A_1/E) against the six factors using a Chi square technique. By comparing mean scores within each Chi square category, it is then possible to ascertain inherent

patterns in institutional effectiveness that might be related to a given factor. This process will be illustrated by university and also by selected faculties within each university.

The specific factors to be applied in this chapter for relationships to institutional effectiveness are:

1. Level of educational expenditure, as determined by the salary paid to the instructor who gives the final grades to the students.
2. The size of the class, as determined by class enrollment (E).
3. The level of instruction at which the class is offered (i.e., first year, second year...eighth year.).
4. The principal method of instruction of the class (e.g., lecture, laboratory or combination).
5. The number of hours that professors are in instructional contact with students, as measured by the hours of instruction (H) multiplied by the number of students enrolled (E). (HxE).
6. The number of classes taught by the grading instructor.

Data Analysis by University

Data for each of the six administratively controllable variables were compared with the institutional effectiveness (A/E) values in each university. When Chi square values were determined in the comparisons, differences significant at the .01 level of confidence were found for each factor in at least one of the universities. Significant relationships

are summzrized in Table 4.1.[20]

TABLE 4.1--FACTORS RELATED TO INSTITUTIONAL EFFECTIVENESS (A/E) (X=.01 level of confidence)*

A/E University	Level of Expenditure	Class Enrollment	Level of Instruction	Method of Instruction	HxE
1	X	X	X	X	X
2	X	X			X
3	X	X	X		X
4	X	X			X
5		X	X		X

*Data for the five universities is found in Appendix B

Level of Expenditure may be observed to be significantly related to effectiveness (A/E) in four institutions. Class enrollment is clearly related in each university as is (HxE), the number of contact hours with students. The other factors are related in varying degrees. The table gives ample evidence of university differences, (i.e., administratively controllable factors are differently related among the five universities.) The effects of each factor on institutional effectiveness (A/E) is discussed in subsequent sections of the chapter.

[20]Data on the number of classes taught by a professor were not subject to Chi square comparison and are not included in Table 4.1. Mean comparisons, which are not subject to levels of confidence, were the analysis employed on the number of classes taught. Relationships were analyzed in subsequent portions of this chapter.

Level of Expenditure and Effectiveness (A/E)

The relationship between institutional effectiveness (A/E) and level of expenditure is illustrated in Table 4.2. Five categories of expenditure are listed: $1-250, $251-500, $751-1000, $1001+.

TABLE 4.2--INSTITUTIONAL EFFECTIVENESS (A/E) BY LEVEL OF EXPENDITURE (In Percent)

Cost	A/E University 1	A/E University 2	A/E University 3	A/E University 4	A/E University 5
$1-250	78.7%	90.7%	88.3%	91.0%	83.8%
$251-500	67.3	85.6	63.5	88.0	83.5
$500-750	69.7	85.0	60.3	74.2	83.5
$751-1000	69.4	85.0	53.5	69.2	83.2
$1000+	70.9	82.6	65.1	74.5	77.8
Chi Square Significance Level	.01	.01	.01	.01	.01

NS= Not significant at .05.

In universities 1, 3, and 4 it should be noted that the highest effectiveness value (A/E) occurs when the level of expenditure paid to the grading professor is lowest. In University 1 when the salary paid is less than $250, effectiveness (A/E) is 7.8 percentage points above the next highest effectiveness ratio. In university 2, a salary less than $250 is 5.1 percentage points above the second highest effectiveness ratio. In university 3, a salary of less than $250 corresponds to an effectiveness ratio that is 23.2 percentage points above the next highest effectiveness ratio. In university 4, in the same category, the effectiveness ratio is

3.0 percentage points above the second highest category. The thesis could be advanced that: As the level of expenditure increases, the effectiveness ratio decreases. However, this tenet is not supported in the data. In fact, other than evidence that the lowest paid instructor has the highest effectiveness ratio, there is no consistent pattern. In universities 1, and 3 the second highest effectiveness ratios occur when professors were paid over $1000 U.S. equivalents for a class. In universities 2 and 4, $251-500 dollar equivalents has the second highest effectiveness ratio.

Because the highest effectiveness ratios in four universities are found in the lowest category of expenditure, a variety of questions can be raised. Are the youngest, newest instructors being paid the least amount of money? Are these instructors more responsive to student needs and problems? Is a high effectiveness ratio in low cost courses an indication of low instructor interest in discriminating the successful student from the unsuccessful? Are low cost courses concentrated in selected faculties that have low class size? The answer to these questions may be found in the Central American practice of utilizing specialists or "practitioners" from the surrounding community to teach one or two classes. These practitioners may have no commitment to the evaluation process and therefore do not follow the usual pattern of the more established and permanent faculty.

Based upon the analysis of data, the hypothesis can be generated that the salary level of the grading instructor is

not a compelling factor in determining institutional effectiveness. Indeed, institutional effectiveness may be achieved at different salary levels.[21]

Data Analysis by Selected Faculty

In the four universities (1,2,3, and 4) where a relationship was noted between level of expenditure and institutional effectiveness, the faculties of Economics, Education, Pharmacy, Engineering, Dentistry, Medicine and Law were analyzed individually. In light of the noted relationship within these universities that a salary of 1-250 dollar equivalents is related to the highest effectiveness ratio, Table 4.3 of level of expenditure figures within selected faculties and the category that exhibited the highest effectiveness (A/E) with .01 significance are delimited. The selected faculties do not comprise the total faculties within any of the universities. Rather, they represent those faculties that enroll the majority of the students in the institution and are somewhat similar across institutions.

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[21]One should not conclude that lower salaries produce higher productivity. Rather, the Central American administrators would be well advised to determine why low paid instructors are highly productive in four institutions and higher salaried professors in the fifth.

TABLE 4.3--LEVEL OF EXPENDITURE CORRESPONDING TO HIGHEST EFFECTIVENESS (A/E) (By Selected Faculty)

University	Economics	Education	Pharmacy	Engineering	Dentistry	Medicine	Law
1	NS	NS	NS	NS	NS	NS	NS
2	NS	NS		NS	NS	NS	NS
3	NS	NS	NS	$251-500	NS	$1-250	NS
4	NS		NS		NS	NS	NS

NS = not significant at .05 level of confidence.

Significant relationships are observable in two of the selected faculties of university 3. The medical faculty did have the highest effectiveness ratio (A/E) when the level of expenditure was lowest (1-250 dollar equivalents). Engineering had the highest effectiveness ratio at cost level of $251-500. Based upon the selected faculty data, it appears unwise to hypothesize that the highest effectiveness ratio occurs in those classes that pay low salaries. The lack of significant data is a hindrance in this instance. To generalize from two selected faculties within one university is not logical. Therefore, it appears unwarranted to judge the utility of the generated hypothesis that low level of expenditure in salaries may yield high institutional effectiveness (A/E) in selected faculties.

Level of Expenditure and Effectiveness (A_1/E)

The relationship between institutional effectiveness (A_1/E) and level of expenditure is reproduced in Table 4.4.

TABLE 4.4--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A_1/E) BY LEVEL OF EXPENDITURE

	Institutional Effectiveness				
Cost	A_1/E University 1	A_1/E University 2	A_1/E University 3	A_1/E University 4	A_1/E University 5
$1-250	75.7%	86.8%	86.8%	91.0%	73.9%
$251-500	63.9	81.7	55.1	85.6	73.9
$501-750	63.1	82.6	49.9	71.2	71.2
$751-1000	66.7	79.3	45.9	62.3	77.8
$1001+	64.7	76.0	51.5	69.4	71.8
Chi Square Significance Level	.01	.01	.01	.01	NS

NS = not significant at .05 level of confidence

Universities 1, 2, 3, and 4 exhibit the pattern noted in A/E and level of expenditure in which the 1-250 dollar equivalent has the highest institutional effectiveness ratio.

The difference in percent between the highest effectiveness ratio and the second highest ratio ranges from a low of 5.1% in university 2 to 41.7% in university 3. Once again it appears unwarranted to state that patterned relationship exists beyond the fact that the lowest cost in instructional salary appears to yield the highest effectiveness ratio.

When level of expenditure and institutional effectiveness (A_1/E) relationships are reduced to selected faculties, two selected faculties in university 3 achieved the desired significance level and in both faculties (Engineering and Medicine), the $1-250 level of expenditure did correspond to

the highest effectiveness ratio as measured by A_1/E. However, the results observed in the small number of significant faculties would not appear to justify generating a hypothesis that relates level of expenditure and institutional effectiveness.

Conclusions and Qualifications Regarding Level of Expenditure and Institutional Effectiveness

Institutional effectiveness data (A/E and A_1/E), when spread by level of instructor salary, exhibit a fairly consistent pattern. With the exception of university 5, (A/E) and University 5 (A_1/E), the lowest cost in dollar equivalents of $1-250 provided the highest institutional effectiveness ratios. However, when these data were further divided into selected faculties, this pattern was not evidenced in sufficient number to warrant hypothesis generation.

A possible explanation for this apparent inconsistency may lie in the fact that the selected faculties do not represent the entire faculty of any university. However, the faculties selected were those with sizeable enrollments and a fairly extensive curriculum offering. It might thereby be possible that the minor fields of study may have a higher ratio of institutional effectiveness because of smaller classes while lower salaries are paid to the professors because of the small student demand. An analysis of all faculties in an institution would provide additional evidence for this inconsistency. Consequently, there is no conclusively established relationship between level of expenditure and institutional effectiveness measures (A/E and A_1/E).

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Class Size and Institutional Effectiveness

To examine the relationship between class size and institutional effectiveness (A/E and A_1/E), the data were divided for each university and for selected faculties within each university. It is possible within certain limitations to control class sizes. Therefore, it would appear desirable for administrators to consider changes that may increase institutional effectiveness. As a result, class sizes of 1-29, 30-109, and 110+ were analyzed to ascertain which class sizes may be deemed to be most effective.

Data Analysis by University

Each university exhibited a relationship between class size and institutional effectiveness. In Table 4.5, institutional effectiveness may be seen to decrease as class size increases.

TABLE 4.5--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A/E and A_1/E) BY CLASS SIZE

Class Size	1 University A/E	A_1/E	2 University A/E	A_1/E	3 University A/E	A_1/E	4 Univerisity A/E	A_1/E	5 University A/E	$A_1/$
1-29	76.9%	72.7%	90.1%	87.7%	71.8%	65.5%	85.0%	82.6%	87.4%	78.
30-109	60.3	54.3	80.5	72.7	53.1	40.3	74.2	69.1	73.0	60.
110+	38.7	32.3	25.5	25.5	35.5	29.5	50.7	45.5	*	*

*No classes taught in this class size category.

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Regardless of the university or the measure of institutional effectiveness, the pattern is consistent. The smallest difference between adjacent categories is 9.6 percentage points between class size 1-29 and 30-109 in university 2. This indicates that there is an expected ten percent drop in institutional effectiveness as class size increases. And, the smallest difference between the smallest class size and the largest class size in any university occurs in university 5 where there is an average difference of 14.4 percentage points, and these categories are adjacent. The pattern is clearly established that the smaller class sizes exhibit higher institutional effectiveness.

Data Analysis by Selected Faculty

The full measure of the relationship between class size and institutional effectiveness must be viable within faculties in order to have optimum utility. Some variation in the pattern may be observed in Table 4.6.

TABLE 4.6---INSTITUTIONAL EFFECTIVENESS (A/E) AND CLASS SIZE (By Selected Faculty)

	University 1	University 2	University 3	University 4	University 5
Economics	30-109 is highest	.01	NS	NS	.01
Education	.05		NS		.01
Pharmacy	*		.01	NS	.01
Engineering	.01	.01	.01		
Dentistry		NS	.01		.05
Medicine		NS	30-109 is highest	NS	NS
Law	.01	A/E increases as class size decreases	.05	.01	A/E increases as class size increases

*An empty cell indicates that the university does not offer the curriculum or that all class sizes were concentrated in one class size.

NS = Not significant at .05.

.01 or .05 = Significance level and the noted pattern regarding class size.

In those selected faculties that exhibit significant Chi square values of .05 or .01 when paired with class size, four exceptions to the pattern exist. In Economics, university 1, the highest effectiveness ratio (A/E) corresponds to a class size of 30-109. In Law, university 2, and Law, university 5, effectiveness increases as class size increases. In Medicine, university 3, effectiveness is lowest in class sizes of 30-109. These differences in pattern suggest that caution must be exercised in concluding that a reduction in class sizes in all university curricula will increase effectiveness. In the

14 selected faculties that appear to follow the consistent pattern of decreasing effectiveness as class size increases, a reduction in class size may be warranted.

Conclusions and Qualifications Regarding Class Size and Institutional Effectiveness

These data appear to present a number of alternatives for Central American administrators. Of course, the limitations of financial resources and class space will impose restrictions upon the generated hypothesis, but it appears that a reduction in class sizes will increase institutional effectiveness in most faculties. If, for example, in university 3, class sizes of 30-109 were reduced to less than 29, the average institutional effectiveness would be expected to increase 16%. The resultant increase would also tend to decrease the number of students that would be repeating classes and taking up class space in the future.

To be specific, suppose that a class in a faculty in university 3 that exhibits the noted pattern is reduced from 100 students to four classes of 25 students. In the larger class the expected effectiveness (A/E) value was 53.1%. But in a class of 25, the A/E ratio is 71.8%, so 18.7% of the students could be expected to pass that would not have done so previously in the larger class. An 18.7% increase in institutional effectiveness could go far toward increasing the absolute numbers of graduates while hastening the completion

of programs and reducing the number of students repeating classes. This example illustrates that a reduction in class size can increase institutional effectiveness. To reduce class size, however, may incur substantial increases in required levels of expenditure. When class size reduction can be coupled with a favorable salary commitment, however, increased productivity may become feasible as well as desirable.

Level of Instruction and Effectiveness

Relationships between institutional effectiveness (A/E) and the level of instruction at which classes are offered are presented in Table 4.7. First and second year courses are combined, third and fourth year courses form a second combination, and level 5, 6, 7, and 8 form the third category of level of instruction.

TABLE 4.7--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A/E) BY LEVEL OF INSTRUCTION

Level of Instruction	University 1 A/E	University 2 A/E	University 3 A/E	University 4 A/E	University 5 A/E
1 and 2	61.1%	85.0%	43.5%	80.2%	75.4%
3 and 4	80.5	89.8	65.8	80.2	86.4
5 - 8	82.6	87.7	81.1	84.1	92.5
Chi Square Significance Level	.01 - .01		.01	NS	.01

NS = Not significant at .05.

In universities 1, 3 and 5, effectiveness increases at each successive level of instruction. Moreover, the difference in effectiveness between level (1 and 2) and level (3 and 4) is greater than the difference between (3 and 4) and (5-8).

If levels (1 and 2) are considered as "lower division" courses, while levels (3 and 4) are considered as "upper division" courses, it can be stated that institutional effectiveness (A/E) increases greatly at upper division levels. In university 3, for example, it can be observed that institutional effectiveness is 22.3% higher in the upper division than in the lower division, and in university 1 institutional effectiveness has increased 19.4% at the upper division. If levels (5-8) are considered "graduate level" courses, it appears that graduate level courses are slightly more effective than upper division courses, but the difference between graduate level of effectiveness and that of upper division work is not as great as the differences between lower and upper division courses.

Data Analysis by Selected Faculty

When the preceeding data were divided into selected faculties, a variety of patterns were revealed. Institutional effectiveness was greater at each successive level of instruction in:

University 1	University 2	University 3	University 4	University 5
Law		Law	Law	
Engineering	Engineering	Engineering		
Economics			Economics	Economics
	Medicine	Medicine		Medicine
		Dentistry		Dentistry
		Pharmacy		Pharmacy

Exceptions to the pattern are noted. In Education, university 1, institutional effectiveness (A/E) decreases at each successive level of instruction. In Economics and Dentistry, university 2, Economics, university 3, and Law, university 5, the institutional effectiveness average in levels (3 and 4) exceed graduate division effectiveness. In Dentistry, university 4, upper division institutional effectiveness is lower than that of both lower division and graduate division courses.

Level of Instruction and Effectiveness (A_1/E)

Effectiveness (A_1/E) and level of instruction appear to exhibit the same pattern noted in (A/E) effectiveness and level of instruction when data are distributed by university. University 4 is the only university that did not achieve a .05 level of significance. In universities 1, 2, 3 and 5 at each successive level of instruction effectiveness (A_1/E) increases. Specific increases are exemplified in Table 4.8.

TABLE 4.8--PERCENT OF EFFECTIVENESS (A_1/E) BY LEVEL OF INSTRUCTION

Level of Instruction	University 1 A_1/E	University 2 A_1/E	University 3 A_1/E	University 4 A_1/E	University 5 A_1/E
1 and 2	55.9%	80.2%	36.3%	78.7%	63.1%
3 and 4	75.1	85.3	50.7	75.1	76.3
5 - 8	79.0	85.9	73.6	79.0	87.7
Significance Level	.01	.01	.01	NS at .05	.01

The greatest difference in effectiveness is observed between the lower division courses and other divisions. The greatest difference occurs in university 3 where a lower division average effectiveness of 36.3% is compared to the 50.7% average noted in the upper division. The graduate division in university 3 is more than twice as effective as the lower division (1 and 2).

Data Analysis by Selected Faculty

All five universities exhibit significant relationships when data are divided into selected faculties. Those faculties that achieved significant Chi square values of .05 are noted in Table 4.9.

TABLE 4.9--PERCENT OF EFFECTIVENESS (A_1/E) BY LEVEL OF INSTRUCTION

University		Levels (1 & 2)	Levels (3 & 4)	Levels (5-8)
1	Education	84.4%	69.1%	*
	Engineering	49.5	65.5	76.3%
	Law	45.5	65.5	82.0
	Economics	40.7	67.0	76.9
2	Medicine	78.4	79.3	92.5
	Dentistry	69.7	87.1	95.5
	Engineering	75.5	83.5	90.4
	Economics	52.7	85.6	61.1
3	Pharmacy	25.5	38.7	77.8
	Medicine	44.3	54.7	85.9
	Dentistry	30.7	53.1	70.9
	Engineering	34.3	37.1	73.6
4	Economics	44.3	55.5	95.5
	Dentistry	95.5	63.1	95.5
	Law	60.7	74.5	83.5
5	Law	32.3	70.6	73.0
	Dentistry	59.5	71.5	95.5
	Pharmacy	58.7	78.4	95.5
	Economics	43.9	73.9	95.5

*No classes offered at this level.

Of particular importance are the mean differences observable in university 3. Each faculty in university 3 evidences large differences in effectiveness percentage between undergraduate and graduate level courses. There is at least a 17.8% difference between these divisions in this university. The consistency of low effectiveness in each selected faculty may indicate a university policy regarding the passing of stu-

dents in undergraduate programs.[22]

Exceptions to the pattern of increasing effectiveness as the level of instruction increases are noted in Education, university 1, Economics, university 2, and Dentistry, university 4. In university 1, Education, effectiveness declines in the upper division. University 2, Economics tends to differentiate students in the graduate division more rigorously than noted elsewhere as the effectiveness average declines 24.5% from upper division courses. Dentistry, university 4--as the course of study becomes increasingly clinical--appears to fail more students in the upper division than in any other level.

Conclusions and Qualifications Regarding Effectiveness and Level of Instruction

The overall conclusion that must be derived from the data is the mean effectiveness of the class increases at successive levels of instruction. Selected faculty data on both measures of effectiveness (A/E and A_1/E) illustrate the same pattern.

Within this pattern, there is a pertinent question that can be raised. University 3, selected faculty data indicate that undergraduate courses are much less effective than graduate courses. Does this indicate a difference in grading philo-

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[22]It is possible that undergraduates as a group are less able to meet university standards. Those that pass on to upper and graduate level courses have proven that they can meet the standards and hence their success rate as a group increases. The number of full time students at upper division levels may also be greater than at undergraduate levels.

sophy for graduate students, or have most of the incapable students been eliminated in undergraduate courses? If this pattern is continued in university 3, it becomes apparent that few students will have completed degree programs without retaking more than half of their undergraduate courses. A serious review of factors affecting the low effectiveness rate of undergraduate courses seems warranted in this university.

Exceptions to the noted pattern also foster a significant question. Economics, university 2, appears to differentiate the upper division from the graduate division. It appears that the graduate division is not passing students at a rate comparable to the upper division. Does this indicate a difference in the degree of difficulty of graduate work or is this faculty one in which those students that successfully complete undergraduate studies are not really prepared? If this be the case, it would appear that undergraduate instruction must be upgraded to better qualify students to complete their graduate level studies successfully.

Data Analysis of Method of Instruction and Effectiveness (A/E) by University

The method of instruction varies with the content of a course. Science courses, for example, may require laboratory periods as well as lecture sessions. Other courses may be limited inclusively to lecture, or seminar method. In medicine, for example, certain courses may be entirely laboratory practicum,

or clinical in nature. Three types of instruction are delineated in this analysis. Lecture and seminar courses are treated as a common type;[23] laboratory, practice and clinical courses are a second type, and the third type of instruction is a combination of lecture and laboratory methods.

An analysis of institutional effectiveness (A/E and A_1/E) and methods of instruction by university indicate that only in university 1 is there exhibited a significant relationship between institutional effectiveness and method of instruction. As noted in Table 4.10, laboratory courses appear to be the most effective. Lecture courses tend to be the next most effective, and combination (lecture-laboratory) courses, the least effective in this university

TABLE 4.10--PERCENT OF EFFECTIVENESS BY METHOD OF INSTRUCTION

	University 1	
Method of Instruction	A/E	A_1/E
Lecture	68.5%	63.5%
Combination	68.5	62.7
Laboratory	87.4	86.2

[23]Although this grouping of apparently dissimilar instructional methods may offend the American educator, the actual classroom behavior of instructors in lecture and seminar courses does not vary materially. The lecture method is the common instructional mode. Seminars that involve substantial independent study and discussion by students are rare in the universities under study.

Data from one university does not appear to warrant generating a hypothesis regarding the relationship between institutional effectiveness and method of instruction. Four universities exhibit nonsignificant differences between methods of instruction and therefore hypothesis generation is withheld pending review of selected faculty data.

Data Analysis by Selected Faculty

Significant Chi square values are evidenced in seven selected faculties in the five universities, Table 4.11 . The noted pattern of laboratory courses being the most effective method of instruction is evidenced in all but the Faculty of Pharmacy, university 4, in which lecture courses are 30% more effective than laboratory courses.

TABLE 4.11--PERCENT OF EFFECTIVENESS BY METHOD OF INSTRUCTION

University		Lecture	Combination	Laboratory
		Percent of A/E by Instructional Method		
1	Education	76.0%	81.1%	90.1%
	Economics	76.0	41.5	95.5
3	Engineering	61.1	37.1	67.9
	Medicine	70.6	83.2	95.5
		Percent of A_1/E by Instructional Method		
1	Education	73.6%	79.9%	90.1%
	Economics	68.5	41.5	95.5
3	Law	27.1	38.7	*
	Engineering	53.1	31.5	55.5
	Medicine	53.9	74.2	95.5
	Economics	66.7	35.5	*
4	Pharmacy	95.5	75.1	65.5

* No courses offered in this category.

Combination courses present an inconsistent pattern from the lowest effectiveness in Economics, university 1, and Engineering, university 3, to the highest effectiveness in Law, university 3. Lecture courses exhibit the highest effectiveness (A_1/E) in Economics, university 3, and Pharmacy, university 4.

Conclusions Regarding Method of Instruction and Effectiveness

Based upon the selected faculty data, it appears possible to hypothesize that the method of instruction is related to institutional effectiveness. Laboratory courses exhibit the highest effectiveness, and it would be expected that this pattern would continue in most faculties. This pattern is not without variation however, and caution should be exercised before deciding that the hypothesis is congruent with practices in a particular selected faculty. Moreover, laboratory classes may tend to be offered at upper division levels and enroll fewer students. Hence, the observed relationship between method of instruction and effectiveness may be an artifical relationship.

Contact Hours (HxE) and Effectiveness by University

Contact hours (HxE) represent the hours of instruction multiplied by the number of students enrolled in a course. Contact hours is a crude measure of instructor load in a course. and also a rough measure of the amount of interaction that the instructor may actually experience with class members. An

instructor in Central America may only teach a portion of the class periods allotted to a class and this ratio tends to allow for this practice.

Data spread by institutional effectiveness (A/E and A_1/E) and contact hours by university indicate the presence of a consistent pattern (Table 4.12). All universities exhibit a decrease in effectiveness as contact hours increase. At a given point in each university, the effectiveness percentage tends to drop more rapidly than previously noted.

TABLE 4.12--PERCENT OF EFFECTIVENESS BY NUMBER OF CONTACT HOURS

		Percent of A/E and Contact Hours				
HxE*	University 1	HxE	University 2	University 3	University 4	University 5
1-1000	80.8%	1-500	89.5%	69.1%	93.1%	84.4%
1001-2500	74.2	501-1000	91.0	72.7	88.3	88.6
2501-5000	59.5	1001-2500	87.7	71.2	77.5	86.5
5001+	58.3	2501-5500	81.4	53.1	72.1	75.4
		5501+	71.2	45.1	64.7	74.5
		Percent of A_1/E and Contact Hours				
1-1000	78.8	1-500	88.0	63.9	92.8	81.4
1001-2500	70.0	501-1000	88.6	66.1	85.9	80.2
2501-5000	53.5	1001-2500	82.3	61.5	73.3	75.4
5001+	49.1	2501-5500	73.6	42.7	66.4	66.7
		5501+	63.5	33.5	58.7	61.5

*In university 1, the categories of contact hours differ from the other universities. The distribution of contact hours in university 1 tended to be grouped heavily toward the middle categories leaving an inadequate number of classes at either extreme. To eliminate a Chi square value that was distorted by a small number of classes falling into the extreme categories, four groupings are employed in university 1, instead of five.

In university 1 the rapid decrease in instructor effectiveness occurs between 1001-2500 and 2501-5000 contact hours. In universities 2, 3 and 5, effectiveness ratios remain relatively stable before dropping rapidly beyond 2500 contact hours. The largest decrease in university 4 occurs beyond 1000 contact hours. The overall pattern for each university indicates a decrease in effectiveness as contact hours increase. Additionally, there appears to be a point in each university where the decrease in effectiveness accelerates as contact hours increase.

Contact Hours and Effectiveness by Selected Faculty

Fifteen selected faculties in the five universities exhibit significant relationships between effectiveness measures and contact hours. Percentages of effectiveness for these faculties are shown in Table 4.13.

TABLE 4.13--PERCENT OF INSTITUTIONAL EFFECTIVENESS BY NUMBER OF CONTACT HOURS

	A/E					A_1/E				
HxE	1-1000	1001-2500	2501-500	5001+		1-1000	1001-2500	2501-500	5001+	
UNIVERSITY 1										
Dentistry	Not significant at .05-------					91.9%	93.1%	89.5%	25.5%	
Engineering	95.5%	89.5%	76.9%	48.3%		95.5	86.5	63.1	42.7	
Education	88.3	82.3	71.5	74.5		88.3	80.5	68.5	74.5	
HxE	1-500	501-1000	1001-2500	2501-5500	5501+	1-500	501-1000	1001-2500	2501-5500	5501+
UNIVERSITY 2										
Economics	*	75.4	84.4	73.0	59.9	*	75.4	82.9	59.5	53.9
Engineering	90.7	93.7	85.0	79.9	45.5	88.0	88.6	75.1	69.7	25.5
Dentistry	95.5	95.5	82.3	76.9	38.7	95.5	95.5	82.3	75.4	38.7
UNIVERSITY 3										
Engineering	79.3	65.5	36.7	25.5	*	70.6	53.1	29.1	25.5	*
Medicine	95.5	95.5	87.4	71.2	74.2	95.5	95.5	83.5	55.5	57.1
Pharmacy	65.5	68.8	53.1	42.3	29.5	57.9	62.7	53.1	38.7	25.5
UNIVERSITY 4										
Law	*	*	*	93.7	65.5	*	*	*	84.4	58.7
Dentistry	92.2	70.6	38.7	*	*	Not significant at .05----------				
Economics	*	76.3	74.8	55.5	41.5	Not significant at .05----------				
UNIVERSITY 5										
Economics	95.5	89.5	84.7	75.4	33.5	95.5	86.5	73.6	52.3	25.5
Education	86.8	91.0	89.2	65.5	*	80.5	78.1	65.5	52.3	*
Pharmacy	*	95.5	87.1	31.1	*	*	95.5	80.5	31.1	*

*No classes listed in this category

As contact hours increase, the effectiveness ratios decrease in the same manner as noted in the university data. There are a few irregularities in the selected faculty data. For example, effectiveness (A/E) in Engineering, university 2, increases from 90.7% to 93.7% before beginning a rapid descent to 45.5% when contact hours exceed 5501. However, these irregularities do not involve percentage differences large enough to note an exception to the pattern. In essence, the selected faculty data supports the pattern that as contact hours increase, effectiveness (A/E or A_1/E) decreases.

Conclusions and Qualifications Regarding Effectiveness and Contact Hours

The relationship between effectiveness measures and contact hours warrants the generation of the hypothesis that: as contact hours increase, effectiveness ratios decrease. Also, when contact hours exceed 2500, effectiveness will decrease rapidly. It appears that a "breaking point" in effectiveness is reached at 2500 contact hours.

In questioning the cause of this "breaking point," the answer may lie in either the number of hours of instruction offered in the course, or in class sizes. The generated hypothesis between class size and effectiveness would appear to supply part of the answer, because hours of instruction tend to be somewhat standardized by selected faculties in most universities. For example, 48 hours of instruction might represent the standard number of hours of instruction for a

faculty. With standarized hours of instruction, it appears that the class size hypothesis may be reflected in the contact hour data: That as class size increases, the percentage of effectiveness declines.

The possibility does exist that an instructor teaching one or two class periods is responsible for passing students. If this be the case, it would appear from the data that these instructors evaluate more rigorously as their contact with the class increases. This may indicate that instructors evaluating with little contact have little interest in the evaluation process. Either possibility can be supported in the data.

Number of Classes Taught and Institutional Effectiveness

In an academic year a faculty member may be called upon to teach a number of classes. In Central America the total number of courses for which an instructor is responsible may vary from one to fifteen classes in an academic year. By combining the institutional effectiveness ratios for all instructors teaching the same number of classes, it is possible to determine the institutional effectiveness ratio for the number of classes taught. These classes were then grouped to form three categories: 1-4 classes taught, 5-8 classes taught, 9-15 classes taught. By comparing the standard deviations and mean scores for each group of classes, it is possible to determine if any relationship exists between institutional effectiveness and the number of classes

taught by an instructor in a calendar year.

Table 4.14 represents the mean scores of institutional effectiveness (A/E and A_1/E) for each university in each level of classes taught by a professor. At first glance, it appears that there are differences between institutional effectiveness and the number of classes taught by a professor.

TABLE 4.14--PERCENT OF INSTITUTIONAL EFFECTIVENESS (A/E and A_1/E) BY NUMBER OF CLASSES TAUGHT

Classes Taught	University 1	University 2	University 3	University 4	University 5
			Percent of A/E		
1-4	72.4%	92.1%	65.1%	78.7%	84.0%
5-8	65.8	95.4	57.6	84.6	82.2
9-15	74.8	91.8	72.0	97.4	70.9
University Mean	70.6%	92.8%	62.9%	82.6%	83.4%
			Percent of A_1/E		
1-4	66.4%	81.1%	55.4%	71.2%	72.9%
5-8	59.9	85.2	46.0	83.0	73.0
9-15	68.1	83.5	63.6	97.3	58.0
University Mean	64.6%	83.3%	52.5%	79.1%	72.4%

If teaching 1-4 classes in an academic year is considered a "light" teaching load, 5-8 as a "moderate" load, and more than nine courses a "heavy" load, it appears that the means scores differ with the number of classes taught by a professor. However, in most universities, those means that differ greatly from the university mean are based on a small number of professors. For example, in University 5, (A_1/E), professors

teaching nine or more courses appear to be less effective than the university average. However, there is only one professor teaching more than nine courses in university 5. There are only seven professors teaching more than five courses in this university in a faculty of 181. The frequency of professors teaching each group of classes is noted in Table 4.15

TABLE 4.15--FREQUENCY DISTRIBUTION OF PROFESSORS BY NUMBER OF CLASSES TAUGHT

Classes Taught	University 1	University 2	University 3	University 4	University 5
1-4	299	318	275	168	173
5-8	50	43	31	15	7
9-15	9	4	5	4	1
Total	358	365	311	187	181

It is evident that the number of professors in each university that are teaching five or more classes is too small to warrant the generation of hypotheses about effectiveness and the number of classes taught by the professor. Of interest, however, is the fact that few professors in the five universities teach what would be considered to be full schedule of classes in an academic year. This supports the findings of Friedman in which most faculty members in Central America may be employed in another position outside of the university.[24] Few professors are engaged in research in Cen-

[24] op. cit., p. 22.

tral America and hence thus possibility does not account for low teaching loads.

Selected faculty data proves to be less conclusive than university data as the frequency distribution of faculty becomes so small as to be inappropriate for analysis. Therefore, no hypotheses can be generated from faculty data.

Conclusions and Qualifications Regarding Number of Classes Taught and Institutional Effectiveness

The distribution of faculty members teaching a number of classes is not sufficiently varied to permit the generation of a hypothesis regarding effectiveness and the number of classes taught by a professor. Most faculty in Central America teach between one and four classes per year, which indicates that one course per semester is closer to the rule than the exception for a professor in an academic year.

Summary

Institutional effectiveness (A/E) or (A_1/E) is clearly affected by certain administratively controllable factors within the central American universities and university faculties. In general, these conclusions seem warranted by the analysis:

1) Class size affects institutional effectiveness in ways that suggest that institutional effectiveness may be increased by planned reductions in large class sizes.

2) Instructor salary, in and of itself, is not generally a compelling factor in institutional effectiveness although it has been noted that professors receiving less than $250 for a class tend to be more productive. A systematic analysis of this pattern would appear warranted in the four universities in which this trend was evidenced. There is little selected faculty support, however.

3) Effectiveness increases at successive levels of instruction from lower to upper to graduate divisions. The self-selection process--rather than improved instruction--may account for this phenomenon.

4) Method of instruction is related to institutional effectiveness. In general, laboratory courses seem to be more productive than lecture courses. However, laboratory courses typically enroll few students at higher levels of instruction; hence, the generalization may need qualification.

5) The number of contact hours of a professor with a class seems to be related to effectiveness. The suggested pattern is a decrease in effectiveness as contact hours increase. This pattern may reflect the trend noted in class size for the hours of instruction in a faculty may be standardized.

6) The data surrounding effectiveness and the number of classes taught by a professor do not warrant hypothesis generation. The distribution of professors teaching a varied number of courses in each university is centered below four classes per academic year. Although 15 classes may be taught by a single professor, the frequency of these occurences does not warrant a statement of a relationship with effectiveness.

CHAPTER V

FACTORS RELATED TO INSTITUTIONAL EFFICIENCY

In Chapter 4, the six administratively controllable factors were related to measures of institutional effectiveness (A/E and A_1/E). The purpose of this chapter is to examine the relationship between the six factors and institutional efficiency. Institutional efficiency was defined in Chapter 1, as a measure of the maximization of input divided by output in the form of examinees (ex) divided by enrollees (E). The significance of institutional efficiency stems from the fact that the successful student (A) must come from the number of examined students (Ex). Therefore, a maximization of institutional efficiency will increase the input necessary to produce successful students.

Two measures of institutional efficiency were employed. First, (Ex/E) in which (Ex) represents all students that were examined and (E) represents the total class enrollment. Second, (Ex_1/E) in which (Ex_1) represents students who presented themselves for examination at the earliest opportunity, usually at the immediate conclusion of the course.

Using Chi square and mean comparisons, it was possible to determine the relationships between measures of institutional efficiency (Ex/E and Ex_1/E) and the factors that were delineated in the previous analysis of institutional effectiveness. Data are presented by university and also by selected faculty within each university.

Level of Expenditure and Institutional Efficiency (Ex/E & Ex_1/E)

An analysis of institutional efficiency (Ex/E & Ex_1/E) and level of expenditure data reveals that the highest measures of institutional efficiency in all universities are evidenced when salaries paid to the instructor are less than $250 dollar equivalents. Table 5.1 summarizes the highest institutional efficiency ratio in terms of dollar equivalent categories.

TABLE 5.1--LEVEL OF EXPENDITURE DISPLAYING HIGHEST INSTITUTIONAL EFFICIENCY

University	Highest Ex/E	Highest Ex_1/E
1	$ 1-250	$ 1-250
2	NS	NS
3	1-250	1-250
4	1-250	1-250
5	NS	NS

NS = Not significant at .05 level of confidence

Inspite of the evidence that all universities with significant Chi square values achieve the most institutional efficiency (Ex/E and Ex_1/E) when salaries paid to the grading instructor are lowest, selected faculty data (Table 5.2) does not exhibit this pattern with enough frequency to warrant the generation of a hypothesis. In university 1, the faculties of Medicine and Economics appear to follow the noted pattern. In university 3, faculties violate the pattern more often than not. Law, university 5, does not adhere to the pattern whatsoever. These faculties are the only faculties in which a significant Chi square value

was determined. The level of expenditure that corresponded to highest institutional efficiency is noted.

TABLE 5.2--LEVEL OF EXPENDITURE DISPLAYING HIGHEST INSTITUTIONAL EFFICIENCY (Selected Faculty)

University		Highest Ex/E	Highest Ex_1/E
1	Medicine	$1-250	$1-250
1	Economics	1-250	1-250
3	Engineering	251-500	251-500
3	Dentistry	NS	251-500
3	Medicine	NS	1-250
5	Law	251-500	NS

NS = Not significant at .05 level of confidence

Conclusions and Qualifications Regarding Institutional Efficiency and Level of Expenditure

Based upon the analysis of university and selected faculty data, there is no conclusive relationship between level of expenditure and institutional efficiency. The pattern evidenced in university data that low expenditure yields high institutional efficiency is not supported in the faculty data to an extent that justifies hypothesis generation.

In the previous chapter the possibility was put forward that "practitioners" from the surrounding community may be affecting the effectiveness ratios. The possibility may exist that these people are also causing a distortion in the institutional efficiency data. If these practitioners are not committed

to evaluation, they may be affecting the effectiveness and efficiency ratio by following a pattern far different from the academician. If these practitioners are paid at a reduced rate, the indication would be exhibited in the university data. Within a faculty, their efficiency ratio may not be great enough to effect a significant Chi square value. However, as a collectivity in the university, these people might exhibit the noted pattern. It is possible that this is the explanation for the pattern in the university data whereby low level of expenditure results in high institutional efficiency.

Class Size and Institutional Efficiency

The relationship between institutional efficiency (Ex/E and Ex_1/E) and class size are examined by dividing data for each university and selected faculty within each university. It is administratively feasible for class size to be controlled and, therefore, evident relationships will enable Central American administrators to alter class sizes in accordance with standards of desired efficiency. Institutional efficiency was examined by categories of class sizes of 1-29, 30-109, and 110+, to determine which, if any, class sizes may be useful in maximizing efficiency.

Data Analysis by University

The analysis of class size data by university suggested that there is a consistent pattern throughout the five universities.

Without exception, as class size increases, institutional efficiency (Ex/E and Ex_1/E) decreases. The patterns are illustrated in Table 5.3.

TABLE 5.3--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E) BY CLASS SIZE

Class Size	University 1	University 2	University 3	University 4	University 5
			Ex/E		
1-29	85.6%	91.0%	78.7%	90.1%	92.5%
30-109	76.6	88.6	78.1	83.8	86.5
110+	75.4	25.5	69.4	65.5	*
			Ex_1/E		
1-29	80.8%	90.7%	72.1%	88.3%	85.6%
30-109	67.9	86.5	59.9	79.6	77.8
110+	58.7	25.5	37.9	55.5	*

*No classes offered in this category.

An illustration of the pattern occurs in university 1. When class size is 1-29, institutional efficiency (Ex/E) averages 85.6%. It is, thereby, expected that 85.6% of all students enrolled in classes with less than 29 students will present themselves for examination. In a class with 30 through 109, the expected percentage of those presenting themselves for examination is 76.6%. This difference represents a loss of 9.0% as class size increases.

Institutional efficiency as measured by (Ex_1/E) declines at a more rapid rate than (Ex/E) in all universities. The

indication is: As class size increases, the percent of students presenting themselves for examination at the earliest opportunity (Ex_1) declines rapidly. Subsequent enrollments in these courses may, thereby, be swelled by previously unexamined students. In university 3, average institutional efficiency (Ex_1/E) decreases from 72.1% in classes of less than 29 students to 37.9% where class size exceeds 110. This small percentage in large classes may result from massive nonattendance,[25] previously unexamined repeaters, or both. As evidenced in university 3, students being examined at a later time or being re-examined in classes of 110 is 31.5% of the total examinee percentage.

Data Analysis by Selected Faculty

The relationship between institutional efficiency and class size by faculty is presented in Table 5.4. It is evident from the analysis of these data that not all selected faculties follow the university pattern of decreasing institutional efficiency as class size increases. Five selected faculties deviated from the noted pattern. Economics and Law, university 2, established that as class size increases, institutional efficiency (Ex_1/E) is concerned. This poses the possibility that

[25]The arbitrary practice of considering each matriculant as a full time student when in fact, less than 30% may legitimately be considered full time, may account for nonattendance.

TABLE 5.4--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E) BY CLASS SIZE (By Selected Faculty)

	Ex/E				
	University 1	University 2	University 3	University 4	University 5
Economics	NS	As class size increases, efficiency increases	30-109 is highest	NS	NS
Education	NS		As class size increases, efficiency increases		.01
Pharmacy			NS	NS	.01
Engineering	.01	NS	.01		
Dentistry		.05	.01		NS
Medicine		NS	30-109 is highest	NS	NS
Law	NS	As class size increases, efficiency increases	.01	.01	NS
	Ex_1/E				
Economics	NS	.01	.01	NS	.01
Education	.05		As class size increases, efficiency increases		.01
Pharmacy			.05	NS	.01
Engineering	.05	.01	.05		
Dentistry		NS	.01		NS
Medicine		NS	30-109 is highest	.05	NS
Law	NS	As class size increases, efficiency increases	NS	.01	NS

Blank space = Not offered or only 1 class size
NS = Not significant at .05
.01 or .05 = Significance level and regular pattern

there were large classes of students repeating courses in this faculty. The percentage of students presenting themselves for examination after repeating or auditing a class in these large classes was very high in comparison to the smaller class sizes. However, the percentage of students being examined for the first time followed the more normal pattern of decreased institutional efficiency as class size increases.

The Economics and Medical faculties in university 3 maintained highest institutional efficiency (Ex/E) in class sizes of 30-109. However, the faculty of Economics maintained the expected pattern with regard to institutional efficiency (Ex_1/E). Again the possibility is posed that medium sized classes of students repeating or auditing courses were established, and a larger percentage of these students were examined than might normally be expected.

Conclusions and Qualifications Regarding Class Size and Institutional Efficiency

The similarity evidenced in many selected faculties warrants the generation of the hypothesis: As class size increases, institutional efficiency (Ex/E and Ex_1/E) decreases. Pattern inconsistencies suggest that this hypothesis warrants application only in those selected faculties that appear to follow the pattern. It would appear, therefore, that this hypothesis has administrative application for at least fifteen faculties in the five universities. Class sizes of one through 29 are deemed

to be more efficient than larger classes. Class sizes between 30-109 are more efficient than classes larger than 110. If increased institutional efficiency (Ex/E and Ex_1/E) is sought, a reduction in class size within the stated categories would appear to achieve the desired objective.

Level of Instruction and Institutional Efficiency

Level of instruction refers to the academic year in which a class is normally taken in a student's curriculum. Three levels of instruction were delineated by examination of data. Years (1 and 2) forms one level, years (3 and 4) another, and years (5-8) form the third group. As indicated in Table 5.5, data from universities 2 and 4 were not significant at the .05 level of confidence.

TABLE 5.5--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E) BY LEVEL OF INSTRUCTION

Level	University 1	University 2	University 3	University 4	University 5
	Ex/E				
(1 and 2)	78.7%	89.2%	73.6%	87.1%	87.7%
(3 and 4)	86.2	91.9	82.3	87.4	91.9
(5-8)	86.2	89.8	87.7	89.5	95.2
Significance Level	.01	NS	.01	NS	.01
	Ex1/E				
(1 and 2)	69.7%	88.3%	53.9%	85.9%	77.5%
(3 and 4)	82.9	90.7	67.0	82.9	85.6
(5-8)	83.2	89.8	79.6	85.0	91.3
Significance Level	.01	NS	.01	NS	.01

NS = Not significant at .05

The data in the preceeding table indicate institutional efficiency (Ex/E and Ex_1/E) increases at each successive level. The pattern is without exception in universities 1, 3, and 5. In university 1, as an illustration, institutional efficiency (Ex_1/E) in first and second year courses averages 69.7%. In third and fourth year courses this percentage has increases to 82.9% and subsequently to 82.3% in years 5-8.

The presence of this pattern tends to indicate that either students at higher levels are not subject to attrition at the same rate as at lower levels, or the enrollments are not inflated with part time students to the extent as in lower levels. The likelihood of attrition differences does not appear great because a student does not normally "flunk out" in a Central American university. Instead, a course may be repeated or audited to prepare for re-examination. If attrition rates do vary during a term with the level of the course, it would appear that some factor other than the six under investigation are causing this phenomena.

If students at higher instructional levels are predominately full time students, would not institutional efficiency differences between high and low levels of instruction actually reflect a loss in part time students? In essence, is it possible that institutional efficiency differences are measuring the extent of part time students in the university? If this be true, real differences between institutional efficiency with respect to full time students may not be extent. Since the full time student is most likely to be coveted it appears that Central American administrators would desire to ascertain if university

differences are real or artificial before recommending changes that may imbalance a functioning system.

Data Analysis by Selected Faculty

The analysis of selected faculty data (Table 5.7) by university indicates that the noted pattern in university data is evidenced. Of the 20 faculties in which relationships proved to be significant, only six exhibited patterns that were contrary to the previously noted pattern of increasing institutional efficiency as level of instruction increased.

In Education, university 1 and education, university 2, both measures of institutional efficiency decreased at successive levels of instruction. Institutional efficiency decreased in Medicine, university 2, from levels (1 and 2) to (3 and 4). Levels (5-8) exceeded all other levels in institutional efficiency. This would seem to indicate that if a student can reach years (5-8) in the medical curriculum, the probability of being examined is greater than at earlier levels in his education. The same pattern is evidenced in Dentistry, university 4, and Dentistry, university 5. The efficiency measures of Economics, university 2, appear to differentiate third and fourth year students from (5-8 year students. The institutional efficiency (Ex/E) percentage decreases 27.8% on the average from 3 and 4 level courses to the (5-8) level courses. If (5-8) level courses are assumed to be graduate level courses, it appears that the Economics faculty may differentiate heavily those who should be examined out of those enrolled at the graduate level.

TABLE 5.6--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E) BY LEVEL OF INSTRUCTION
(By selected Faculty)

	Ex/E			Ex_1/E		
	Level			Level		
	1 and 2	3 and 4	5-8	1 and 2	3 and 4	5-8
UNIVERSITY 1						
Education	93.1%	72.4%	none	90.7%	71.2%	none
Engineering		not significant		49.5	79.6	84.7%
Law	41.5	77.5	84.7%		not significant	
UNIVERSITY 2						
Economics	65.5	88.9	61.6	73.0	90.4	61.1
Medicine		not significant		87.7	81.7	94.0
Dentistry	81.1	94.0	95.5	82.6	94.0	95.5
Engineering		not significant		89.8	92.2	93.4
Education	95.5	92.2	65.5	95.5	92.2	65.5
UNIVERSITY 3						
Economics		not significant		70.3	82.3	83.5
Pharmacy	61.1	64.3	82.6	38.3	52.3	79.9
Medicine	81.4	84.7	91.3	70.3	70.9	88.3
Law	57.1	73.6	90.4		not significant	
Engineering	74.5	86.2	91.9	52.3	61.5	82.9
UNIVERSITY 4						
Economics	58.3	83.5	95.5	53.9	70.0	95.5
Dentistry	95.5	74.8	95.5	95.5	74.8	95.5
Law	84.4	92.5	95.5		not significant	
UNIVERSITY 5						
Economics		not significant		72.4	85.6	95.5
Pharmacy	73.0	89.2	95.5	58.7	78.4	95.5
Dentistry		not significant		81.7	73.6	95.5
Law	70.6	95.5	95.5	65.5	95.5	76.9

The varying patterns noted in institutional efficiency in the faculty data in universities 2 and 4 would dispell the possibility that a university policy regarding institutional efficiency is operating. The diverse patterns evidenced increase the probability that nonsignificance was the result of normal distribution. If there had not been a significant pattern evidenced in faculty data for these institutions, it would have been possible to speculate that a policy of examining students was in operation.

Conclusions and Qualifications Regarding Institutional Efficiency and Level of Instruction

The analysis of data by university and faculty justify the generation of the hypothesis that as the level of instruction increases, institutional efficiency increases. This hypothesis is supported by 70% of the selected faculties that exhibit significant Chi square values. The fact that varying patterns are evidenced cannot be overlooked. It does appear that varying patterns are apt to occur in the education and dentistry faculties. This variation may be the result of specialized content in these courses and may result in the generation of a separate hypothesis to cover the exigencies of these faculties.

Method of Instruction and Institutional Efficiency

The methods of instruction considered in this chapter are (1) lecture and seminar, (2) laboratory, practicum and clinic,

and (3) a combination of lecture and laboratory. The relationship between these three methods of instruction and measures of institutional efficiency (Ex/E and Ex_1/E) are examined by university and also by selected faculty. No attempt is made to control any other factor in this analysis and, therefore, data represent the summation of all courses utilizing a particular method of instruction.

Data Analysis by University

An analysis of data indicates that universities 1 and 3 are the only institutions in which a .05 level of significance was observed. Universities 2 and 4 and 5, did not exhibit differences that warranted a .05 level of significance. Therefore, universities 1 and 3 are the only institutions utilized in this analysis as evidenced in Table 5.7.

TABLE 5.7--PERCENT OF INSTITUTIONAL EFFICIENCY BY METHOD OF INSTRUCTION

	Ex/E		Ex_1/E	
	University 1	University 3	University 1	University 3
Lecture	79.3%	75.1%	73.3%	63.9%
Combination	84.7	81.7	75.1	67.3
Laboratory	90.1	81.7	88.3	74.5

The preceeding table indicates that both measures of institutional efficiency are highest in courses that are taught by the laboratory method which is consistent with institutional effectiveness data in Chapter 4. The second

most efficient method of instruction is the combination of lecture-laboratory instruction. Pure lecture courses have the lowest average of institutional efficiency. This is contrary to the results reported in Chapter 4 for institutional effectiveness in which lecture courses were the second most effective method of instruction.

It is possible to question the pattern in which the laboratory method appears to retain a greater portion of those enrolled. Is it possible that little teacher-pupil instruction actually occurs in laboratory courses and that the greater the self-discovery of the student provides greater motivation to continue with this type of course? Is it also possible that this method of instruction is more conducive to continuance because of the technical nature of laboratory curricula? By administering a questionnaire to laboratory students to ascertain student motivation in various classes, this pattern may be elucidated more clearly.

Data Analysis by Selected Faculty

Five selected faculties in the five universities exhibit significant relationships between efficiency and method of instruction (Table 5.8). Partial explanation for the small numbers of faculties may be inherent in the fact that five faculties employ all three methods of instruction; 21 utilize two methods; and five employ one method. Most of the faculties that employ two methods are using one method almost exclusively

with only the occasional second method being employed. Therefore, the number of faculties evidencing significant relationships is necessarily restricted.

In Table 5.8 the faculties that exhibited a significant relationship between institutional efficiency (Ex/E and Ex_1/E) are shown. The faculties of Economics, university 1, medicine and Engineering, university 3, follow the pattern whereby laboratory classes are more efficient than other methods of instruction. Economics, university 3, does not teach pure laboratory courses; efficiency (Ex_1/E) of lecture classes in this faculty is 10.8% higher than in combination classes. Engineering, university 2, departs from the pattern. Both measures of institutional efficiency are highest in lecture courses.

TABLE 5.8--PERCENT OF INSTITUTIONAL EFFICIENCY BY METHOD OF INSTRUCTION (By Selected Faculty)

	Ex/E			Ex_1/E		
University	Lecture	Combination	Laboratory	Lecture	Combination	Laboratory
1 Economics	83.5%	53.5%	95.5%	80.5%	45.5%	95.5%
2 Engineering	93.4	89.5	91.9	91.9	88.0	91.3
3 Medicine	not significant .05			74.2	80.5	95.5
3 Economics	not significant .05			80.2	69.4	*
3 Engineering	85.3	75.1	89.2	69.4	49.9	74.2

*No laboratory classes taught

Conclusions and Qualifications Regarding Institutional Efficiency and Methods of Instruction

The significant data by university and faculty indicates that laboratory courses tend to exhibit the highest institutional efficiency. Lecture-laboratory combination courses are second in institutional efficiency and lecture courses are the least efficient. It appears that the limitations imposed by course content will limit the use of methods of instruction indiscriminately. Therefore, the administrative implications of this pattern do not appear to be extensive when viewed independently of other relationships.

Contact Hours and Institutional Efficiency

As mentioned in Chapter 4, contact hours are determined by multiplying the hours of formal instruction and the number of students enrolled in a course. The contact hour reflects the faculty load and may also serve as a rough measure of the degree of interaction that the instructor sustains with the class. The percent of institutional efficiency by number of contact hours by university is represented in Table 5.9.

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TABLE 5.9--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E & Ex_1/E) BY NUMBER OF CONTACT HOURS

Ex/E						
HxE	University 1	HxE	University 2	University 3	University 4	University 5
1-1000	86.2%	1-500	90.7%	71.8%	94.0%	91.9%
1001-2500	85.0	501-1000	91.3	81.4	91.3	94.3
2501-5000	77.5	1001-2500	92.2	85.0	86.5	91.9
5001+	74.5	2501-5500	87.7	78.1	83.8	84.4
		5501+	82.3	74.2	77.2	91.0
Significance Level	.01		.01	.01	.01	.01

Ex_1/E						
1-1000	83.2%	1-500	90.7%	67.6%	94.0%	85.6%
1001-2500	79.3	501-1000	91.0	74.2	88.9	89.8
2501-5000	67.9	1001-2500	90.4	73.9	82.9	83.2
5001+	65.8	2501-5500	86.2	86.2	78.6	77.2
		5501+	79.9	79.9	71.5	81.1
Significance Level	.01		.01	.01	.01	.01

The analysis of contact hours and institutional efficiency (Ex/E and Ex_1/E) by university did not uncover a consistent pattern. Universities 1 and 4 evidence a regular pattern in which institutional efficiency declines as the number of contact hours increase. University 3 exhibits a pyramidal effect. Highest efficiency occurs when contact hours are moderate, the decreases at the extremes. In university 2, institutional efficiency decreases irregularly as contact hours increase. University 5 exhibits no relationship between institutional efficiency and contact hours.

In Chapter 4, it was noted that as contact hours increase, institutional effectiveness decreases. The lack of pattern in institutional efficiency may indicate that the effect of increased contact hours may have more impact on the instructor's marking practices than it does on students presenting themselves for examination. In university 5, for example, the difference between highest and lowest institutional efficiency (Ex/E) percentage is 9.9 points. In university 4, the difference in high and low efficiency (Ex/E) is 16.8%. While the difference is more pronounced in institutional efficiency measure (Ex_1/E), the differences do not approach the 30-35 percentage point differences noted in institutional effectiveness (A/E).

If increased contact hours do in fact affect institutional effectiveness (A/E) to a greater extent than institutional efficiency (Ex/E), it appears that support is gained for a method to reduce contact hours by reducing class size. As class size declines, both institutional efficiency (Ex/E and Ex_1/E) and institutional effectiveness (A/E and A_1/E) increase. No hypothesis can be generated based upon the analysis of data by university, as no consistent pattern is noted. However, the small differences between the highest and lowest efficiency measures in each university suggest potentially useful applications for institutional effectiveness and contact hours.

Data Analysis by Selected Faculty

Selected faculty data are represented in Table 5.10 Sixteen faculties achieved the .05 significance level, with nine faculties evidencing one significant relationship with institutional efficiency, and seven faculties exhibit two significant measures.

The patterns are as varied in faculties as they were by university. In Engineering, university 1, there is a steady decline in institutional efficiency (Ex_1/E) as contact hours increase. Medicine, university 4, evidences an increase in institutional efficiency when contact hours are moderate and also when contact hours are high.

TABLE 5.10--PERCENT OF INSTITUTIONAL EFFICIENCY (Ex/E and Ex_1/E) BY NUMBER OF CONTACT HOURS (By Selected Faculty)

	Ex/E					Ex_1/E				
	1-1000	1001-2500	2501-5000	5001+		1-1000	1001-2500	2501-5000	5001+	
UNIVERSITY 1										
Engineering	Not significant at .05					95.5%	89.5%	80.5%	48.3%	
	1-500	501-1000	1001-2500	2501-5500	5501+	1-500	501-1000	1001-2500	2501-5500	5501+
UNIVERSITY 2										
Engineering	92.5%	94.6%	93.7%	90.4%	65.5%	92.2	93.7	90.1	89.2	65.5
Dentistry	95.5	95.5	90.4	86.2	65.5	95.5	95.5	90.4	88.0	65.5
Economics	25.5	75.4	84.4	77.5	82.6	25.5	75.4	84.4	73.0	48.4
UNIVERSITY 3										
Engineering	*	92.2	87.1	77.5	70.9	*	80.8	72.1	51.5	41.9
Dentistry	95.5	95.5	90.7	81.4	73.0	Not Significant at .05				
Medicine	Not Significant at .05					95.5	95.5	87.4	73.0	73.0
Pharmacy	Not Significant at .05					67.3	68.8	59.5	52.3	37.5
Economics	Not Significant at .05					95.5	79.3	81.7	80.5	70.0
UNIVERSITY 4										
Law	Not Significant at .05					*	*	*	91.9	73.0
Dentistry	92.2	75.4	70.6	*	*	92.2	75.4	70.6	*	*
Economics	Not Significant at .05					*	61.9	76.9	65.3	53.5
UNIVERSITY 5										
Pharmacy	*	95.5	90.4	53.9	*	*	95.5	80.5	31.1	*
Education	91.3	95.5	90.7	68.8	*	90.4	86.2	72.1	61.1	*
Economics	Not Significant at .05					95.5	89.5	90.1	72.1	65.5

*No classes in this category.

Conclusions Regarding Institutional Efficiency and Contact Hours

There is no consistent pattern in university or faculty data that would support the generation of a hypothesis. Faculty patterns are so diverse that it would be necessary to view the individual pattern of each faculty before deciding to alter existing procedures. In essence, administrative decision-making should be varied by faculty within each university to implement these results.

Number of Classes Taught and Institutional Efficiency

The data regarding institutional efficiency and the number of classes taught by the grading professor is subject to the same limitations noted in Chapter 4. In the five Central American universities, most professors teach less than five classes in an academic year. The range in classes taught in the 1962-63 school year is from one to 15 classes taught, but with 80% of the professors teaching less than five classes differences in mean scores of efficiency are not subject to conclusive analysis. Table 5.11 represents the frequency distribution of the number of classes taught by professors in the five universities. The uneven distribution of faculty is evident.

As a result of the uneven distribution of data, mean comparisons are not warranted. No conclusive relationship between institutional efficiency and the number of classes taught by the grading professor can be determined.

TABLE 5.11-FREQUENCY DISTRIBUTION OF PROFESSORS BY NUMBER OF CLASSES TAUGHT

Classes Taught	University 1	University 2	University 3	University 4	University 5
1-4	299	318	275	168	173
5-8	48	43	31	15	7
9-15	9	4	5	4	1

Data Analysis by Selected Faculty

The division of university data into selected faculties results in a frequency distribution that contains small values in the upper categories of classes taught. Because comparisons would be meaningless with small frequencies these data are not included in this chapter.

Conclusions and Qualifications Regarding the Number of Classes Taught and Institutional Efficiency

In Central America it appears that most professors teach on a part time basis. The number of professors teaching 1, 2, 3, or 4 courses in the academic years 1962-63 represent over 80% of the professors in the five Central American universities. The small number of faculty teaching varying numbers of classes does not justify mean comparisons of the number of classes taught by the grading professor and institutional efficiency.

Summary

Institutional efficiency (Ex/E) or (Ex_1/E) is affected by administratively controllable factors in the Central American universities and university faculties. These conclusions seem warranted by analyses of data.

1. No conclusive relationship is evidenced between the salary paid to the grading instructor and institutional efficiency. The manipulation of instructor salary would not materially affect the institutional efficiency of the university.
2. Class size affects institutional efficiency in ways that suggest that institutional efficiency may be increased by the systematic reduction in certain class sizes.
3. Institutional efficiency increases at successive levels of instruction, from lower to upper to graduate divisions. This phenomenon may result from student self-selection and more full time students in the upper and graduate levels.
4. The method of instruction is related on institutional efficiency. Laboratory courses seem to be most efficient, but these courses are more apt to be taught in small class sizes at the upper and graduate levels of instruction. Hence, the generalization may have limited administrative utility in and of itself.

5. There is no conclusive relationship between faculty-class interaction as measured by contact hours and institutional efficiency. Individual selected faculties may heed the pattern evidenced in contact hours, but no generalization is warranted.
6. No conclusive relationship between the number of classes taught by the grading instructor and institutional efficiency is evidenced. Over 80% of the professors teach little more than one course per semester on the average.

The thesis was advanced that: Administratively controllable variables are related to institutional efficiency in ways that efficiency may be increased. Supportive data from the five Central American universities lend credance to this thesis. The next step would appear to be the delineation of interrelationships between the six factors and institutional efficiency.

CHAPTER VI

FACTORS RELATED TO INSTRUCTIONAL EFFICIENCY

Instructional efficiency (A/Ex and A_1/Ex_1) was designated in Chapter 1 to be the ratio of successful students (A and A_1) to those examined (Ex). The term instructional efficiency was assigned to these ratios in recognition of the fact that the decision as to who will pass a course is determined principally by the evaluation of student achievement on the final examination. Therefore, the efficiency of the class is determined by those factors surrounding the instructor, and the instructional atmosphere and the ability of the student to transfer relevant concepts in the examination process.

The relationships between two measures of instructional efficiency (A/Ex and A_1/Ex_1) and factors that could affect instructional efficiency are examined in this chapter. Level of expenditure, class size, level of instruction, method of instruction, contact hours and number of classes taught by the instructor were spread by university and by selected faculties in order to ascertain significant Chi square values involving instructional efficiency. The mean scores within each Chi square cell were than analyzed to determine the direction as well as degree of significant relationships.

Level of Expenditure and Instructional Efficiency by University

The examination of level of expenditure and instructional efficiency is restricted by relationships that are not significant at the desired level of confidence. Table 6.1 indicates that universities 1 and 5 did not achieve the .05 level of confidence and instructional efficiency as measured by A/Ex in university 2 also fell short of .05 level

TABLE 6.1--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY LEVEL OF EXPENDITURE

	A/Ex				
Cost	University 1	University 2	University 3	University 4	University 5
$1-250	84.7%	91.6%	90.1%	94.6%	84.7%
$251-500	80.8	91.0	89.2	91.6	85.0
$501-750	78.7	90.4	73.3	85.9	84.1
$751-1000	79.9	89.5	76.9	82.3	87.4
$1001+	79.9	87.7	76.9	82.6	82.0
Significance Level	NS	NS	.01	.01	NS

Cost	University 1	University 2	University 3	University 4	University 5
$1-250	86.5%	91.6%	90.1%	94.6%	86.2%
$251-500	82.0	90.4	88.3	91.9	85.3
$501-750	79.0	89.8	72.4	85.3	85.3
$751-1000	80.5	88.9	77.5	83.5	85.9
$1001+	80.5	85.9	76.3	83.5	82.0
Significance Level	NS	.05	.01	.01	NS

Those measures of instructional efficiency did evidence a significant relationship with level of expenditure present a consistent pattern. As the level of expenditure increases, measures of instructional efficiency decrease slowly. A contrary trend is noted in university 3 where a sharp decrease occurs when the level of expenditure is 501-750 dollar equivalents. A slight increase occurs as level of expenditure exceeds 750 dollar equivalents.

One noteable relationship requires comment. There is a relatively high level of instructional efficiency in evidence, in universities 2, 3 and 4 regardless of the level of expenditure. It appears clear that if a student presents himself for examination, his chances of success are quite high. Of course, particular selected faculties may not adhere to this pattern, but the evidence for the university as a whole indicates that instructional efficiency is rather high in all institutions.

Data Analysis by Selected Faculty

Seven selected faculties exhibited significant relationships between instructional efficiency and level of expenditure. The pattern of relationships is varied in these faculties as evidenced in Table 6.2.

TABLE 6.2--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY LEVEL OF EXPENDITURE (By Selected Faculty)

	A/Ex					A_1/Ex_1				
	$1-250	$251-500	$501-750	$751-1000	$1001+	$1-250	$251-500	$501-750	$751-1000	$1001+
UNIVERSITY 2										
Economics	93.4%	94.3%	74.2%	82.6%	95.5%	91.3%	94.3%	74.2%	82.6%	95.5%
Dentistry		Not Significant at .05				90.4	90.4	91.3	95.5	75.4
UNIVERSITY 3										
Medicine	95.5	95.5	77.8	95.5	79.9	95.5	95.5	77.8	95.5	78.4
Engineering	65.5	82.3	56.7	25.5	*	65.5	84.4	60.3	25.5	*
UNIVERSITY 4										
Dentistry	95.5	88.0	91.3	80.5	84.4		Not Significant at .05			
UNIVERSITY 5										
Pharmacy	95.5	93.1	77.5	95.5	*		Not Significant at .05			
Law	95.5	77.5	84.7	*	69.7		Not Significant at .05			

*No Classes in this Category

In four faculties, the lowest level of expenditure ($1-250) exhibits the highest degree of instructional efficiency, but in two of those, Medicine, university 3 and Pharmacy, university 5, instructional efficiency equal to that in expenditure 1-250 is achieved at other points of level of expenditure. Therefore, the lack of pattern in selected faculties negates the hypothesis generated from the university data. Data provides inconclusive evidence that as the level of expenditure increases, instructional efficiency decreases.

Conclusions and Qualifications Regarding Instructional Efficiency and Level of Expenditure

University data supports the generation of the hypothesis that as the level of expenditure increases, instructional efficiency decreases. Faculty data is inconsistent and no hypothesis appears warranted. Selected faculty data tend to be most important in administrative decision-making and the importance of the hypothesis in university data should be minimized.

Class Size and Instructional Efficiency

At first glance, it would appear that no relationships should exist between instructional efficiency measures and class size. Instructional efficiency is derived from the number of successful students divided by the number of students examined in a course, while class size reflects the enrollment

necessary to produce examined candidates. In essence, the question could be raised, why should class size affect the instructional efficiency ratios?

While the question would appear to be warranted, data by university and selected faculties indicate that a relationship does exist. As illustrated in Table 6.3 by the five universities, as class size increases, instructional efficiency decreases.

TABLE 6.3--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY CLASS SIZE

	A/Ex				
Class Size	University 1	University 2	University 3	University 4	University 5
1-29	85.0%	93.1%	87.1%	90.4%	87.7%
30-109	74.8	85.6	66.4	84.4	75.5
110+	58.7	80.5	51.1	84.4	*
Significance Level	.01	.01	.01	.01	.01
	A_1/Ex_1				
1-29	85.9%	93.1%	86.5%	91.3%	88.3%
30-109	75.4	84.7	66.7	83.8	79.0
110+	58.7	95.5	49.9	84.4	*
Significance Level	.01	.01	.01	.01	.01

*No classes listed.

The instructional efficiency (A_1/Ex_1) patterns of universities 2 and 4 provide the only exceptions to this hypothesis. In university 2, the instructional efficiency (A_1/Ex_1) in class sizes above 110 is 10.8 percentage points above the average for

class sizes 30-109. In university 4, there is a .6% difference between class sizes of 30-109 and classes above 110. Other universities follow a consistent pattern of decreasing instructional efficiency as class size increases.

Data Analysis by Selected Faculty

Selected faculty data of the five universities establish 17 faculties with significant relationships. As illustrated in Table 6.4, 16 of the 17 faculties adhere to the pattern already noted.

TABLE 6.4--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY CLASS SIZE
(By Selected Faculty)

	A/Ex			A_1/Ex_1		
Class Size	1-29	30-109	110+	1-29	30-109	110+
UNIVERSITY 1						
Engineering	91.3%	65.5%	*	84.7%	65.5%	*
Education	93.4	88.9	*	94.0	89.5	*
Law	95.5	82.0	*	95.5	81.4	*
Economics	89.8	79.9	57.5%		Not Significant at .05	
UNIVERSITY 2						
Economics	95.5	87.1	*	94.0	87.1	*
Engineering	91.9	80.5	*	91.0	79.3	*
UNIVERSITY 3						
Education	94.0	65.5	*	92.8	65.5	*
Law	95.5	76.3	62.3		Not Significant at .05	
Engineering	82.3	52.3	31.5	85.0	54.7	34.3
Dentistry	78.1	65.5	*	76.0	65.5	*
Medicine	95.5	79.6	95.5	95.5	79.6	80.5
Pharmacy	86.5	43.1	32.3	84.1	43.1	32.3
UNIVERSITY 4						
Law	*	91.9	65.5	*	90.7	65.5
UNIVERSITY 5						
Economics	88.6	59.5	*	90.1	62.7	*
Medicine	95.5	85.6	*		Not Significant at .05	
Pharmacy	94.3	75.4	*	94.3	80.5	*
Dentistry	91.6	41.5	*	91.6	41.5	*

*No classes of this size are taught in this faculty.

The faculty of Medicine, university 3, is the sole exception. Class sizes of 30-109 appear to be less efficient than either extreme. Based upon selected faculty data and university data, it is apparent that the hypothesis can be generated that instructional efficiency decreases as class size increases.

The question raised earlier regarding the reason for a relationship between instructional efficiency and class size may be answered in supporting data. The pattern evidenced by institutional efficiency (Ex/E) indicated that as class size increased, institutional efficiency decreased. This decline was rather gradual and the percentage difference between small and large classes was minimal. In absolute numbers, therefore, a class size of more than 110 would provide more students to be examined, on the average than a class of less than 29. In essence, in a larger class, the instructor is called upon to grade more final examinations than in a smaller class. Is it possible that the relationship between class size and instructional efficiency is more closely a reflection of the absolute numbers of examinations that must be evaluated in a large class? If this be true, additional support is garnered for smaller classes.

Conclusions and Qualifications Regarding Instructional Efficiency and Class Size

Class size appears to have an effect on instructional efficiency. As class size increases, instructional efficiency

measures decrease. The administrative implication derived from this pattern tends to favor smaller classes if greater student success is desired from those examined. University data follow the established pattern and all but one of the selected faculties support the pattern.

Level of Instruction and Instructional Efficiency

Level of instruction refers to the academic year in which a course is ordinarily taken in a student's curriculum. Three levels of instruction were delineated for examination of data. Years (1 and 2) form one level, years (3 and 4) another, and years (5-8) form the third group. Two measures of instructional efficiency (A/Ex and A_1/Ex_1) were spread with the grouped levels by university and selected faculty to determine Chi square relationships.

Data Analysis by University

The analysis of data regarding level of instruction and instructional efficiency is based on Table 6.5. Instructional efficiency percentages are evidenced for each level of instruction in each university, although university 2, (A_1/Ex_1) and university 4, (A/Ex and A_1/Ex_1) did not achieve the .05 level of significance.

TABLE 6.5--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex & A_1/Ex_1) BY LEVEL OF INSTRUCTION

Years	University 1	University 2	University 3	University 4	University 5
			A/Ex		
(1 and 2)	74.2%	89.2%	57.5%	88.6%	79.9%
(3 and 4)	87.7	92.5	76.3	87.4	86.8
(5-8)	90.4	92.2	88.0	90.4	90.4
Significance Level	.01	.01	.01	NS at .05	.01
			A_1/Ex_1		
(1 and 2)	75.7%	89.2%	57.9%	88.6%	80.8%
(3 and 4)	87.7	91.3	75.4	87.1	87.4
(5-8)	90.7	92.5	88.3	92.2	91.3
Significance Level	.01	NS at .05	.01	NS at .05	.01

The pattern in each university with significant Chi square values is similar. Instructional efficiency increases at each successive level of instruction. In university 2, level (5-8) are .3 percentage points below level (3 and 4) in A/Ex, but this is a minor exception in the pattern. It is also noted that instructional efficiency measures do not differ greatly in any given grouping. For example, in group (1 and 2), university 1, the difference between measures of instructional efficiency is 1.5 percentage points. This is the greatest difference noted in any category.

It is also noted that instructional efficiency differences between groups (3 and 4) and (5-8) are smaller than differences

between groups (1 and 2) and (3 and 4). This trend opens the possibility that instructors in lower level courses discriminate to a greater extent in determining which student will pass. It may be possible, however, that more unqualified students present themselves for examination in lower level courses, and that these students do not continue into upper level courses. While the latter possibility is usually evoked in Central America, the former possibility is not without significance, and may be operant in the universities.

Data Analysis by Selected Faculty

The pattern noted in university data is upheld in selected faculty data. Table 6.6 exhibits the data of 19 selected faculties evidencing significant Chi square values.

TABLE 6.6--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY LEVEL OF INSTRUCTION (By Selected Faculty)

	A/Ex			A_1/Ex_1		
	(1 & 2)	(3 & 4)	(5-8)	(1 & 2)	(3 &4)	(5-8)
UNIVERSITY 1						
Law	Not Significant at .05			65.5%	86.5%	90.1%
Economics	63.5%	85.0%	90.4%	65.5	83.2	89.8
UNIVERSITY 2						
Law	85.6	95.5	83.5	Not Significant at .05		
Medicine	90.4	95.5	95.5	90.4	95.5	95.5
Engineering	83.2	90.7	92.2	82.0	88.0	93.4
UNIVERSITY 3						
Economics	59.1	77.2	83.5	59.1	80.5	85.6
Pharmacy	46.7	81.4	93.4	44.3	77.5	93.4
Medicine	70.3	76.3	94.6	70.3	76.3	94.0
Dentistry	63.1	76.9	86.8	63.1	72.4	85.0
Engineering	42.3	61.5	84.7	45.1	63.5	88.3
Law	62.7	75.4	70.6	Not Significant at .05		
UNIVERSITY 4						
Economics	79.6	85.0	95.5	79.6	85.0	95.5
Dentistry	95.5	84.4	95.5	95.5	84.4	95.5
Law	Not Significant at .05			73.0	92.5	95.5
UNIVERSITY 5						
Economics	59.5	85.6	95.5	62.3	87.1	95.5
Medicine	82.0	93.1	93.1	84.7	93.1	94.3
Pharmacy	82.9	95.5	95.5	85.6	95.5	95.5
Dentistry	74.8	89.5	95.5	Not Significant at .05		
Law	70.6	82.9	91.9	67.9	82.9	91.9

Sixteen of these faculties evidence an increase in instructional efficiency at successive instructional levels. In Law, university 2, students in level (5-8) do not pass as often as students at lower levels. There is a 12.0% decrease from levels (3 and 4) in this faculty. The same patterns is exhibited in Law, university 3. Dentistry, university 3, shows a decline from levels (1 and 2) to (3 and 4): however, levels (5-8) increase once again.

The exceptions to the noted pattern warrant analysis. If instructional efficiency represents a measure of the extent to which faculties are discriminating adequate from inadequate students, is it possible that Law, universities 2 and 3, are evaluating to a greater extent at levels (5-8) then they were in levels (3 and 4)? The trend indicates that possibly two standards of evaluation are reflected in these data. One standard is used through level 4 and a more rigorous standard is applied in more advanced courses. Dentistry, university 4, appears to evaluate most rigorously at the (3 and 4) year levels of instruction.[26]

Conclusions and Qualifications Regarding Level of Instruction and Instructional Efficiency

The hypothesis has been generated that instructional efficiency increases at each successive level of instruction. This hypothesis has been substantiated by analyses of university and selected faculty data. Several pertinent questions were posed that attempt to locate the causes surrounding this relationship. T o possible answers to this question were elucidated.

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[26] It should be noted, however, that data are limited to a single academic year. Comparison with performance in other years will further clarify the meaning and significance of these relationships.

Method of Instruction and Instructional Efficiency

Three methods of instruction have been delineated in previous chapters. They are: the lecture, laboratory, and combination lecture-laboratory methods of instruction. Instructional efficiency measures and methods of instruction were divided by university and faculty data to ascertain pertinent relationships. Recurring patterns were used to generate hypotheses surrounding instructional efficiency and methods of instruction.

Data Analysis by University

Data spread by university (Table 6.7) indicate that universities 1 and 3 are the only universities sustaining a significant chi square value between instructional efficiency and method of instruction. This is consistent with previous data regarding institutional efficiency and methods instruction.

TABLE 6.7--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex & A_1/Ex_1) BY METHOD OF INSTRUCTION

	A/Ex				
Method	University 1	University 2	University 3	University 4	University 5
Lecture	81.4$	91.0%	80.2%	88.9%	84.1%
Combination	74.5	89.5	72.1	87.1	83.8
Laboratory	92.8	90.4	78.7	88.3	91.3
Significance Level	.01	NS at .05	.01	NS at .05	NS at .05
	A_1/Ex_1				
Lecture	81.7%	90.7%	79.0%	88.9%	85.3%
Combination	76.6	88.9	71.8	87.4	84.1
Laboratory	93.4	90.4	80.8	89.5	91.3
Significance Level	.01	NS at .05	.01	NS at .05	NS at .05

Universities 1 and 3 exhibit different patterns. In university 1, laboratory courses evidence the highest percentage of instructional efficiency. The lecture method is the second most efficient type of instruction, and combination courses evidence the least instructional efficiency. In university 3, the lecture method is the most efficient followed by the laboratory method and then the lecture-laboratory method.

The paucity of significant data and the conflicting patterns evidenced in the two universities with significant values, precludes the generation of a testable hypothesis. The only clearcut evidence at this juncture is that the combination method of instruction provides the lowest percentage of instructional efficiency.

Data Analysis by Selected Faculty

Selected faculty data (Table 6.8) indicate an inconclusive pattern. The lack of a large number of faculties with significant relationships is only a partial explanation for the inconclusive trend.

TABLE 6.8--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY METHOD OF INSTRUCTION (By Selected Faculty)

	A/Ex			A_1/Ex_1		
	Lecture	Combination	Laboratory	Lecture	Combination	Laboratory
UNIVERSITY 1						
Engineering	86.8%	58.7%	*	Not Significant at .05		
Economics	Not Significant at .05			78.1%	55.5%	*
Medicine	74.2	89.2	95.5	74.2	88.3	95.5
UNIVERSITY 3						
Engineering	66.1	43.1	76.9	68.8	45.5	78.1
UNIVERSITY 4						
Economics	85.0	25.5	*	85.0	25.5	*
UNIVERSITY 5						
Education	Not Significant at .05			91.3	79.6	*

*No laboratory courses in this faculty

Of the six faculties, four employ only lecture and combination methods of instruction. In these faculties, the lecture method elicits the highest percentage of instructional efficiency. In the two faculties that do employ three methods of instruction, the pattern is irregular and inconclusive.

Conclusions and Qualifications Regarding Instructional Efficiency and Method of Instruction

The lack of conclusive evidence prevents the generation of hypotheses to describe a relationship between methods of instruction and instructional efficiency. There is a reduction in the number of faculties that can be included in this category, as six faculties employ the lecture method in all courses. The reduction in usable faculties and the lack of faculties evidencing significant Chi square relationships between method of instruction and instructional efficiency contribute to the inconclusive trends.

Contact Hours and Instructional Efficiency

As delineated in previous chapter, contact hours (HxE) result from multiplying the hours of instruction and the number of students enrolled in the course. Earlier chapters also have indicated that contact hours may reflect the size of the class as the hours of instruction in most faculties are standardized. Resulting differences within faculties appear to reflect class size differences.

Data Analysis by University

All universities exhibit at least one significant relationship between instructional efficiency and contact hours. University 5 does not evidence a significant relationship between instructional efficiency measure A_1/Ex_1 and contact hours.

TABLE 6.9--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY NUMBER OF CONTACT HOURS

	A/Ex				
HxE	University 1	HxE	University 2	University 3	University 4	University 5
1-1000	89.3%	1-500	92.8%	91.3%	94.3%	84.4$
1001-2500	82.9	501-1000	93.4	86.2	93.7	86.8
2501-5000	74.2	1001-2500	89.5	80.2	85.6	87.4
5001+	73.6	2501-5000	87.9	65.8	82.0	83.8
		5001+	84.1	58.3	81.7	73.0
Significance Level	.01		.01	.01	.01	.01
	A_1/Ex_1					
HxE	University 1	HxE	University 2	University 3	University 4	University 5
1-1000	89.5%	1-500	92.8%	90.1%	94.3%	83.5%
1001-2500	84.1	501-1000	93.7	85.3	94.3	87.4
2501-5000	75.4	1001-2500	88.9	79.3	86.2	87.7
5001+	71.8	2501-5000	86.2	67.3	82.3	84.1
		5001+	82.6	57.5	81.7	76.9
Significance Level	.01		.01	.01	.01	NS at .05

A rather consistent pattern is evidenced in the universities. As contact hours increase, instructional efficiency decreases. In university 3, instructional efficiency (A/Ex) decreases 33.5% as contact hours increase from the lowest group (5501+). In other universities, the pattern is rela-

tively consistent, but the differences are less pronounced than in university 3.

Minor exceptions to the trend are evidenced in University 2 and university 5. In both universities, there is a slight increase in instructional efficiency before the prolonged decrease occurs. This inconsistency appears to be of minor importance and does not affect the generated hypothesis that as contact hours increase, instructional efficiency decreases.

Data Analysis by Selected Faculty

In Table 6.10 it is noted that five of the faculties exhibit patterns of instructional efficiency that differ from the previously stated pattern. That as contact hours increase, instructional efficiency declines.

TABLE 6.10--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex and A_1/Ex_1) BY NUMBER OF CONTACT HOURS (By Selected Faculty)

	A/Ex					A_1/Ex_1				
Contact Hours	1-1000	1001-2500	2501-5000	5001+		1-1000	1001-2500	2501-5000	5001+	
UNIVERSITY 1										
Engineering	95.5%	95.5%	86.2%	48.3%		95.5%	92.5%	76.9%	53.9%	
Education	Not Significant					95.5	92.5	89.5	86.5	
Dentistry	91.9	95.5	95.5	65.5		91.9	93.1	95.5	25.5	
Contact Hours	1-500	501-1000	1001-2500	2501-5500	5501+	1-500	501-1000	1001-2500	2501-5500	5501+
UNIVERSITY 2										
Economics	95.5	95.5	95.5	94.0	76.3	95.5	95.5	94.0	92.5	78.4
Medicine	Not Significant					93.7	95.5	84.4	95.5	95.5
Engineering	Not Significant					91.3	92.2	82.3	75.7	65.5
UNIVERSITY 3										
Economics	Not Significant					95.5	79.3	86.2	75.4	53.1
Education	94.0	95.5	65.5	*	*	94.0	80.5	65.5	*	*
Pharmacy	90.1	89.8	74.8	70.6	37.5	88.0	87.7	70.0	70.6	37.5
Engineering	*	81.7	73.9	44.3	29.1	*	85.3	73.9	48.7	31.5
UNIVERSITY 4										
Economics	Not Significant					*	92.8	86.2	73.0	74.5
Dentistry	Not Significant					*	95.5	90.4	70.6	*
Medicine	Not Significant					75.4	95.5	93.1	75.4	82.3
UNIVERSITY 5										
Economics	95.5	95.5	79.0	72.1	41.5	95.5	95.5	82.0	75.4	41.5
Pharmacy	*	95.5	95.5	74.2	*	*	95.5	95.5	78.4	*

*No classes in this category

In Dentistry, university 1, instructional efficiency (A_1/Ex_1) increases steadily and then declines sharply as contact hours exceed 5000. The faculty of Medicine, university 2, appears to have the least instructional efficiency when contact hours are moderate. Economics and Education, university 3, exhibit irregular patterns, while Medicine, university 4, exhibits highest instructional efficiency when contact hours are moderate.

The most consistent pattern remains that instructional efficiency declines as contact hours increase. Ten faculties adhere to this trend and would appear to substantiate the hypothesis generated from university data.

An interesting occurence is noted in Table 6.10 that has not been evidenced previously. Seven faculties do not maintain significant relationships between instructional efficiency (A/Ex) and contact hours, and yet there is a significant relationship between instructional efficiency (A_1/Ex_1) and contact hours. It does not seem possible to speculate as to the cause of this pattern, but it should be noted because it is unique. If the percentages differed greatly for each measure of instructional efficiency in a specific category (e.g., 1-500 contact hours), it might be postulated that different methods of evaluation were being applied to those that had been examined previously. However, this does not occur and consequently no evident cause for the pattern can be established.

Conclusions and Qualifications Regarding Instructional Efficiency and Contact Hours

All data indicate that as number of contact hours increase, instructional efficiency decreases. This trend appears to be a direct reflection of class size differences that have been noted previously. It would appear desirable therefore, administratively to reduce class size, hence contact hours, if an increase in instructional efficiency is to be achieved. There are exceptions to this trend that have been noted in faculty data, and it would appear to be desirable to examine previous data on faculties before implementing this procedure on a university wide basis.

Number of Classes Taught and Instructional Efficiency

In previous chapters, data regarding the number of classes taught by a professor was limited by a preponderance of professors teaching few courses in an academic year. Although as many as 15 courses were taught by a professor, over 80% of the professors taught less than five courses. The same trend is evidenced in Table 6.11

TABLE 6.11--FREQUENCY DISTRIBUTION OF PROFESSORS BY NUMBER OF CLASSES TAUGHT

Classes Taught	University 1	University 2	University 3	University 4	University 5
1-4	299	318	275	168	173
5-8	48	43	31	15	7
9-15	9	4	5	4	1

The inordinate distribution of professor's teaching more than four courses tends to minimize differences in instructional efficiency that may be noted. For example, if instructional efficiency in university 2 in the category of 9-15 classes taught is slightly different from the university average, this difference is based on four faculty members. This minimizes and even precludes mean comparison. Table 6.12 represents institutional efficiency (A/Ex) percentages to illustrate that differences do exist between institutional efficiency percentages in the categories of the number of classes taught.

TABLE 6.12--PERCENT OF INSTRUCTIONAL EFFICIENCY (A/Ex) BY THE NUMBER OF CLASSES TAUGHT

Classes Taught	University 1	University 2	University 3	University 4	University 5
1-4	84.1%	92.8%	78.8%	87.8%	86.4%
5-8	78.0	95.4	77.8	92.4	88.7
9-15	82.3	91.8	86.5	93.0	60.3
University Mean	82.0%	92.8%	79.1%	89.7%	85.9%

Based upon the frequency distribution of professors, the differences in instructional efficiency (A/Ex) percentage in the categories of number of classes taught by the professor are inconclusive. No hypothesis generation is possible nor warranted.

Data Analysis by Selected Faculty

A division of data into selected faculties is not practical because frequencies become rather small in the upper categories of number of classes taught. Comparisons would be meaningless in small frequencies and, therefore, are not included in this chapter.

Conclusions and Qualifications Regarding the Number of Classes Taught and Instructional Efficiency

The lack of pertinent data precludes the generation of hypotheses that describes relationships between instructional efficiency and the number of classes taught by the grading instructor. The number of professors teaching less than five classes indicates that most professors teach little more than one course per semester.

Summary

Instructional efficiency (A/Ex) or (A_1/Ex_1) is affected by factors under administrative control in Central American universities. A a result, the following conclusions are warranted by the analyses:

1) Instructor salary is not conclusively related to instructional efficiency.
2) Class size and instructional efficiency are related to the extent that institutional efficiency appears to increase as certain class sizes are reduced.

3) Instructional efficiency increases at successive levels of instruction.
4) There is no conclusive evidence of relationship bwtween instructional efficiency and mode of instruction.
5) Professor interaction with students as measured by hours of contact with the class is related to instructional efficiency. This relationship may be a reflection of varying class sizes in which large class sizes raise the contact hours and thereby lower instructional efficiency.
6) There is no conclusive evidence of a relationships between the number of classes taught by a professor and instructional efficiency.

In Chapter 1, the thesis was stated that administratively controllable variables are related to instructor efficiency. The analysis of instructional efficiency data from the five Central American universities tend to support this thesis in this chapter.

CHAPTER VII

ADMINISTRATIVE IMPLICATIONS--A CASE STUDY

In the previous three chapters the measures of efficiency and effectiveness have been matched with factors that could be affecting the measures. In this chapter, the administrative application of these matchings will be determined by illustrating that efficiency and effectiveness can be altered through administrative manipulation. Illustrations are derived from the university and selected faculty data to indicate that both divisions contain useful information for the Central American administrator.

Data Analysis by University

University 3 will be used for illustrative purposes because it appears to contain most of the possible ramifications that can be found in the data. Table 7.1 contains the efficiency-effectiveness mean scores for university 3.

TABLE 7.1--INSTITUTIONAL EFFICIENCY, INSTRUCTIONAL EFFICIENCY, AND INSTITUTIONAL EFFECTIVENESS (In Percent)

	Institutional Efficiency Ex/E	Instructional Efficiency A/Ex	Institutional Effectiveness A/E
University 3	77.5%	77.8%	63.5%
	Ex_1/E	A_1/Ex_1	A_1/E
University 3	66.1%	76.9%	53.9%

The average institutional efficiency (Ex/E) for all classes in university 3 is 77.5%. Of all students enrolled in a class, it is expected that 77.5% of these students will present themselves for examination. There is an expected loss in average efficiency of 22.5% in each class in the university.

Instructional efficiency (A/Ex) for university 3 is 77.8% for all classes. This measure indicates that there is 22.3% loss of students who took the examination, but did not pass.

The resultant measure of institutional effectiveness (A/E) for university 3 is 63.5%. In other words, for every 100 students enrolled in a class, 63.5% would be expected to pass in university 3. Thirty-six point five percent of the class would not pass and would either drop out, be re-examined if they failed the examination, or take the examination for the first time at a later date.

If measures of efficiency and effectiveness are employed that stress the rapid progression of students in classes, the results are more dramatic. Institutional efficiency (Ex_1/E) is 66.1%. This indicates that only 66.1% of an enrolled class take the examination at the earliest opportunity. Of that 66.1%, 76.9% will pass (A_1/Ex_1). The result is that 53.9% of those enrolled (E), pass at the first opportunity (A_1). Institutional effectiveness (A_1/E) indicates, therefore, that 46.1% of every class enrollment did not complete the class at the earliest opportunity.

Assuming that administrators are interested in achieving higher percentages of efficiency and effectiveness from classes in university 3, factors affecting these percentages must be uncovered. Data from university 3 indicate that the following hypotheses can be generated about the measures of efficiency and effectiveness and the six factors considered throughout:

Ex/E Institutional Efficiency

1. As class size increases, institutional efficiency decreases.
2. Institutional efficiency may be expected to increase at each successive level of instruction.

A/Ex Instructional Efficiency

1. As class size increases, instructional efficiency decreases.
2. Instructional efficiency may be expected to increase at each successive level of instruction.
3. As contact hours increases, instructional efficiency decreases.

A/E Institutional Effectiveness

1. As level of expenditure increases, institutional effectiveness decreases.
2. As class size increases, institutional effectiveness decreases.
3. Institutional effectiveness may be expected to increase at each successive level of instruction.

Ex_1/E Institutional Efficiency

1. As level of expenditure increases, institutional efficiency decreases.
2. As class size increases, institutional efficiency decreases.
3. Institutional efficiency may be expected to increase at each successive level of instruction.

A_1/Ex_1 Instructional Efficiency

1. As class size increases, instructional efficiency decreases.
2. Instructional efficiency may be expected to increase at each successive level of instruction.
3. As contact hours increase, instructional efficiency decreases.

A_1/E Institutional Effectiveness

1. As level of expenditure increases, institutional effectiveness decreases.
2. As class size increases, institutional effectiveness decreases.
3. Institutional effectiveness may be expected to increase at each successive level of instruction.
4. As contact hours increase, institutional effectiveness decreases.

The administrators of university 3 appear to have two paths of action open to them to increase efficiency and effectiveness. A specific measure of efficiency or effectiveness may be designed as in need of improvement. For example, the administrator may wish to improve institutional efficiency (Ex/E). The second alternative would be to seek recurring factors that may be affecting all or most of the efficiency-effectiveness measures.

Because of the similarity in hypotheses between efficiency and effectiveness measures, it would appear that the second alternative is the most likely choice in university 3. The following recommendations for university 3 would then be warranted:

1. First and second year courses should have class size of less than 29 students. If this is impossible, then class enrollments should be kept below 109, or in combinations of small and relatively large enrollments.

2. Class sizes in years beyond levels 1 and 2 can be larger than those in the first two years with little loss of effectiveness or efficiency.

3. Employ low salary instructors in classes in the first two years.[27]

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[27]This recommendation assumes that present low salaried professors who are also highly productive of successful students are involved.

These recommendations are based upon university data and it must be noted that all faculties within the university may not adhere to this pattern. No attempt is made to qualify these recommendations for the local exigencies of the institution. For example, if practitioners are causing the level of expenditure to yield artificial data in the university, it may be wise to avoid the third recommendation.

No intimation is made that these recommendations will predictably increase efficiency and effectiveness in the university. If the factors noted are the major factors affecting the ratios, then there is reason to believe that an increase in efficiency and effectiveness is to be expected. However, it has been mentioned previously that these factors merely illustrate the use of the efficiency and effectiveness concept and are not a comprehensive list of factors that might be affecting instruction in university 3.

Data Analysis by Selected Faculty

Two selected faculties will serve to illustrate the utility of the efficiency-effectiveness ratios. Faculty data appears to be more practical than university data because each faculty within an institution may possess a pattern of efficiency and effectiveness that is indeigenous to it alone. Therefore, the factors that may be operating in one faculty may exert limited influence in another. Indiscriminant

application of the hypotheses that were generated in university data, may neutralize or reverse the positive patterns already established in a selected faculty.

The Pharmacy faculty of university 5 serves to illustrate the utility of the efficiency-effectiveness ratios and the resulting generated hypotheses. Appendix C contains the data from which the following hypotheses are generated.

Ex/E Institutional Efficiency

1. As class size increases, institutional efficiency decreases.
2. Institutional efficiency may be expected to increase at each successive level of instruction.
3. As contact hours increase, institutional efficiency decreases.

A/Ex Instructional Efficiency

1. Salaries paid to instructors between 501-750 dollar equivalents result in lowered instructional efficiency.
2. As class size increases, instructional efficiency decreases.
3. Instructional efficiency may be expected to increase at each successive level of instruction.
4. As contact hours increase, instructional efficiency decreases.

A/E Institutional Effectiveness

1. As class size increases, institutional effectiveness decreases.
2. Institutional effectiveness may be expected to increase at each successive level of instruction.
3. As contact hours increase, institutional efficiency decreases.

Ex_1/E Institutional Efficiency

1. As class size increases, institutional efficiency decreases.
2. Institutional efficiency may be expected to increase at each successive level of instruction.
3. As contact hours increase, institutional efficiency decreases.

A_1/Ex_1 Instructional Efficiency

1. As class size increases, instructional efficiency decreases.
2. Institutional efficiency may be expected to increase at each successive level of instruction.
3. As contact hours increase, institutional efficiency decreases.

A_1/E Institutional Effectiveness

1. As class size increases, institutional effectiveness decreases.
2. Institutional effectiveness may be expected to increase at each successive level of instruction.
3. As contact hours increase, institutional effectiveness decreases

It is highly probable that administrators in university 5 would tend to implement changes that encompass all measures of efficiency and effectiveness because of the similarity in hypotheses for all measures. In light of the generated hypotheses, it would appear that the following recommendations would be appropriate:

1. Reduce class sizes below 29 where possible. There is a 46.7% difference in institutional efficiency (Ex/E) between classes of less than 29 and those of more than 30. If no change is noted in instructional efficiency (A/Ex), an 18.9% increase in successful students could be expected.

2. Classes taken in the first two years (1 and 2) should all have class sizes below 29 as these levels are the least efficient and effective. Smaller class enrollments may increase these ratios.

3. Contact hours should not exceed 750 for any class if possible because measures of efficiency and effectiveness decrease markedly beyond this point.

A different interpretation is evidenced in the faculty of Engineering, university 3. Whereas level of expenditure and method of instruction were not important in Pharmacy, university 5, these factors appear to be related to effectiveness and efficiency in the Engineering faculty of university 3. The data from which the following hypotheses were generated are located in Appendix B.

Ex/E Institutional Efficiency

1. Levels of expenditure less than $250 and more than $751 tend to be related to low institutional efficiency.
2. As class size increases, institutional efficiency decreases.
3. Institutional efficiency may be expected to increase at each successive level of instruction.
4. Laboratory courses may be expected to be more institutionally efficient than other modes of instruction. The lecture method may be expected to be more efficient than courses

that employ a combination of lecture and laboratory methods of instruction.
5. Institutional efficiency decreases as contact hours increase.

A/Ex Instructional Efficiency

1. Levels of expenditures of $251-500 are more instructionally efficient than any other category.
2. As class size increases, instructional efficiency decreases.
3. Instructional efficiency may be expected to increase at each successive level of instruction.
4. The laboratory method of instruction is most efficient. The combination method is the least efficient.
5. As contact hours increase, institutional efficiency decreases.

A/E Institutional Effectiveness

1. Levels of expenditure less than $250 and more than $751 tend to be related to low institutional effectiveness.
2. As class size increases, institutional effectiveness increases.
3. Institutional effectiveness may be expected to increase at each successive level of instruction.
4. The laboratory method of instruction may be expected to be the most effective method of instruction. The combination method may be expected to be the least effective method of instruction.
5. As contact hours increase, institutional effectiveness decreases.

Ex/E Institutional Efficiency

1. Levels of expenditure less than $250 and more than $751 tend to be related to low institutional efficiency.
2. As class size increases, institutional efficiency decreases.
3. Institutional efficiency may be expected to increase at each successive level of instruction.
4. Laboratory courses may be expected to be more institutionally efficient than the other modes of instruction. The lecture method may be expected to be more efficient than courses that employ a combination of lecture and laboratory methods of instruction.
5. Institutional efficiency decreases as contact hours increase.

A_1/Ex_1 Instructional Efficiency

1. Levels of expenditure of $251-500 are more instructionally efficient than any other category.
2. As class size increases, instructional efficiency decreases.
3. Instructional efficiency may be expected to increase at each successive level of instruction.

4. The laboratory method of instruction is most efficient. The combination method is the least efficient.
5. As contact hours increase, institutional efficiency decreases.

A/E Institutional Effectiveness

1. Levels of expenditure less than $250 and more than $751 tend to be related to low institutional effectiveness.
2. As class size increases, institutional effectiveness increases.
3. Institutional effectiveness may be expected to increase at each successive level of instruction.
4. The laboratory method of instruction may be expected to be the most effective method of instruction. The combination method may be expected to be the least effective method of instruction.
5. As contact hours increase, institutional effectiveness decreases.

Based upon faculty data and the generated hypotheses, the following recommendations would appear pertinent for the faculty of Engineering of university 3:

1. Employ professors with a level of expenditure that is between 251 and 750 dollar equivalents. Extremes in level of expenditure produce the lowest efficiency and effectiveness values.

2. Decrease class sizes where possible. Class sizes below 29 appear to be the most efficient and effective. However, class sizes between 30 and 109 are consistently more efficient and effective than classes larger than 110.

3. Smaller classes are recommended in levels of instruction one and two, as these levels are the least efficient and effective. Smaller classes may tend to neutralize or reverse this tendency.

4. Where possible avoid teaching classes that employ a combination of lecture and laboratory methods. Pure lecture and pure laboratory courses are more efficient and effective by at least 18%.

5. Avoid classes that exceed 2500 contact hours. Efficiency and effectiveness drop off rapidly beyond this point. Decreasing class size would also accomplish this without necessarily reducing the hours of instruction.

Summary

This chapter has demonstrated the utility of the efficiency-effectiveness concepts in administrative decision-making. The generation of hypotheses between efficiency-effectiveness measures and university and faculty data of various factors leads to recommendations that could increase the efficiency and effectiveness of the university.

No attempt is made to predict that the implementation of recommendations will necessarily result in an increase in efficiency and effectiveness as the factors considered may not be the only factors affecting the ratios. Instead, the factors served to illustrate the utility of the efficiency-effectiveness ratios. This is a major purpose of this thesis.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

General Summary

The purpose of this dissertation was to present a constructed model of efficiency and effectiveness that delineates those stages in university instruction where potentially productive inputs are being dissipated. By testing the model against empirical data in Central America, the utility of the model was evidenced. Six factors that could be causing the loss of inputs were presented to illustrate the utility of the model in providing method and direction in administrative decision-making. Conclusive statements of direction were derived from the relationship of the six factors to the efficiency-effectiveness ratios to form the basis for rational decision-making in future university instruction.

Central American national universities of Costa Rica, El Salvador, Guatemala, Nicaragua, and Honduras comprised the population in which to illustrate the utility of the constructed efficiency-effectiveness measures. By utilizing instructional data for the academic year 1962-63, in Chi square and mean difference formats, it was possible to delineate inter-relationships between efficiency-effectiveness measures as well as relationships with factors that could be affecting these measures.

Inter-relationships of Efficiency and Effectiveness Ratios

The applicability of constructed relationships in the efficiency-effectiveness concept were determined. Stated succinctly, the following relationships were supported:

1. As institutional efficiency increases, institutional effectiveness increases.

2. As instructional efficiency increases, institutional effectiveness increases.

3. An unanticipated relationship occurred between institutional efficiency and instructional effectiveness which tended to indicate that a third factor may be operating to affect these ratios. The utility of the model was not affected by this relationship as long as the relationship is considered in administrative decision-making.[28]

Internal consistency was examined and found to follow the theoretical construction. In essence, the ability of the efficiency-effectiveness model to isolate various stages in an instructional class was supported.

Factors related to institutional effectiveness, institutional efficiency, and instructional efficiency were delineated and relationships with efficiency-effectiveness measure were uncovered. Specific patterns and trends are found within the five Central American universities and in selected faculty data within each university, which support the thesis that it is possible to isolate factors that may affect efficiency and effectiveness. The most prevalent patterns which have relevance only for the five Central American universities being examined, are as follows:

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[28]These patterns are supported by data presented in Chapter 2.

A/E and A_1/E Institutional Effectiveness[29]

1. There is no conclusive relationship between level of expenditure and institutional effectiveness.
2. A class size exceeds 29, institutional effectiveness decreases.
3. Institutional effectiveness increases at each successive level of instruction.
4. Laboratory courses exhibit highest institutional effectiveness.
5. Classes that exceed 2500 contact hours with a professor, exhibit low institutional effectiveness.
6. There is no conclusive relationship between the number of classes taught by the professor and instructional efficiency.

Ex/E and Ex_1/E Institutional Efficiency[30]

1. There is no conclusive relationship between level of expenditure and institutionally efficiency.
2. Class sizes beyond 29 are less institutionally efficient than class sizes below 29. Class sizes exceeding 110 students are less institutionally efficient than class sizes between 30 and 109.
3. Institutional efficiency increases at each successive level of instruction.
4. The laboratory method of instruction is the most institutionally efficient method. Combination courses are more efficient than the pure lecture method.
5. There is no conclusive relationship between contact hours and institutional efficiency.
6. There is no significant trend between the number of classes taught by a professor and institutional efficiency.

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[29]These patterns are supported by data presented in Chapter 3 and are relevant only in the five Central American universities under consideration.

[30]These patterns are supported by data presented in Chapter 5 and are relevant only in the five Central American universities under consideration.

A/Ex and A_1/Ex_1 Instructional Efficiency[31]

1. No consistent relationship is noted between level of expenditure and instructional efficiency.
2. As class size increases, instructional efficiency decreases. Classes with less than 29 students are the most efficient.
3. Classes taught in the first two years in a university program exhibit the lowest instructional efficiency. Instructional efficiency increases at each successive level of instruction.
4. There is no conclusive trend noted between methods of instruction and instructional efficiency.
5. Classes with fewer than 2500 contact hours are more instructionally efficient than those with more than 25000 contact hours.
6. There is no conclusive relationship between the number of classes taught by the professor and instructional efficiency.

The patterned relationships between six administratively controllable variables and the efficiency-effectiveness constructs provides support for the thesis that a rational basis for administrative decision-making can be developed in university instruction. The moderation of the efficiency-effectiveness constructs by six variables has been established and directions for future decision-making will be noted in the directive conclusions of this chapter.

Conclusions

The conclusions derived from this study can be divided into methodological and directive categories. The methodological conclusions refer to the utility of the efficiency-effectiveness

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[31]These patterns are supported by data presented in Chapter 6 and are relevant only in the five Central American universities under consideration.

concepts and the inter-relationships between the resulting ratios. Directive conclusions stem from the patterned relationships and generated hypotheses resulting from the division of efficiency-effectiveness with stated factors using Chi square.

Methodological

Institutional efficiency, instructional efficiency, and institutional effectiveness are more than theoretical concepts. When applied to Central American university data, logical and understandable differences in the ratios may be noted that enable a university administrator to ascertain those stages in instruction at which potentially successful students are being lost. An advantage that has been uncovered in data analysis is that an administrator may concentrate on one stage of efficiency or effectiveness and work to improve that ratio, or the administrator may decide to view the entire pattern of efficiency and effectiveness ratios and then make appropriate decisions. The methodological conclusions of greatest significance, therefore, is that the theoretically constructed models of efficiency and effectiveness possess practical application in Central American universities.

Directive

Conclusions regarding the relationship between efficiency, effectiveness and six factors in the five Central American universities, may be administratively moderated, may be delineated. Data analysis by university indicate the following directions for administrative modification and decision-making in Central America:

1. A level of expenditure in instructor salaries below $250 equivalents yields the highest institutional effectiveness, institutional efficiency, and instructional efficiency. Although administrative decisions should not be based on this directive alone, the evidence is noted nonetheless.

2. Class sizes of less than 29 are the most efficient and effective. Class sizes of greater than 110 are the least efficient and effective. In the future decisions, it would behoove administrators in Central America to limit class sizes within stated boundaries to increase efficiency and effectiveness.

3. Levels of instruction differ in efficiency and effectiveness. Efficiency and effectiveness increase at each successive level of instruction. Administrators should attempt to determine the causes of this phenomenon in order to salvage more students at the lower levels of instruction.

4. Laboratory classes tend to exhibit the highest efficiency ratios. Classes taught with a combination of lecture and laboratory methods are more efficient than pure lecture classes. When initiating new classes, or revamping curricula this directive should be considered to insure that the highest efficiency-effectiveness ratios will not be lowered by unnecessary methods of instruction.

5. As contact hours increase in a class beyond 2500, efficiency decreases rapidly. The indicated direction for Central American administrators is a reduction in class sizes. By reducing class sizes and holding hours of instruction constant, contact hours are reduced and efficiency measures would be expected to increase.

These conclusions are based on university data only. Selected faculties within universities may follow these conclusions, but the diversity of patterns precludes more than a general statement of direction. As illustrated in Chapter 7, selected faculty data tends to be unique. It is most fruitful, therefore, to analyze each selected faculty as a separate unit before making administrative decisions. Conflicting patterns of faculty data within a university would question the application of procedures regarding the six considered factors on a university wide basis.

The directive conclusions for Central American administrators support the thesis that when relationships are established empiricially between the administratively controllable variables and the efficiency-effectiveness constructs, a rational basis for administrative decision-making results. By manipulating the administratively controllable variables in directions that are deemed to be more efficient and effective, it would be expected that these productivity measures would increase. As evidenced in data analysis and the directive conclusions, the thesis is indeed supported.

Conclusion Regarding Efficiency--Effectiveness Ratios.

The analysis of data indicates an important conclusion for administrator's desiring to improve the efficiency and effectiveness of instruction. On an individual basis, the ratios of institutional efficiency would appear to indicate

the major stumbling block to increasing output. Institutional efficiency is represented by the ratios Ex/E and Ex_1/E. These ratios indicate the percentage of students that presented themselves for examination divided by those enrolled in a course. These ratios would appear to be the most important measures in Central America because it is at this point at which the greatest percentage of students is lost. In light of the fact that the number of students passing is relatively high out of those examined, the major individual area of concerted analysis would be institutional efficiency, for if this ratio is raised, the probability of increasing output would appear to increase.

Inplications for Future Research

The major purpose of this thesis was to demonstrate that the measures of efficiency and effectiveness have utility in providing direction and method in administrative decision-making. The utility of the thesis has been demonstrated in Central American data and it appears that the following implications for further research are indicated:

1. Level of expenditure, class size, level of instruction, contact hours, method of instruction, and the number of classes taught by a professor do not represent a comprehensive examination of factors that might affect instructional efficiency and effectiveness. Additional factors that might provide increased direction for administrators include: the rank of the grading professor, differences between full time and part time students, and physical classroom characteristics.

2. Each factor was considered independently for relationship with efficiency and effectiveness ratios. It would be possible, using discriminant analysis, to ascertain optimum combinations of factors that produce maximum efficiency and effectiveness values. For example, what combination of class size, method of instruction, and contact hours produce the desired efficiency-effectiveness ratios? This methodological advancement would enhance administrative utility as well as add substantially to the test of the thesis.

3. Questions that could not be answered in these data should be examined. For example, what causes low paid instructors to pass more students? A differntiation of faculty by rank, length of teaching experience, or interest in the teaching profession might provide additional insight into this and other questions.

4. Central American universities comprised the population used for this study. The utility of the thesis indicates that there may be application of the concepts of efficiency and effectiveness in other areas of the world. For example, South America might use this format to evaluate the efficiency and effectiveness of institutions. The use of efficiency-effectiveness concepts in other geographic locations would provide additional support for the inherent concepts.

Further refinements should be employed in future research to effectuate greater use of efficiency-effectiveness concepts. Suggestions as herein outlined would enhance the utility and broaden the areas of application of these concepts.

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APPENDICES

APPENDIX A

IIME INSTITUTO DE INVESTIGACIONES Y MEJORAMIENTO EDUCATIVO
UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

DESGLOSE DE CURSO ("ASIGNATURA" O "MATERIA")

A

UNIVERSIDAD | FACULTAD 2-3 | DEPARTAMENTO 4

IDENTIFICACION DEL CURSO: NOMBRE [41-79] | NÚMERO 5-7 | SECCION NO. 8-9 | FRACCIONADA SÍ ☐ | PARTE # ☐☐ DE ☐☐ 10-11 12-13

CONTENIDOS 14-6 | CLASE: CONFERENCIA 1 ☐ | CONFERENCIA Y LAB. 2 ☐ | SEMINARIO 3 ☐ | LABORATORIO 4 ☐ | PRACTICA O CLINICA 5 ☐ | OTRA (ESPF.) 6 ☐

CURSO DIARIO 18 [/] | CURSO ALTERNO [2] | DURACION 19: PRIMER SEMESTRE 1 ☐ | SEGUNDO SEMESTRE 2 ☐ | AÑO COMPLETO 3 ☐ | CADA SEMESTRE 4 ☐ | DOS SEMESTRES 5 ☐ | OTRA (ESPF.) 6 ☐

PERMANENCIA: PERMANENTE 1 ☐ | ANUAL 2 ☐ | TEMPORAL 3 ☐ 20 | FRECUENCIA: CADA AÑO 1 ☐ | CADA DOS AÑOS 2 ☐ | CADA TRES AÑOS 3 ☐ | ESPORADICAMENTE (ESPF.) 4 ☐ 21

REUNIONES Y TIEMPO EN CLASE

CLASE	REUNIONES POR SEMANA	NO. DE SEMANAS
CONFERENCIA O SEMINARIO	A 22: 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	B 23-4
LABORATORIO, CLINICA O PRACTICA	D 28: 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	E 29-30

NUMERO TOTAL DE REUNIONES: C 25-27 | F 31-33

TOTAL DE MINUTOS: H | K

CLASE	MINUTOS POR REUNION									
CONFERENCIA O SEMINARIO G 34	1 ☐ 45	2 ☐ 50	3 ☐ 55	4 ☐ 60	5 ☐ 90	6 ☐ 100	7 ☐ 110	8 ☐ 120	9 ☐ 160	10 ☐ 180 o MAS
LABORATORIO CLINICA O PRACTICA J 35	1 ☐ 50	2 ☐ 55	3 ☐ 60	4 ☐ 90	5 ☐ 100	6 ☐ 110	7 ☐ 120	8 ☐ 150	9 ☐ 165	10 ☐ 180 o MAS

AÑO	PROFESOR: NOMBRE 1er Apellido	2º Apellido	Nombre	NUMERO	ASIGNA LAS NOTAS: 1 SI	2 NO	CLASE DE PARTICIPACION: INT. 1	TIT. 2	AUX. 3	ADJ. 4	INST. JEFE 5	INST. ADJ. 6	MON. 7	OTRO 8	"PROPIEDAD": NO LA TIENE 1	POR EXAM. 2	POR MERITO 3	NO SE APLICA 4	AÑOS
1961																			
1962																			
1963																			

	1961	T	AÑO	SEM.	HORAS DE INSTRUCCION	PROFESOR	DA NOTAS	●	PROPIEDAD TIPO	PROPIEDAD AÑOS	ESTUDIANTES	EXAMINADOS 1ER EXAM.	EXAMINADOS 2º EXAM.	EXAMINADOS 3ER EXAM.	EXAMINADOS TOTAL	APROBADOS 1ER EXAM.	APROBADOS 2º EXAM.	APROBADOS 3ER EXAM.	APROBADOS TOTAL	COSTO DE ENSEÑANZA	80
		36	37	38	39 40 41	42 43 44	45	46	47	48	49 50 51	52 53 54			55 56 57	58 59 60			61 62 63	64 65 66 67 68	
B	CONFERENCIA O SEMINARIO	2	1																		5X
C	LABORATORIO CLINICA O PRACTICA	3	1																		5X
D	TOTAL	4	1																		5X
	1962	36	37	38	39 40 41	42 43 44	45	46	47	48	49 50 51	52 53 54			55 56 57	58 59 60			61 62 63	64 65 66 67 68	80
E	CONFERENCIA O SEMINARIO	2	2																		5X
F	LABORATORIO CLINICA O PRACTICA	3	2																		5X
G	TOTAL	4	2																		5X
	1963	36	37	38	39 40 41	42 43 44	45	46	47	48	49 50 51	52 53 54			55 56 57	58 59 60			61 62 63	64 65 66 67 68	80
H	CONFERENCIA O SEMINARIO	2	3																		5X
I	LABORATORIO CLINICA O PRACTICA	3	3																		5X
J	TOTAL	4	3																		5X

● PARTICIPACION

REVISADO: 20-V-63

COLUMNAS / CLAVES

1	
2-3	
4	
5-7	
8-9	
10-11	
12-13	
14-16	
17	
18	
19	
20	
21	
22	
23-24	
25-27	
28	
29-30	
31-33	
34	
35	

INSTRUCCIONES

TARJETA "A"

col. 36	1
col. 37	0
41-79	NOMBRE DE CURSO
col. 80	5X

TARJETAS "B" - "J"

col. 1-35	Reproduzca cols. 1-35 arriba
col. 36-80	Perfore los datos a la izquierda

Appendix B

University 1

(A/E = 70.6%)

Level of Expenditure	A/E
$ 1-250	= 78.7%
$ 251-500	= 67.3%
$ 501-750	= 69.7%
$ 751-1000	= 69.4%
$1001+	= 70.9%
significant at .01	

Enrollment	A/E
1-29	= 76.9%
30-109	= 60.3%
110+	= 38.7%
significant at .01	

Level of Instruction	A/E
1-2	= 61.1%
3-4	= 80.5%
5-8	= 82.6%
significant at .01	

Method of Instruction	A/E
lecture	= 68.5%
combination	= 68.5%
laboratory	= 87.4%
significant at .01	

HxE	A/E
$ 1-1000	= 80.8%
$1001-2500	= 74.2%
$2501-5000	= 59.5%
$5001+	= 58.3%
significant at .01	

University 2

A/E = 86.8%

Level of Expenditure	A/E
$ 1-250	= 90.7%
$ 251-500	= 85.6%
$ 501-750	= 85.0%
$ 751-1000	= 85.0%
$1001+	= 82.6%
significant at .01	

Enrollment	A/E
1-29	= 90.1%
30-109	= 80.5%
110+	= 25.5%
significant at .01	

Level of Instruction	A/E
1-2	= 85.0%
3-4	= 89.8%
508	= 87.7%
significant at .01	

Method of Instruction	A/E
lecture	= 86.2%
combination	= 87.1%
laboratory	= 91.0%
not significant at .05	

HxE	A/E
$ 1-500	= 89.5%
$ 501-1000	= 91.0%
$1001-2500	= 87.7%
$2501-5500	= 81.4%
$5501+	= 71.2%
significant at .01	

University 3

A/E = 63.5%

Level of Expenditure	A/E
$ 1-250	= 88.3%
$ 251-500	= 63.5%
$ 501-750	= 60.3%
$ 751-1000	= 53.5%
$1001+	= 65.1%
significant at .01	

Enrollment	A/E
1-29	= 71.8%
30-109	= 53.1%
110+	= 35.5%
significant at .01	

Level of Instruction	A/E
1-2	= 43.5%
3-4	= 65.8%
5-8 significant at .01	= 81.1%

Method of Instruction	A/E
lecture	= 62.7%
combination	= 64.7%
laboratory	= 66.4%
not significant at .05	

HxE	$\bar{A/E}_e$
$ 1-500	69.1%
$ 501-1000	72.7%
$1001-2500	71.2%
$2501-5500	53.1%
$5501+ significant at .01	45.1%

University 4

A/E = 80.8%

Level of Expenditure	A/E
$ 1-2500	= 91.0%
$ 251-250	= 88.0%
$ 501-750	= 74.2%
$ 751-1000	= 69.4%
$1001+	= 74.5%
significant at .01	

Enrollment	A/E
1-29	= 85.0%
30-109	= 74.2%
110+	= 50.7%
significant at .01	

Level of Instruction	A/E
1-2	= 80.2%
3-4	= 80.2%
5-8	= 84.1%
not significant at .05	

Method of Instruction	A/E
lecture	= 81.4%
laboratory	= 77.8%
combination	= 81.4%
not significant at .05	

HxE	A/E
1-500	= 93.1%
501-100	= 88.3%
1001-2500	= 77.5%
2501-5500	= 72.1%
5501+	= 64.7%
significant at .01	

University 5

A/E = 83.2%

Level of Expenditure	A/E
$ 1-250	= 83.8%
$ 251-500	= 83.5%
$ 501-750	= 83.5%
$ 751-1000	= 83.2%
$1001+	= 77.8%
not significant at .05	

Enrollment	A/E
1-29	= 87.4%
30-109	= 73.0%
significant at .01	

Level of Instruction	A/E
1-2	75.4%
3-4	86.4%
5-8	92.5%
significant at .01	

Method of Instruction	A/E
lecture	= 82.9%
combination	= 82.0%
laboratory	= 89.8%
not significant at .05	

HxE	A/E
$ 1-500	= 84.4%
$ 501-1000	= 88.6%
$ 1001-2500	= 86.5%
$ 2501-5500	= 75.4%
$5501+	= 74.5%
significant at .01	

Appendix C

Pharmacy, University 5

INSTITUTIONAL EFFECTIVENESS (A/E) IN PERCENT

(A/E = 79.0%)

Level of Expenditure	A/E
$ 1-250	= 95.5%
$ 251-500	= 81.1%
$ 501-750	= 65.5%
$ 751-1000	= 80.5%
not significant	

Enrollment	A/E
1-29	= 88.9%
30-109	= 25.5%
significant at .01	

Level of Instruction	A/E
1-2	= 62.3%
3-4	= 84.7%
5-8	= 95.5%
significant at .01	

Method of Instruction	A/E
lecture	= 79.9%
combination	= 75.4%
laboratory	= 95.5%
not significant	

Contact Hours	A/E
1-500	none
501-1000	= 95.5%
1001-2500	= 87.1%
2501-5500	= 31.1%
significant at .01	

Pharmacy, University 5

INSTITUTIONAL EFFICIENCY (EX/E) IN PERCENT
(EX/E = 84.7%)

Level of Expenditure	EX/E
$ 1-250	= 95.5%
$ 251-500	= 84.7%
$ 501-750	= 77.5%
$ 751-1000	= 95.5%
not significant	

Enrollment	EX/E
1-29	= 92.2%
30-109	= 45.5%
significant at .01	

Level of Instruction	EX/E
1-2	= 73.0%
3-4	= 89.2%
508	= 95.5%
significant at .05	

Method of Instruction	EX/E
lecture	= 85.0%
combination	= 82.3%
laboratory	= 95.5%
not significant	

Contact Hours	EX/E
1-500	none
501-1000	= 95.5%
1001-2500	= 90.4%
2501-5000	= 53.9%
significant at .01	

Pharmacy, University 5

INSTRUCTIONAL EFFICIENCY (A/EX) IN PERCENT
(A/EX = 91.0%)

Level of Expenditure	A/EX
$ 1-250	= 95.5%
$ 251-500	= 93.1%
$ 501-750	= 77.5%
$ 751-1000	= 95.5%
significant at .05	

Enrollment	A/EX
1-29	= 94.3%
30-109	= 75.4%
significant at .01	

Level of Instruction	A/EX
1-2	= 82.9%
3-4	= 95.5%
5-8	= 99.5%
significant at .01	

Method of Instruction	A/Ex
lecture	= 92.8%
combination	= 85.6%
laboratory	= 95.5%
not significant	

Contact Hours	A/EX
1-500	none
501-1000	=95.5%
1001-2500	=95.5%
2501-5000	=74.2%
not significant	

Pharmacy, University 5

INSTITUTIONAL EFFECTIVENESS (A_1/E) IN PERCENT
(A_1/E = 75.4%)

Level of Expenditure	A_1/E
$ 1-250	= 95.5%
$251-500	= 76.3%
$501-750	= 65.5%
$751-1000	= 80.5%
not significant	

Enrollment	A_1/E
1-29	= 84.4%
30-109	= 25.5%
significant at .01	

Level of Instruction	A_1/E
1-2	= 58.7%
3-4	= 78.4%
5-8	= 95.5%
significant at .01	

Method of Instruction	A_1/E
lecture	= 74.5%
combination	= 75.4%
laboratory	= 95.5%
not significant	

Contact Hours	A_1/E
1-500	none
501-1000	= 95.5%
1001-2500	= 80.5%
2501-5500	= 31.1%
significant at .01	

Pharmacy, University 5

INSTITUTIONAL EFFICIENCY (EX_1/E) IN PERCENT
(EX_1/E = 75.4%)

Level of Expenditure	EX_1/E
$ 1-250	= 95.5%
$251-500	= 76.3%
$501-750	= 65.5%
$751-1000	= 80.5%
not significant	

Enrollment	EX_1/E
1-29	= 84.4%
30-109	= 25.5%
significant at .01	

Level of Instruction	EX_1/E
1-2	= 58.7%
3-4	= 78.4%
5-8	= 95.5%
significant at .01	

Method of Instruction	EX_1/E
lecture	= 74.5%
combination	= 75.4%
laboratory	= 95.5%
not significant	

Contact Hours	EX_1/E
1-500	none
501-1000	= 95.5%
1001-2500	= 80.5%
2501-5500	= 31.1%
significant at .01	

Pharmacy, University 5

INSTRUCTIONAL EFFICIENCY (A_1/EX_1) IN PERCENT
(A_1/EX_1 = 91.9%)

Level of Instruction	A_1/EX_1
$ 1-250	= 95.5%
$251-500	= 93.1%
$501-750	= 83.5%
$751-1000	= 95.5%
not significant	

Enrollment	A_1/EX_1
1-29	= 94.3%
30-109	= 80.5%
significant at .01	

Level of Instruction	A_1/EX_1
1-2	= 85.6%
3-4	= 95.5%
5-8	= 95.5%
significant at .05	

Method of Instruction	A_1/EX_1
lecture	= 91.6%
combination	= 92.2%
laboratory	= 95.5%
not significant	

Contact Hours	A_1/EX_1
1-500	none
501-1000	= 95.5%
1001-2500	= 95.5%
2501-5500	= 78.4%
significant at .01	

Engineering, University 3

INSTITUTIONAL EFFECTIVENESS (A/E) IN PERCENT
(A/E = 52.3%)

Level of Expenditure	A/E
$ 1-250	= 45.5%
$251-500	= 73.0%
$501-750	= 51.1%
$751-100	= 25.5%
significant at .01	

Enrollment	A/E
1-29	= 76.6%
30-109	= 45.9%
110+	= 25.5%
significant at .01	

Level of Instruction	A/E
1-2	= 37.5%
3-4	= 51.1%
5-8	= 81.1%
significant at .01	

Method of Instruction	A/E
lecture	61.1%
combination	37.1%
laboratory	67.9%
significant at .01	

Contact Hours	A/E
1-500	none
501-1000	= 79.3%
1001-2500	= 65.5%
2501-5500	= 36.7%
5501+	= 25.5%
significant at .01	

Engineering, University 3

INSTITUTIONAL EFFICIENCY (EX/E) IN PERCENT
(EX/E = 81.7%)

Level of Expenditure	EX/E
$ 1-250	= 80.5%
$251-500	= 89.8%
$501-750	= 82.3%
$751-1000	= 55.5%
significant at .01	

Enrollment	EX/E
1-29	= 89.8%
30-109	= 81.7%
110+	= 68.8%
significant at .01	

Level of Instruction	EX/E
1-2	= 74.5%
3-4	= 86.2%
5-8	= 91.9%
significant at .01	

Method of Instruction	EX/E
lecture	= 85.3%
combination	= 75.1%
laboratory	= 89.2%
significant at .01	

Contact Hours	EX/E
1-500	none
501-1000	= 92.2%
1001-2500	= 87.1%
2501-5500	= 77.5%
5501+	= 70.9%
significant at .01	

Engineering, University 3

INSTRUCTIONAL EFFICIENCY (A/EX) IN PERCENT
(A/EX = 58.7%

Level of Expenditure	A/EX
$ 1-250	= 65.5%
$251-500	= 82.3%
$501-750	= 56.7%
$751-1000	= 25.5%
significant at .01	

Enrollment	A/EX
1-29	= 82.3%
30-109	= 52.3%
110+	= 31.5%
significant at .01	

Level of Instruction	A/EX
1-2	= 42.3%
3-4	= 61.5%
5-8	= 84.7%
significant at .01	

Method of Instruction	A/EX
lecture	= 66.1%
combination	= 43.1%
laboratory	= 76.9%
significant at .01	

Contact Hours	A/EX
1-500	none
501-1000	81.7%
1001-2500	73.9%
2501-5500	44.3%
5501+	29.1%
significant at .01	

Engineering, University 3

INSTITUTIONAL EFFECTIVENESS (A_1/E) IN PERCENT
(A_1/E = 44.3%)

Level of Expenditure	A_1/E
$ 1-250	= 25.5%
$251-500	= 63.1%
$501-750	= 43.9%
$751-1000	= 25.5%
significant at .01	

Enrollment	A_1/E
1-29	= 69.1%
30-109	= 36.7%
110+	= 25.5%
significant at .01	

Level of Instruction	A_1/E
1-2	= 34.3%
3-4	= 37.1%
5-8	= 73.6%
significant at .01	

Method of Instruction	A_1/E
lecture	= 53.1%
combination	= 31.5%
laboratory	= 55.5%
significant at .01	

Contact Hours	A_1/E
1-500	none
501-1000	= 70.6%
1001-2500	= 53.1%
2501-5500	= 29.1%
5501+	= 25.5%
significant at .01	

Engineering, University 3

INSTITUTIONAL EFFICIENCY (EX_1/E) IN PERCENT
(EX_1/E = 63.1%)

Level of Expenditure	EX_1/E
$ 1-250	= 55.5%
$251-500	= 78.7%
$501-750	= 62.3%
$751-1000	= 40.7%
significant at .05	

Enrollment	EX_1/E
1-29	= 79.6%
30-109	= 59.5%
110+	= 40.3%
significant at .05	

Level of Instruction	EX_1/E
1-2	= 52.3%
3-4	= 61.5%
5-8	= 82.9%
significant at .01	

Method of Instruction	EX_1/E
lecture	= 69.4%
combination	= 49.9%
laboratory	= 74.2%
significant at .01	

Contact Hours	EX_1/E
1-500	none
501-1000	= 80.8%
1001-2500	= 72.1%
2501-5500	= 51.5%
5501+	= 41.9%
significant at .01	

Engineering, University 3

INSTRUCTIONAL EFFICIENCY (A_1/EX_1) IN PERCENT
(A_1/EX_1 = 69.9%)

Level of Expenditure	A_1/EX_1
$ 1-250	= 65.5%
$251-500	= 84.4%
$501-750	= 60.3%
$751-1000	= 25.5%
significant at .01	

Enrollment	A_1/EX_1
1-29	= 85.0%
30-109	= 54.7%
110+	= 34.3%
significant at .01	

Level of Instruction	A_1/EX_1
1-2	= 45.1%
3-4	= 63.5%
5-8	= 88.3%
significant at .01	

Method of Instruction	A_1/EX_1
lecture	= 68.8%
combination	= 45.5%
laboratory	= 78.1%
significant at .01	

Contact Hours	A_1/EX_1
1-500	none
501-1000	= 85.3%
1001-2500	= 73.9%
2501-5500	= 48.7%
5501+	= 31.5%
significant at .01	